Direct Research Journal of Agriculture and Food Science
Vol.3 (12), pp. 223-231, December 2015
Available online at http://directresearchpublisher.org/journal/drjafs
ISSN 2354-4147 ©2015 Direct Research Journals Publisher

Review

Aquaculture in Nigeria: Sustainability issues and challenges

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Received 3 December 2015; Accepted 8 December, 2015

Nigeria is the most populous black nation in the world, with an estimated population of about 150 million people. Its citizens as at the end of 2012 have a projected fish demand of 2.66 million tonnes of fish. Fish supply within the same period was 132 million tonnes. This figure was made up of 0.7 million tonnes from importation and 0.62 million tonnes from both artisanal and aquaculture. Fish, a relatively cheaper source of food protein is very important in the diet of many Nigerians and is thus in high demand. The Nigerian fishery sector is characterized by a rich resource base, comprising of harvests from capture and culture. Due to over exploitation of the capture fisheries, the hope of the Nigerian fisheries is in aquaculturedevelopment.Productionfrom aquaculture is increasing and supplied between 5 – 22% of total domestic fish production between 2000 and 2007. For aquaculture to be sustainable, production systems must focus on the interactions between the culture techniques and the environment. It is pertinent to note that the growth and the expansion of aquaculture as an industry occurred during a period of growing concern of its environmental implications. Opportunities exist for the government to improve farm productivity through the promotion of appropriate responsible production, extension technologies and policy that is environmentally friendly.

Key words: Eutrophication, clarias, tilapia, wastes, overfishing and tank.

INTRODUCTION

Aquaculture can be defined as the rational rearing of fish in an enclosed and fairly shallow body of water where all its life processes can be controlled. It is an important sector for the nation's economic development, at a time when government is seeking for ways to diversify the economy, from being purely oil based. It is a potential means of contributing to the food security of the nation, directly by producing fish for food and indirectly by generating employment for the teaming unemployed populace, save foreign exchange and generate foreign exchange through export of fish and fish products.

Aquaculture, according to Ayinla (2012), is the fastest growing food producing industry in the world. He stated that global aquaculture production has quadrupled over the past twenty years and that aquaculture production is likely to double in the next fifteen years, as a result of wild fisheries approaching their biological limits and the world demand for cultured fish continuing to increase. In Nigeria the annual fish demand as at 2012 is 2.66 million metric tonnes, with supply being only 1.32 million metric tonnes. Out of this figure, local production is 0.62 million metric tonnes while 0.7 million metric tonnes is from importation. Of the total fish supply, aquaculture accounts for only 200,000 metric tonnes. The current aquaculture production, is a far cry from its potential production of 2.5-4.0 million metric tonnes.

Table 1. Nigeria fish supply by sector.

Sector	2000	2001	2002	2003	2004	2005	2006	2007
Artisanal	418,069	433,537	450,965	446.203	434,830	513,537	530,332	504,227
Aquaculture	25,720	26,398	30,664	33,667	43,950	56.355	84,523	85.087
Industrial trawler	23,308.3	28,378	30,091	33,882	30,421	33,778	33,778	28,193
Imported Fish	557,884	681,152	663,180	663,152	611,152	646,484	646,484	737,666

Source (FDF, 2007).

Nigeria is a coastal state bordered in the South by the Atlantic ocean. It has a land mass of 923,766 km^2, with about 1.75 million hectares of suitable sites for aquaculture development. The aquaculture sub-sector is considered a very viable alternative to meeting the nation's need for self sufficiency in fish production. This is based on its high reliability in return on investment and low capital intensity, relative to capture fisheries.

The Federal government of Nigeria is of late, actively pursuing the development of the agriculture sector in order to cope with the rising demand for fish and fish products and also to diversify its oil-based economy. The Federal government's aim is to achieve self-sufficiency in fish production and ultimately to have fish products available for export. Unfortunately, the fisheries sub-sector is under-developed despite it being the source of livelihood for many of the coastal populace. Rapid population growth in developing countries such as Nigeria, increased disposable income and changing consumer preferences has drastically increased the annual demand for aquatic food source. Proliferation of more efficient capture technologies, decades of government subsidies, increased market access even for remote fishing communities, and development programs aimed at increasing production from the fragile open-access resource has led to large scale depletion of fish resources. Thus, there is growing concern over the sustainability of wild fish stocks. The need for long-term investments to ensure the sustainability of production from aquaculture cannot therefore be over-emphasized. Intervention in this seemingly critical, but neglected sector, can be in the areas of planning, ecosystem-based resource management, post harvest sector, human resource development This seeks to review the principles, status, trends, and future needs for investments in fisheries and aquaculture.

