

CONSULTANCY REPORT

Synthesis of Aquaculture Policy and Development Approaches in Africa

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EXECUTIVE SUMMARY

The WorldFish Center was tasked to undertake a study to access, collate and develop background materials to produce an internationally linked and Africa-wide perspective on sectorally relevant policy issues. The specific objective of the study was to assess and define conditions and impact pathways, in Africa or elsewhere, where markets, policies, resources and technologies have combined to promote steady and sustainable growth of aquaculture, and where have been clear direct impacts on food supply, income, employment and consumption opportunities, as well as increase in supply that has led to stabilised prices. The study was also aimed at providing guidelines for scaling up the implementation of the synthesis study via Afri-FishNet (CAADP Fish Expert Pools) at the national and regional levels.

The synthesis study showed that aquaculture development in Africa is driven by market-led commercial aquaculture development (also referred to as immanent forms of aquaculture development) and rural food security and economic development approaches (also referred to as interventionist development approach). The review further showed that market-led approaches such as that occurring in Nigeria, Egypt and Asia can generate more impacts with respect to fish output, employment generation and economic growth than interventionist forms of aquaculture development that focus on rural food security and economic development.

The review results suggest that general policies and laws related to trade and investment may be more important for facilitating commercial aquaculture development than elaborate aquaculture sector specific policies, laws and regulations. Thus, weak aquaculture sector policies may not be an impediment to development of commercial aquaculture in Africa. Based on the results, the team arrived at the following conclusions.

1. Rapid aquaculture development is occurring in countries where market, governance and investment conditions are conducive for economic growth and where governments have demonstrated political will to support the aquaculture sector;
2. Market-led or immanent aquaculture development approaches offer the best options for accelerating aquaculture growth in Africa;
3. Interventionist approaches can be applied by governments to jump-start commercial aquaculture development provided that this approach is supported by strong strategic and implementation plans;
4. Good policies are not an indispensable and essential condition for commercial aquaculture development in Africa;
5. In order for countries to achieve high rates of aquaculture production and development in the absence of sector policies, they must have strong strategic and implementation plans, privatized services and laws and regulations that protect investor and farmer investments;

6. Although not a definitive determinant, our review suggests that the quality of governance with respect to economic and human development matters in fostering aquaculture development.

Taking these conclusions into account, the review team has made several recommendations for jumpstarting African aquaculture development which include the following:

1. Regional and national aquaculture development programmes should focus on countries and regions where market-led aquaculture investments and developments are underway and accelerated rates of aquaculture production are being achieved;
2. Aquaculture strategies and plans should be mainstreamed into national development plans in order to leverage national resources and increase allocation of national budgets to aquaculture;
3. In the short to medium term, governments and regional bodies should focus on strengthening private and public sector capacity to develop and implement comprehensive and realistic aquaculture strategic plans;
4. NEPAD, through the Aquaculture Working Group, should lobby national, regional and global funding agencies to increase funding for strengthening the technological basis for commercial aquaculture and supporting nascent private sector investments which demonstrate potential for success.
5. Successful models of aquaculture development should be disseminated and promoted more widely through policy dialogues, workshops and the Afri-FishNet website.

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1. INTRODUCTION

1.1.Objectives and Terms of Reference

The NEPAD Planning and Coordinating Agency (NEPAD Agency) is implementing the Pan-African Fisheries and Aquaculture Development Programme, within the CAADP framework. Under the mandate from the African Union Commission (AUC) it is also coordinating the new Partnership for African Fisheries (DFID-funded through NEPAD), which aims to tackle the issues of fisheries management and the means by which African fisheries and aquaculture can be better managed and contribute sustainably to African growth and welfare. PAF is elaborating coherent approaches for reform in fisheries through an inclusive think-tank process that promotes change through communication, learning and advocacy. It is also developing innovative approaches to sectoral investment in order to ensure growth in trade in African fishery products. Specific initiatives for aquaculture are being developed through its Aquaculture Working Group (AWG). Amongst these, the PAF/AWG aims to undertake a regional policy synthesis for the aquaculture sector. This is intended to establish knowledge of the policy context for the sector, defining and linking the conditions for effective development drawing on experience of key tools, systems, practices and policy approaches. Outcomes of this synthesis would be used to create a platform for shared learning around the region and to define appropriate goals and pathways for achieving positive and sustainable sectoral development.