Fisheries and aquaculture play a significant role in global food supplies, and demand for high-quality aquatic protein is expected to increase substantially as income levels rise and Asia and African populations expand (Delgado *et al.,* 2003). Fish is very important in the diet of many Nigerians, high in nutritional value with complete array of amino acids, vitamins and minerals.

In addition, fish products are relatively cheaper compared to beef, pork and other animal protein sources in the country ((FDF, 2008). Fish is thus in high demand. Fish make up about 41 percent of the meat in the average Nigerian diet, but domestic supply falls short of that, forcing the country to spend $500 million a year on imported fish (Oyinbo and Rekwot, 2013).

The Nigerian fishery Sector is characterized by a rich resource base, comprising:

(i) Offshore waters between the 30 mile territorial limit and the 200 miles Exclusive Economic Zone (EEZ).
(ii) Coastal waters adjacent to the country's 853-km coastline, and a continental shelf varying in width between 2 and 12 miles off the coast, from the western to the eastern borders.
(iii) The huge River Niger delta.
(iv) Inland waters associated with the major rivers, Niger, Benue, etc., their tributaries and flood plains.
(v) Natural lakes and wetlands.
(vi) Reservoirs, impounded for various purposes including irrigation, water supply and hydroelectricity power generation.
(vii).Purpose-built ponds, mining paddocks and animal watering lots.

These resources together provide a basis for the long-established industrial and artisanal capture fisheries, and the more recent aquaculture industry that is fast growing in content and output. In general, Nigerian fisheries can be divided into:

(a) marine capture (industrial and artisanal).
(b) inland capture (mainly artisanal).
(c) aquaculture (commercial and subsistence).

The output of Nigeria's fisheries by sector is presented in (Tables 1 and 2), which also includes the landings of Distant-Water Vessels (imports) that constitute the bulk of total supplies.

The domestic fish production witnessed an upward trend in output level due to the establishment of fish farming across the country in recent years. A critical look on the data in the table shows that there is no significant difference in domestic fish production in 2006 and 2007. While in 2008 and 2009 the production increased to 684,575 and 780,704 metric tonnes respectively. However, the domestic fish production has not been able to reduce the dependency on imported fish whose figure also shows a rising trend in imports over the period under review. It could be seen from the available data that the importation of fish during the period under review showed a steady rise. The fish imports rose from 646,484 metric tonnes in 2006 to 739,666 metric tonnes in 2007 showing an increase of 5.72 %. In 2008 the figure went up by

Table 2. Nigerian fish supply by system (National Bureau of Statistics, 2010).

Sector	2006	2007	2008	2009	2010
Artisanal					
Brackish	269,878	260,099	264,988	288,229	N/A
Inland River & Lakes	248,659	244,128	246,394	309,981	N/A
Fish Farm:(Aquaculture)	84,533	85,087	143,207	152,796	N/A
Industrial : Commercial Trawlers					
Fish(Inshore)	19,129	18,040	18,585	18,820	N/A
Shrimps(Inshore)	13,767	5,995	9,881	10,878	N/A
Eel	882	2,158	1,520	-	N/A
Total Domestic Production	636,848	615,507	684,575	780,704	
Distant (Imports)	646,484	739,666	937,428	946,851	N/A

14.41 % or 937,428 metric tonnes when compared with the figure in 2007 while in 2009 the figure went up again by 26.74 % or 946,851 metric tonnes when compared with the 2008 figure. Therefore, the importance of the fishing industry to the sustainability of animal protein supply in the country cannot be over-emphasized. Regrettably, the supply of food fish has been on the decline. This is due to consistent decline from the country's major source of food fish, (Global Agriculture Information Network GAIN, 2007). Currently, domestic fish production is put at 620,000 metric tons as against the present national demand of about 2.66 million metric tons (Ayinla, 2012).

INTENSITY OF AQUACULTURE PRODUCTION IN NIGERIA

By January 2014, the Federal government of Nigeria announced the introduction of import quotas and a cut in fish importation, to the country, by 25% per year, in order to promote aquaculture development. Production from aquaculture is increasing (Adewumi and Fagbenro, 2010), compared to the almost stagnant, artisanal sources (the result of overfishing) and supplied between 5–22% of total domestic fish production between the periods 2000–2007 (FDF, 2007). This increasing aquaculture production is, however, not able to meet the increasing rate of consumption because of the wide gap between fish demand and supply. Demand is on the rise as a result of population explosion in the country in recent years (Falaye and Jenyo-Oni, 2009). Aquaculture in Nigeria, which started in Panyam fish farm, Jos in 1951, as a government-driven venture, has now spread to all parts of the federation as a private sector-driven affair, encompassing all aquatic environments and using a range of aquatic species (Akinrotimi et al., 2011). Although production in the country is largely based on small-scale operations in most parts, there is a wide consensus that aquaculture has the potentials to meet the growing demand for nutrition food fish, contribute to the growth of economy and support the sustainable livelihoods of many communities, especially in the rural parts of the country (FAO, 2006). The awareness on the potential of aquaculture to contribute to domestic fish production has continued to increase in the country. This stems from the need to meet the much needed fish for domestic production and export. Fish species commonly cultured include Clarias and Heterobranchus spp. (catfish), Tilapia spp. (Tilapia),*Cyprinus carpio* (Common carp),*Heterotis niloticus* (Slap water). This culturable species usually grow to a minimum acceptable marketable size in a reasonable growing period (usually between 4-9 months of culture) depending on the production system. The country has large natural resources to support aquaculture development: inland freshwater of 14 million hectares and available land area of 1.7 million hectares for the aquaculture development. The cultured species include Clarias, Tilapia (Figures1 and 2), Carp and Heterotis, amongst others. Some form of shrimp (*Macrobrachium vollenhovenii*) farming is going on, but not yet at a commercial scale. The Nigerian aquaculture is presently, mainly urban-driven.

Figure 1. Clarias fish (Adewumi, 2005).

The story of the Nigerian aquaculture is essentially that of catfish farming (Adewumi and Olaleye, 2011). The culture of clarias catfish has grown rapidly in the country since 1985 and this species is grown by both small-scale and large–scale fish farmers in all the states of the federation. With the introduction of tank culture cum flow-through (Figures 3 and 4), enhanced by water recirculation systems, there has been a considerable increase in production of fish per unit area throughout the federation.Despite this celebrated increase in aquaculture

Figure 2. A harvest of tilapia fish.

Figure 3. Catfish in concrete tanks, being fed with poultry maggots.

production however, Ekunwe and Emokaro (2009) showed that Nigeria imports about 560,000 tonnes of fish estimated at about $400 million annually while annual domestic fish supply in Nigeria stands at about 400,000 tonnes. This gives room to further expansion. The level of growth and intensification witnessed in aquaculture recently has raised several environmental issues and is witnessing a number of challenges that need to be addressed for sustainability of the industry. Some of the issues and challenges are hereby discussed.

Aquaculture wastes and the environment

As aquaculture becomes more intensive with corresponding increase in wastes output, the effect of these wastes on the receiving environment has been a crucial issue, generating a lot of concern among aquaculturists, environmentalists, fishery biologists and the general public. As aquaculture production becomes more intensive, fish feed will be a significant factor in increasing the productivity and profitability of aquaculture. Given that feed is the biggest source of nutrient loading in aquaculture production, clear understanding of its impact on the environment is highly essential for sustainable development. Potential pollutants from aqua feed are phosphorous and nitrogenous substances as well as organic matter and these are released to the environment majorly through excretion of faecal wastes, misuse of medicated feed and uneaten feed. Apart from wastes

Figure 5. Water recirculation using locally fabricated material for fish culture (Source: Adeogun *et al.,* 2007).

from feed nutrients, waste waters from aquaculture may also contain residues of some chemicals, such as, medicants, feed additives, antibiotics, fertilizers, disinfectants, hormones, therapeutants and anesthetics commonly applied during farm operations.

The culture system commonly practiced in Nigeria includes stagnant tank, flow through, earthen pond and water recirculation systems. In stagnant and flow-through tank culture systems, all dissolved and suspended solid wastes are released into the environment on continuous basis throughout the production cycle. On the other hand, wastes from earthen ponds are released periodically, in most cases, at the end of production cycle and consist of a mixture of inorganic and organic particulate materials (Akinrotimi *et al*., 2007a). In the recirculation system (Figure 5), Gabriel *et al*. (2009) observed that the waste released is low, compared to tanks and earthen pond culture.