NEPAD through the Partnership for African Fisheries Aquaculture Working Group commissioned WorldFish Center to carry out aquaculture policy synthesis work for Africa. Specifically WorldFish was requested to access, collate and develop background materials to produce an internationally linked and Africa-wide perspective on sectorally relevant policy issues. The main terms of reference for the assignment were as follows:

- Assess and define conditions and impact pathways, in Africa or elsewhere, where markets, policies, resources and technologies have combined to promote steady and sustainable growth of aquaculture, and where have have been clear direct impacts on food supply, income, employment and consumption opportunities, as well as increase in supply that has led to stabilised prices;
- Suggest Strategies and guide African states in implementation of their CAADP-linked national aquaculture strategies.
- Provide guidelines to Aquaculture Working Group on how to effectively up-scale the implementation of the synthesis via the Afri-FishNet (CAADP Fish Expert Pools) at regional and national levels.

1.2. Approach and Methodology

The study was undertaken by a team¹ of two scientists (Aquaculture Scientist and Senior Policy Analyst) who were assisted by a Research Analyst² and a Politics and Governance Expert³. In order to deliver the outputs of this assignment, we adopted the following approach:

We first undertook an extensive and comprehensive review of aquaculture development and production in Africa and Asia to establish the following:

- 1) *African aquaculture development pathways*: We reviewed the aquaculture development literature to understand different approaches and pathways that have been used by African governments to develop aquaculture. We focused on review papers on aquaculture development published in peer-reviewed journals and FAO's National Aquaculture Sector Overview (NASO) publications for Africa to isolate and synthesise information on aquaculture development approaches and pathways. The review of NASO publications covered all African countries;
- 2) *The status of policy, legislative, regulatory and investment environment in aquaculture producing countries*: Lack of aquaculture policies, strategies and regulations has been identified as one of the major constraints to the development of the sector (FAO, 2001; Jamu and Ayinla, 2003). However, recent literature has questioned the critical and pivotal role of sector specific policies, laws and regulations in aquaculture development. Brummett et al (2008) suggest that because of the current environment where governments have limited resources to support a comprehensive leadership of aquaculture development, general policies that provide guidelines for aquaculture development and key regulations that assure investors access to land and water resources may be sufficient to promote aquaculture development. This position is supported by Belton and Little (2011) who indicate that policies that relate to the much larger arena of trade and investment are more important for promoting aquaculture development than aquaculture sector policies.

We then undertook a review in order to understand the aquaculture policy making processes in Africa, laws and regulations adopted by different African countries and how these impact aquaculture performance of African countries. We first ranked African countries using total production (kg) and value (US\$). Based on these rankings, we divided the countries into four categories: (i) top producers (first ten countries in the rank table); (ii) medium producers (second group of ten countries in the rank table); (iii) low producers (next lot of ten countries after the medium producers in the

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rank table), and (iv) bottom of the ladder (last ten countries in the rank table). We then analysed policy, planning (strategic and implementation); regulatory/ legislative (environmental, food safety, investment) documents in order to establish, through qualitative rankings, the status (strong, adequate, weak) of policies, regulations and legislations in the selected countries. In doing these analyses, we adopted FAO assessments of the policy, planning and development environment as contained in the NASO publications. These analyses were also enriched by our own analyses of information obtained from published articles. Based on reviews on aquaculture development approaches and policies, legislation and investment environment (section 2.2 and 2.3) we identified ten factors or parameters that are critical for aquaculture development for assessment (Table 1).

Each of the factors was rated as very strong, strong and weak based on the degree to which the situation in each country best fitted the above descriptions. For example, for policies, strategies and plans, the rating descriptions were as below:

a) *Very strong*:

- Aquaculture policies articulate a clear vision for the sector and provide clarity on subsidiary policies that are relevant to the operationalization of the policy.
- Country strategies and plans have clearly defined roles of the public and private sector, specific time frames and targets to be achieved.
- Processes for developing policies, strategies and plans should be inclusive and in particular involve the private sector

b) *Strong* -Same as above except that:

- the policies do not provide enough clarity on the subsidiary policies (e.g. land, water, environment) that support the sector policies;
- strategies and plans do not provide specific targets and time frames for achieving set targets;
- the process of formulating policies, strategies and plans is not inclusive especially with respect to private sector and civil society

c) *Weak*:

- Aquaculture policies do not articulate a clear vision for the sector and neither do they provide clarity on subsidiary policies that are relevant to the operationalization of the policy.
- Country strategies and plans do not have clearly defined roles of the public and private sector, specific time frames and targets to be achieved.

3. *Drivers of aquaculture development in each of the production categories:* We used information from (2) above to establish commonalities and differences between and within the country categories and used these to identify key drivers of aquaculture growth and development.

Based on (1) to (3) above, we derived a synthesis of policies, strategies and development approaches which could result in sustained aquaculture development. We further derived recommendations on how African governments could facilitate the rapid growth of aquaculture and achieve sustainable development of the sector.