Akinrotimi *et al.* (2007b) reported that effluent from some catfish farms in Port Harcourt metropolis in Rivers State, Nigeria, constantly released into the environment, leads to destruction of the aesthetic value of the surrounding, with putrefying odour emanating from these areas. The release of these wastes on continual basis can lead to the buildup of some pathogenic organisms and result in the outbreak of epidemic disease. The environmental impact of aquaculture wastes include:

Eutrophication: Ecosystems of water body can show a typical reaction or shift in the river continuum when disturbed by nutrient-rich fish farm effluents (Loch et al., 1996).

Reduction in dissolved oxygen (DO) level: Release of aquaculture wastes into the aquatic ecosystems results in overproduction of organic matter and its subsequent decomposition usually lead to reduced dissolved oxygen concentrations (5 mg^{-1}) in the bottom water strata, which may impose a stressful condition on fish.

Production of toxic micro-organisms: Constant flushing of fish farm effluents into the receiving waters have been reported to stimulate the production of some toxic algae such as cyanobacteria, dinoflagellates and diatoms.

Direct toxicity on aquatic animals: Nitrogenous waste is a major component of aquaculture wastes, which can directly result in deleterious effect on aquatic animals, particularly fish and fish food organisms. Ammonia has been reported to induce high level of toxicity in fish, even at low concentrations.

Disruption of fish assemblage in the wild: Disruption of fish assemblage, changes in the population of various species of fish in the natural environment is one of the effects of aquaculture wastes discharge into the environment.

Reduction of aesthetic value of the environment: Continuous discharges of aquaculture wastes into the environment especially land-based aquaculture have been reported to reduce the aesthetic value of the environment.

STRATEGIES TO REDUCE THE IMPACT OF AQUACULTUREWASTES ON THE ENVIRONMENT

Proper planning of fish farms

While establishing fish farms, there should be proper

planning concerning the issue of waste management procedures. Effluent treatment possibilities should be included in the facility in the planning stage in order to reduce the effluent loads and make the treatment more efficient. For example, the use of dual drain tanks to concentrate settable solids into a smaller, more effectively treated flow, which lead to an overall improved effluent (Summerfelt *et al.,* 2004).

Good farm management

Effective management practices have been recognized as key to environmental sustainability of a fish farm. Farms should be encouraged to have soak-away pits to reduce the discharge of farm effluents into the environment.

Good diet formulation

Reduction of solid wastes output from aquaculture operation can be achieved by using highly digestible ingredients with high protein and lipid contents (Cho and Bureau, 2001).

Improved feeding strategy

The feeding strategy deals with alternatives to reduce the uneaten feed and increase feed efficiency. For efficient management of waste production, *ad libitum* feeding is not advisable. Several agricultural by-products have been researched into and recommended as substitutes to fishmeal (Agbebi *et al.,* 2009; Adewumi, 2012), some of which the digestibilities have not be monitored. Many of these materials would definitely pollute the environment.

Practice of integrated fish farming

This involves combination of animal husbandry or crop with fish production in a farm simultaneously whereby the effluents from the fish pond are released into the farm to serve as manures. Akinrotimi *et al.* (2005) reported that in some parts of the country, especially in the rural areas, there is combination of fish production with planting of arable crops such as vegetables. In order to help smallholder farmers improve their production, food security and profits, the West and Central African Council for Agricultural Research and Development (WECARD) and University of Ibadan (UI) are recently promoting the integration of fish, poultry/pig and rice farming. This will translate to viable and sustainable aquaculture.

Recycling aquaculture waste

The wastes excreted by fish in form of dissolved nitrogen and phosphorous material can be re-used inside the system and converted into valuable products for the fish.

Regular monitoring of fish farms

Monitoring practices must be adopted from time to time. The monitoring program should be carried out by the main interest groups: the scientists, the regulators and the farmers. The regulator agencies are to develop easily enforceable best environmental practices that comply with the international standard, and set environmental quality objectives.