Table 1: Factors that identified from the literature review as potentially important to aquaculture development

Factor	Definition
Policy	Purposive and consistent course of action produced as a response to a perceived problem of a constituency, formulated by a specific political process, and adopted, implemented, and enforced by a public agency. In this respect this refers to aquaculture and all other broad policies that guide development and implementation of aquaculture
Strategic plan	A broadly-defined plan aimed at creating a desired future. In this respect the strategic plan refers to national aquaculture strategic plans
Implementation plan	Detailed list of activities, costs, roles and responsibilities of implementers and schedules required to achieve the objectives of a strategic plan. In this assessment , this refers to the aquaculture sector implementation plan
Legislation	This refers to laws and regulations specific to aquaculture sector as well as other laws and regulations such as investment, environmental etc that can be used to regulate aquaculture
Mainstreaming sector policies and plans into national plans	This refers to the extent to which aquaculture sector policies and strategies are mainstreamed into national policies e.g. poverty reduction strategies programmes (PRSP), national development policies, national adaptation plans of action (NAPA)
Market led approach	Aquaculture development that is driven by the private sector in response to the needs of the market. This is in contrast to government-led approach where government sets strategies and devises plans to implement strategies mainly using public resources.
Food security approach	Aquaculture development whose sole objective is to address food security needs of households through own production of fish.
Export orientation	Aquaculture sector whose main objective is to produce fish for the export market.
Private aquaculture services	Aquaculture services (business, extension, hatcheries) that are provided by the private sector. Privatized services suggest the presence of more options for extension delivery and provision of technical and managerial services to aquaculture
Land and water rights	Land and water rights as prescribed by law securing tenure and use of land by the investors.

2. CONTEXT

2.1. Aquaculture production

Aquaculture production in Africa over the period 1970–2008 has been steadily increasing at an annual average growth rate of 12.6% per annum. Between 2006 and 2010, African aquaculture production growth rate jumped to 18.6 per annum. Production in 2010 was estimated at 1,301,432 tons represented 2.3% of total global aquaculture production (FAO, Brown, 2011). Aquaculture production in Africa is low. In comparison, Asia produces 50,793,600 tons representing 88.8% of total global aquaculture production (FAO, 2011).

Egypt, which produces 64% of total farmed fish in Africa, leads the continent in aquaculture production followed by Nigeria (15.4%) and Uganda (7.2%) (FAO, 2011). The total share of total production by other African countries relative to Egypt has also been growing (Figure 1a). As a consequence, Egypt's contribution to total production declined from 74% in 2005 to 64% in 2010. The steady growth in aquaculture production is occurring against a backdrop of relatively zero growth in total capture fisheries production (Figure 1b) and increased demand for fish (FAO, 2011; Delgado, 2005). These two scenarios imply that aquaculture production will have to increase to meet the increasing demand for fish in Africa.

Figure 1a shows that the period 2005-2007 was the turning point for aquaculture production for the rest of Africa (Nigeria and Uganda inclusive) because the continent started to experience accelerated aquaculture growth rates. This period coincided with two major events in Africa's aquaculture development history. First, through a series of FAO led workshops conducted between 1987 and 2004, African governments replaced poverty alleviation objectives of aquaculture development projects with commercial aquaculture development objectives (Brummett, 2008; Moehl, et al., 2005). Secondly, the NEPAD Fish for All Summit which was held in Abuja in 2005 raised the profile of aquaculture in the development portfolio of African governments and developed recommendations on key investment areas which could accelerate growth of the sector (NEPAD, 2005). For example, in response to outcomes of the FAO and NEPAD events, Kenya, Uganda, Ghana, Malawi and Uganda have implemented various strategies and public-private sector initiatives such as the aquaculture economic stimulus programme (Kenya), commercial cage culture development (Ghana) and the Presidential Initiative on Aquaculture Development (Malawi). The implementation of these initiatives resulted in growth in aquaculture production observed in Figure 1a (Africa) and Figure 2 (Malawi and Kenya).

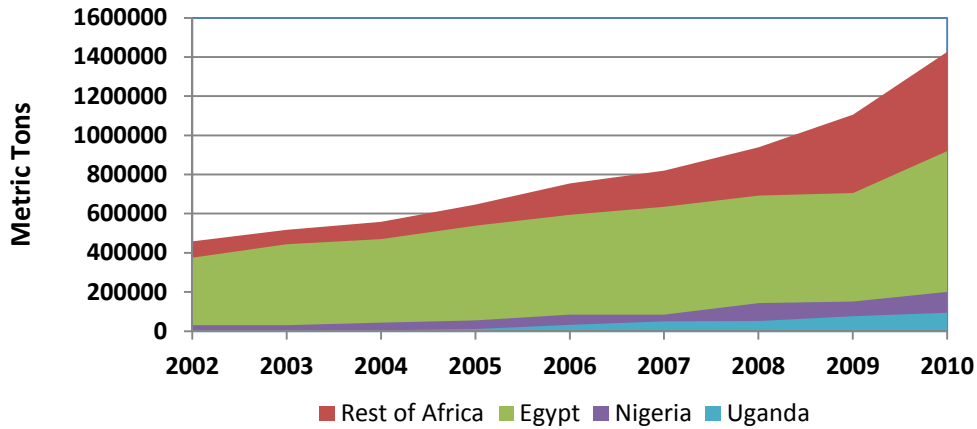


Figure 1a: Total fish production from aquaculture showing contributions by the three largest producers (Egypt, Nigeria and Uganda) in Africa and the increasing share in total production by the rest of Africa.