OTHER CHALLENGES

Several other challenges, pertinent to sustainability, are confronting aquaculture development in Nigeria. Some of these challenges are:

Government policy

In Nigeria, a large number of farms have failed to attain profitability in one or more years because of major disruptions in the production process. There are financial risks, which the farmer must contend with; due to unstable government financial policies. A change of government or changes in government policies, common to Nigeria, are risks to the utilization of capital by the farmer. Government should encourage fish farmers by evolving a number of non-fiscal incentives, which may include grants for development, government equity shareholding, government insurance, leasing of facilities and compensation schemes, and there may also be subsidies for construction, equipment, supplies, labour and price support. Credit on advantageous terms through quasi-government credit schemes, special loans, with deferred repayment schedules and loan guarantees, should be made available. There is need for a stable polity. Such stability will boost the development of the fish industry. In order to ensure sustained and increased inflow of investment into Nigerian agriculture, agricultural policies must endure and even outlive the governments that formulated them. The practice of changing macroeconomic policies by successive federal governments is inimical to long-term investments in fish farming.

Land

Land is one of the most important resources readily available for production in developing countries. Ugwuba and Chukwuji (2010) in their study reported lack of land for pond establishment as one of the constraints to aquaculture in eastern part of Nigeria. According to

Adeogun et al, (2007), the mode of acquisition of land varies from one part of the country to other. This could involve outright purchase from individual owners or acquisition from government, by issuance of a certificate of occupancy. It could also be by traditional inheritance, family, communal/cooperation. Ownership affects land use. Land tenure systems put serious limitations on the amount of land that is available for aquaculture.

Water and pollution

This is one of the most important resources used in fish farming. Without assured, adequate and good quality water supply, fish production would be made impossible. Water is one of the most critical factors besides good feed/feeding, in fish production. Water quality and quantity are critical factors to successful fish production. The water should be void of any chemical harmful to fish and be within acceptable pH range of 6.5 – 9.0. To a large extent, water temperature will determine what species of fish can be grown successfully. The amount of water available will limit the size of the fish farm. At a minimum you want enough water to drain and fill a fish production pond at least once a year, as well as the capability of replacing any water lost through leakage or evaporation.

The major source of water for fish farmers in Nigeria includes: tap water from domestic water supply, water from streams/ rivers, well and borehole. The greatest challenges encountered by fish farmers in Nigeria have to do with pollution from industrial activities, mining and the petroleum industries. Water pollution has become a great issue especially in the oil-rich areas. Pollution of surface water has had severe impacts on fisheries production. Olowosegun *et al.* (2005) reported that in Nigeria, most of the fishing grounds have been rendered unproductive by oil exploration, dredging of some water bodies and dumping of toxic industrial effluents. Massive fish kills have been reported to occur in the aquaculture industry. Also the level of yield in the industry has been reported to be affected by pollution (Akanni and Akinwumi, 2007).

Production and management

Many technical problems arise in the production of fish seed either in the pond or hatchery system. Principal among these are: the lack of and poor management of brood stock, especially feeding and handling; and the poor record keeping of all activities regarding induced spawning, care of eggs, fry, feeding, and general management of fingerlings. Many erstwhile enthusiastic farmers have suffered colossal failures due to poor management skills. Aquaculture involves risk of crop loss due to wide pH fluctuations, oxygen depletion, parasites, water pollution, disease, predators, flooding, vandalism and more. A sound business plan and proactive management will help avoid or minimize these problems. Hard work and a drive to succeed are needed. Knowing 'how to' and a willingness to learn more of 'how to' is necessary for success. How to react to problems and being prepared for problems is essentially a personal commitment to aquaculture. Here the human resource factor is critical to a successful aquaculture enterprise Ofuoku *et al.,* (2008).

Availability of seed

Availability of fish seed is one of the most important factors for sustainable and profitable fish farming. In the tropics, most aquaculture species can be grown year round, subject to suitable availability of water and demand for the cultured fish. There is need to produce good quality seed and high quality broodstock at a good price in order to solve the problems encountered by fish farmers in Nigeria. To this end, a number of stakeholders are seeking private public partnership (PPP). It was reported recently that Lagos State government and a Finland-based firm is planning to set up a fish feed plant in the state.

Nigerian aquaculture industry also needs to explore the potentials of genetics and modern technologies in breeding. This will enable the development of high quality fish seed. A number of successful research work is on-going on the cryopreservation of Clarias sperm and testing of the viability of this cryo-preserved sperm in fertilizing freshly spawned eggs (Omitogun *et al*., 2006; Oyeleye and Omitogun, 2007; Omitogun *et al*., 2010). Success of these research and application on a commercial scale will help to conserve male brood stock, which are normally slaughtered for fry production of catfish, and likewise ensure all-year round artificial propagation, helping the fish farmers in overcoming the problem of scarcity of male catfish breeders which are often encountered in the dry season.