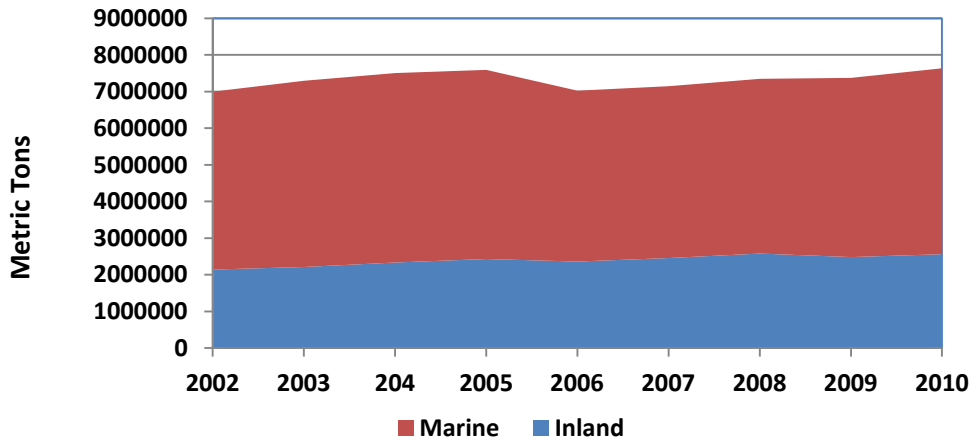


Figure 1b: Total fish production from marine and inland fisheries in Africa showing that production has remained relatively stagnant between 2002 and 2010.

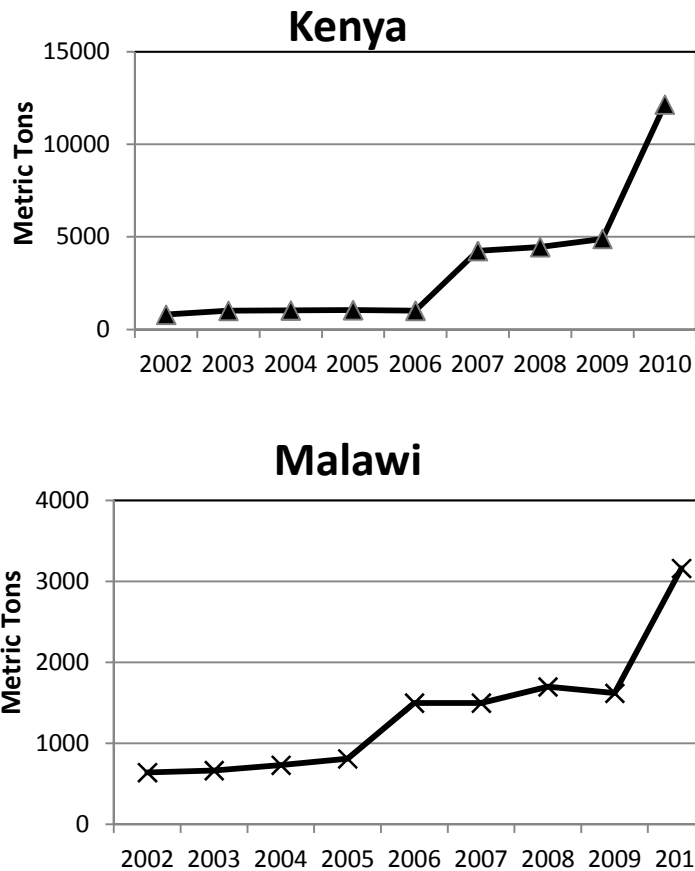


Figure 2: Aquaculture production in Malawi and Kenya after adoption of commercial aquaculture policies and implementation of the aquaculture economic stimulus programme in Kenya (2009) and the Presidential Initiative on Aquaculture Development in Malawi (2005).

2.2. Aquaculture development approaches

Since its introduction on the African continent in the 1940's, African governments have used variety of aquaculture development approaches (Brummett et al., 2008). During the colonial period, aquaculture was introduced as a viable means of food production and later was adopted by newly independent African states as a tool for rural food security. This aquaculture development paradigm continued to be applied till the 1960's until newly independent African countries started to deprioritize aquaculture in favor of social sectors such as education and health (Brummett et al., 2008).