One other aspect of the Nigerian seed industry which needs to be addressed is the standardization of fingerling size and pricing. Due to the absence of institutionalized quality controlled practices, seed producers sell different sizes of fry and fingerlings to farmers, with neither standardization nor guarantee on the quality. While some hatcheries sell 1-2 cm fry as fingerlings, others may sell 5-6 cm fry for the same price. The market capitalizes on the ignorance and desperation of the buyers. The adverse effect of this is the heavy post-stocking mortalities which could discourage farmers from continuing the business.

Marketing and distribution

This is an integral aspect of fish production because it is

only when the fish gets to the final destination (consumers) that production can be complete. Marketing has been defined as all processes involved from the production of a commodity until it gets to the final consumer. Apart from seasonality, scarcity and means of preservation which are the main problems of fresh fish marketing, transportation is also observed to be a major problem in fish marketing and distribution in Nigeria. Most fresh fish sellers travelled by road and some of the roads are bush tracks while others are tarred but in a state of disrepair. This raises the cost of transporting fish. In a survey carried out by Adeogun *et al.* (2007) in Lagos state, most (91.1 percent) farmers prefer to sell fish at farm gate at a selling price that does not compare favourably well with fish sold in the market. The government should open up more roads and intensify efforts on the maintenance of existing road to create a more enabling environment for distribution/marketing.

There is also need for farmers to network and explore international markets. Adedeji and Okocha, (2011) opined that the most important constraint to aquaculture development is dissemination of existing knowledge, whether derived from research or indigenous technical knowledge of farmers. Research should follow farming systems research and extension methods in which inter-disciplinary teams work with farmers to evaluate and develop both production systems and extension methods that are appropriate to the local conditions of farmers and their resource base.

Low level of technology adoption

Ajieh, (2010) identified low level of adoption of fishery technology due to lack of extension service as one of the factors that contributes to low productivity in the industry. In Nigeria the interaction between the extension agent and the farmers, is poor, due to the low level of education of most farmers. To improve the yield of fish production from aquaculture there is need to improve the educational status of most of the farmers and those consulting for them. The Government should continually engage farmers in mandatory training sessions to update their knowledge. These steps would lead to enhanced fish production for viable and sustainable aquaculture development in Nigeria.

CONCLUSION

For aquaculture to be sustainable, production systems must focus on the interactions between the culture techniques and the environment. It is pertinent to note that the growth and the expansion of aquaculture as an industry occurred during a period of growing concern of its environmental implications. As a result, the sustainability of aquaculture practices has come into increasing scrutiny for social equity, ecological integrity and long term economic viability. The social implications generally becomes evident from the very early stages of farm development, but the ecological impacts may take a much longer time to unravel and the reducing effects may be monumental. Opportunities exist for the government to improve farm productivity through the promotion of appropriate production and extension technologies that are environmentally friendly.

Recommendations

Aquaculture, properly harnessed, represents a new investment source, and an insurance against the fish protein deficit of Nigeria. In order to ensure sustainable aquaculture development and fish sufficiency in Nigeria, it is hereby recommended that:

(a)There is need to facilitate national strategies, policy and legislative frameworks. Government/aquaculturist should come up with a comprehensive and articulate aquaculture development plan.

(b) There is need for more coordinated research on feed and fish seed. Of the twelve cultivable finfish and four shellfish available for aquaculture, the African catfish, *Clarias gariepinus, Chrysichthys nigrodigitatus; (Obokun), tilapia spp,* African freshwater *prawn; Macrobrachium vollenhovenii are* candidates for genetic engineering for now.

(c) There has to be aggressive rural infrastructure development to make aquaculture rural-based.

(d) Banks should relax their collateral requirements. Unless this is done, loans earmarked for aquaculture could remain unutilized if not passed to other sector of the economy.

(e) A framework of regulations to ensure sustainability and minimize potential environmental impacts. Representation of stakeholders in the policy formulation process; in policy dissemination, the presence of sufficiently qualified, experienced and enthusiastic staff, inter-ministerial and inter-actor coordination in implementation.

(f) Governments should provide more enabling environment for private sector-driven aquaculture.

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