In the 1970's until the late 1980's aquaculture was promoted as a tool for rural food security and economic development. Policies, strategies and implementation plans were invariably developed with donor funding and implemented by national governments to achieve set objectives. Since aquaculture development in Africa at that time was largely seen as the responsibility of national governments (Moehl et al., 2005; Brummett, 2008), policies and plans were exclusively developed by central governments with support of

development partners. This type of approach where aquaculture is promoted as a tool for rural food security and economic development is referred to as interventionist approach to aquaculture development (Belton and Little, 2011).

In the past 15 years, commercial aquaculture in some African countries has developed through private sector investments in response to national and international market demand (Brummett, 2008; FAO, 2011). Aquaculture development which is driven by the private sector in response to market demands and occurs in tandem with other socio-economic development is defined as immanent aquaculture development (Belton and Little, 2011).

In the following section, we provide a review of these two approaches in order to draw lessons and policy recommendations for future development of Aquaculture in Africa.

2.2.1. Interventionist form of aquaculture development

Belton and Little (2011) classify the rural food security and economic development approaches as the interventionist programme for aquaculture development and concludes that this approach has been the basis for most bilateral and multilateral donor support to aquaculture in developing countries. Africa has benefited from interventionist approaches through the construction of public aquaculture infrastructure (research stations, public hatcheries and fingerling production centers, training of researchers and extensionists (Brummett et al., 2011). For effective implementation and impact, this form of development requires formulation of policy frameworks, strategies and development programmes or projects that implement interventions to achieve specific policy goals (Bebbington, 2004).

Interventionist approaches in Asia are credited for enhancing human and institutional research capacity and development of aquaculture technologies such a system for mono-sex tilapia production and seed propagation techniques for *Pangansius* (Belton and Little, 2011). Enhanced capacity and improved culture technologies formed the basis for the immanent development of *Tilapia* and *Pangansius* aquaculture in Asia (see Case Study 3 for details).

Case Study 1: The Fish Farming Enterprise Productivity Economic Stimulus Programme. -“Kenya High Input Interventionist Model”

This case study provides an example of how targeted interventions implemented within the framework of strong strategies, high political will and large financial resources can, within a short time, generate big outcomes which otherwise would have taken a long time to achieve with an evolutionary interventionist approach such as that adopted in Malawi (Case Study 2).

Fish Farming Enterprise Productivity Economic Stimulus Programme is a component of Kenya’s Economic Stimulus Programme. Under this programme \$52.5 million has been put into the sector creating what has become a case study as the world struggles with dwindling fish stocks amid growing demand. Under the programme the following achievements have been recorded:

1. A national aquaculture suitability appraisal was conducted and suitability maps developed for each of the 210 constituencies, and over 9.5 million hectares of land was found highly suitable for aquaculture.
2. Developed a fish selective breeding programme with a current capacity of over 150,000 brood-stock, developed fish feed specifications, encouraged fish feed producers and improved the feed supply chain enabling the farmers across the 140 constituencies use quality fish feeds
3. Constructed over 27,000 fish ponds in the target constituencies, stocked them with over 13 million fingerlings, increased the area under aquaculture from 722 hectares to 20,000 hectares and increased national aquaculture production from 4,220 tonnes to 12,154 tonnes (7% of national fish production). It is projected that the production will increase to over 20,000 tonnes in the short term to over 100,000 tonnes in the medium and long terms providing close to Ksh6 billion (\$75 million) as direct earnings to farmers.
4. Created direct employment for over 28,000 fish farmers, short-term employment for over 280,000 youths and indirect employment of over 140,000 other Kenyans, and created a national short term demand of 28 million certified tilapia/cat fish fingerlings and 14,000 tonnes of specified and formulated fish feeds. The demand for fingerlings and feeds is expected to increase to 100 million and 100,000 tonnes respectively in the medium and long terms.

The Ministry of Fisheries Development has also been constructing an additional 100 ponds per constituency in the original 140 constituencies and will build some other 300 ponds per constituency in 20 new constituencies country-wide.

It is also supporting a private sector-driven fingerling supply chain, support a rural-based fish feed development programme and employ 480 fisheries extension officers. Further, it is, digitizing all ponds countrywide using GIS technology, and establishing 80 mini-processing and cold storage facilities to serve the 160 constituencies. These small processing plants will serve as nerve centers for aquaculture products branding, value addition and marketing at the constituency level.

The research challenges which have to be met for successful aquaculture include poor quality fish seed; lack of affordable quality fish feed; resulting from lack of formulations focusing on needs for different species and different fish stages, lack of a seed, feed certification and quality assurance system; inadequate value addition, processing and weak marketing strategies; lack of policy, strategy and regulation framework for the sector; weak culture systems research for increased production; and weak extension and technology transfer mechanism.

To meet the above challenges, the ministry has established a National Aquaculture Research, Development and Training Centre in Sagana which is a hub of a network of 5 regional centers of excellence for aquaculture research and development.

(Adapted from an article which originally appeared in the East African and published on the internet website: <http://www.thefishsite.com/fishnews/13862/kenya-leads-aquaculture-in-east-africa> , accessed on 10th May 2012)

In Africa, the aquaculture infrastructure built through interventionist programmes (e.g. National Aquaculture Center-Malawi; National Aquaculture Research, Development and Training Center (NARDTC-Kenya); Center Laboratory for Aquaculture Research (CLAR)-Egypt) has contributed towards development and adaptation of technologies. Through these stations, critical aquaculture technologies and systems such as integrated aquaculture-agriculture, improved tilapia strains and feeding practices have been developed. Lately, public aquaculture infrastructure has found a new lease of life and is now pivotal to the development of commercial aquaculture in Africa. For example, the Malawi National Aquaculture Center hosted has hosted successful research projects that adapted integrated aquaculture-agriculture for local application and developed improved strains of the local tilapia, *Oreochromis shiranus* using selective breeding protocols developed in Asia. In Kenya, NARDTC is involved in selective breeding of Nile tilapia, seed production and also serves as the hub for the Kenya Aquaculture stimulus programme. In Egypt, CLAR in Egypt has been critical in developing feeds and fish production practices for the country's aquaculture sector. Examples of interventionist aquaculture approaches are presented in Case Study 1 and 2 above.

Case Study 2: Interventionist forms of aquaculture development: A case study of aquaculture development in Malawi-“Malawi Evolutionary Model”

Aquaculture development in Malawi has largely been based on donor-funded programmes. These programmes had food security and rural economic development objectives in line with development paradigms which existed during this period (1970 to late 1990's). Key donors for these programmes included EU, GTZ (now GIZ) and JICA. These development programmes assisted the Malawi Government in the construction of satellite extension stations, three public research stations at Domasi, Buda College and in Mzuzu. These research programmes achieved the following: (i) established the technological basis for integrated aquaculture-agriculture (IAA) and supported the adoption of IAA country-wide, (ii) conducted research on breeding biology and management of local tilapia species; (iii) developed seed production methods for aquaculture species and candidate species for aquaculture and (iv) supported the development of human capacity in aquaculture research and extension. All these interventions led to sustained adoption of IAA at by small-scale farmers but did not significantly increase national fish production.

Because of the low impacts of above investments on national fish supply and the increasing demand for fish, the Malawi Government re-aligned its policy focus from aquaculture for rural food security and economic development to development and promotion of commercial aquaculture. This change in strategy and conducive economic and market conditions attracted the first large private sector investments in cage aquaculture by Press Corporation Limited. The Malawi Government later developed the National Aquaculture Strategic Plan (NASP) in 2005 with the assistance of the Government of Japan. The sector was further boosted with the creation of the Presidential Initiative on Aquaculture Development (PIAD) by the Malawi Government which is supporting development of community commercial fish farming areas, quality fingerling production and capacity building of aquaculturists. Wholesale and retail fish prices of US\$3.4 and US\$9/kg and high demand for fresh fish have lately been attracting new small-scale and commercial investors into the sector resulting in a jump in production from under 1000 tons in 2005 to 3100 tons in 2010.

The combination of donor support to develop the aquaculture infrastructure backbone of extension and research stations and incorporation of aquaculture into national development frameworks such as the Malawi Growth and Development Strategy has created a good platform for development of small-scale aquaculture. However, the lack of clear implementation plan for the NASP and PIAD has interfered with growth of the SME and large-scale commercial aquaculture sector due to lack of clarity regarding permitting and licensing of new investments and roles and responsibilities of various public sector institutions involved in the facilitation of aquaculture investments.

Case Study 1 provides details of the success and constraints of interventionist aquaculture development in Malawi where evolutionary strategies were used to implement

interventions in an iterative and learning mode (Brummett and Williams, 2000; Brummett and Jamu, 2011). The evolutionary interventionist approach adopted in Malawi led to sustained increases in small-holder fish farming, improved household fish supply and food security but failed to catalyze the evolution of these farms into sustainable commercial production units. This form of aquaculture development has also generally failed to increase national fish supplies and to spur transformative rural economic growth in most African countries (Brummett, 2008).

Case Study 2 provides an example where the Kenya Government adopted a military strategy of using overwhelming power to jumpstart the development of commercial aquaculture. The Kenyan Government developed the Aquaculture stimulus programme with the overall goal of increasing the country's aquaculture production and developing commercially viable and sustainable aquaculture value chain. These investments increased the country's aquaculture production from 4,895 tons in 2009 to 12,154 tons in 2010 at a total cost of US\$16million (see Case Study 3 for details of this programme). Early results show potential for success and replication to other African countries.

2.2.2. Immanent aquaculture development

Immanent development refers to processes of structural, political and economic change, such as the expansion of capitalism (Bebbington, 2004). Immanent forms of aquaculture development are driven by farmers and other actors in the value chain who seize or create opportunities using resources that become available as a result of the developmental process. Belton and Little (2011) first used this term in aquaculture to refer to aquaculture development in Thailand that has occurred alongside industrialization and urbanization and growth of affluent consumers which spurred demand for aquaculture products and in turn led to the development of an aquaculture value chain. Immanent aquaculture development is associated with increased specialization and production efficiencies on the part of fish producers and increased demand for fish. In Asia, examples of immanent aquaculture development include the development of *Pangansius* culture in Vietnam (Case Study 3) and evolution of *Pangansius* culture systems in Bangladesh (Munir, 2009). This form of aquaculture development has shown greater impacts on output, employment and the creation of economic value than donor-funded projects (Belton and Little, 2011).

Case Study 3: The role of liberalized markets and infrastructure developments in the immanent development of the catfish industry in Vietnam (adapted from FAO, 2011: World Aquaculture Report).

Aquaculture of striped catfish, *Pangasianodon hypophthalmus*, locally known as “ca tra” and also commonly referred to as river catfish and sutchi catfish, in Viet Nam, is one of the largest single species-based farming systems within a relatively small geographical area, the Mekong Delta, popularly known as the food basket of Viet Nam (Phan *et al.*, 2009). Striped catfish constitutes about 95–97 percent of the total catfish production in Viet Nam, with the Mekong catfish (*Pangasius bocourti*) accounting for the balance (Thanh Phuong and Oanh, 2010). In 2008, the total production was about 1.4 million tonnes, which resulted in about 640 800 tonnes in volume of processed fish valued at about US\$1.5 billion. The fish was exported globally to more than 100 markets. In the western world, striped catfish is considered as an affordable and acceptable substitute for “white fish” such as Atlantic cod (*Gadus morhua*). The sector has reached its current status within a decade or less, surpassing any form of aquaculture development in the world, production increasing from a mere 10 000 tonnes in 1996 to 1.4 million tonnes in 2008. The meteoric rise in production is associated with key technological, infrastructure and policy changes in the aquaculture sector in Vietnam. These included: (i) a shift from use of wild to artificial seed, (ii) a shift from the Mekong to striped catfish, (iii) development of transport, communications and processing infrastructure; (iv) creation of land markets; (v) liberalization of agricultural input & output markets; (vi) promotion of exports and (vii) foreign direct investment (Belton and Little, 2011).

Being a relatively new and fast-developing sector, it has affected the socio-economic aspects of the region to a great extent, with the striped catfish being labeled as the “princess in Vietnamese aquaculture” (Thanh Phuong and Oanh, 2010). Most farms are small-scale and farmer owned, managed and operated. Although a quantitative assessment of these socio-economic aspects has yet to be made, one of the most significant impacts of the industry has been on increased land prices. In addition, as almost all the production is exported, the sector also supports a large processing sector where 90 percent of the employees are women. It is predicted that, in 2015, the labor requirement will be 42 000 people in catfish farming and 210 000 people in the processing sector (Sub-Institute for Fisheries Economics and Planning in Southern Vietnam, 2009). The catfish farming sector has also stimulated a number of subsidiary service sectors, such as the feed manufacturing and fresh-fish transportation sectors (by boat). It has been estimated that these subsidiary sectors provide about 10 percent of the total livelihood opportunities to those living in the Mekong Delta.

Since the 1980s, Viet Nam’s fisheries sector has had a thriving export subsector. Seafood now ranks fourth among the foreign currency earners for the country, behind crude oil, garments and textiles, and footwear. Export earnings from fish and fishery products increased from US\$0.8 billion in 1998 to US\$4.6 billion in 2008, when Viet Nam became the fifth-largest exporter in the world. The export value of catfish exceeded US\$1.4 billion in 2008, accounting for about one-third of the total value of Vietnamese fisheries exports.

Examples of immanent aquaculture development in Africa include private sector investments in cage culture in Zimbabwe, Malawi and Ghana, catfish farming in Nigeria and intensive tilapia pond aquaculture in Egypt. Case Study 4 and 5 illustrate the mixed interventionist/immanent development of aquaculture in Egypt and the immanent development of aquaculture in Nigeria.

In these two case studies and the other cited examples of Malawi, Ghana and Zimbabwe, the private sector took advantage of improved local (Malawi, Ghana and Nigeria) and international (Zimbabwe) market and investment opportunities. The participation of the private sector enabled investments in processes, practices and technologies such as hatcheries, feed mills, processing plants, mono-sex culture, improved catfish and tilapia strains.

Case Study 4: The role of strong planning and the private sector in the mixed interventionist/ immanent development of intensive pond tilapia aquaculture in Egypt –“Egypt Commercial Tilapia Production Model”

Egypt has the largest aquaculture industry in Africa and aquaculture is currently the main single source of fish supply accounting for almost 65% of the total fish production of the country with over 99% produced from privately owned farms. Total aquaculture production in 2010 reached 919585 tonnes (GAFRD, 2010). The total market value amounted to over USD 1.5 billion (FAO, 2010). Freshwater species mainly Nile tilapia (*Oreochromis niloticus*) dominate the sector. Tilapia is cultured as sex reversed all male (due to their faster growth to table size than female tilapia) or mixed sex tilapia in intensive pond system and tank system (in the desert areas) and cage aquaculture system (in the northern branches of the Nile Delta).

Aquaculture development in Egyptian has been driven by high fish market demand within the country due to a large and growing population. Egyptians also eat more fish than other sources of animal proteins. The dramatic rise in aquaculture production in Egypt has been fuelled by the following factors: (i) strong aquaculture strategic plan; (ii) natural environmental factors e.g. availability of suitable land and an abundance of water, (iii) the entrepreneurial nature of the private sector in the country, (iv) Government support to the sector (e.g. government hatcheries and feed mills, demonstration farms, research, and extension. The government of Egypt also adopted a very strong aquaculture development strategic plan whose implementation is overseen by the General Authority for Fish Resources Development (GAFRD).

Key technological changes were witnessed in the second half of the 1990's with the introduction of, and increase in application of intensive pond aquaculture by farmers themselves. Such expansion created an increase in demand for monosex tilapia fingerlings, pelleted feed (both extruded and expanded) and skilled technicians. As a result within six years, the number of fish hatcheries increased from 28 to over 350 hatcheries in 2009. Similarly, the number of feed mills increased from two to more than fourteen within the same period. Cage aquaculture flourished rapidly supported by international and local experts and technicians.

Egyptian aquaculture industry is dominated by the private sectors who are the main players in production and service provision. As noted earlier, Egypt is by far the largest aquaculture producer in Africa, and the sector is a pioneering and vibrant one. When one considers the attempts by other African countries to develop aquaculture, Egypt's aquaculture growth is more impressive despite weak aquaculture sector policy. This impressive performance has been made possible through strong stewardship of the sector's strategic plan by GAFRD, high market demand and a highly skilled private sector which, together with the aquaculture research sector, has continued to seek solutions to emerging problems. The Egypt case also provides an example of the role of government support through research and extension support and development of feed mills and hatcheries during the nascent stage of aquaculture growth.

Case Study 5: The immanent development of the catfish aquaculture industry in Nigeria in the absence of strong aquaculture policies (adapted from: Miller and Atanda, 2011)-“Nigeria Commercial Catfish Model”.

This case study illustrates the role that markets and socio-economic factors play to catalyze immanent aquaculture development in the absence of strong strategic plans and human capacity. It is also an exemplar of how the potential for high economic returns from aquaculture can unleash innovation and entrepreneurship that can act as a driver for rapid development of aquaculture.

The story of aquaculture in Nigeria is essentially the story of catfish culture and its development. The favored catfish species include: *Clarias gariepinus*, *Heterobranchus bidorsalis*, and *Clarias x Heterobranchus* hybrid (*Heteroclarias*) and *Clarias nigrodigitatus*. *Heterobranchus species* is the more commonly cultured fish in the South Eastern parts of the country. Catfish culture systems are mainly land based using earthen ponds, concrete tanks which are designed in a water flow-through system as well as indoor water recirculation system (WRS).

Nigeria’s aquaculture development has followed a similar development path from the colonial era with a focus on subsistence production where 2000 small-scale ponds were built. In the past 10 years, Nigeria’s aquaculture has taken advantage of a strong growing population (150m) and its high demand for fish to adopt a market-driven aquaculture development path. Nigeria’s fast growth in aquaculture is a replication of that observed in other regions such as Egypt and Asia where the market has been a key factor in driving growth (Miller and Atanda, 2011).

The growth of the catfish industry in Nigeria has arisen from a confluence of market, social and technical changes and has largely occurred in the absence of a strong aquaculture policy. The market, technical and social factors that supported growth of the industry include the ready availability of abandoned ponds built through government programmes, low fish supply and high demand, special focus on African catfish, investments in management and hatcheries, development of fish feeds and establishment of fish farming villages. The existence of abandoned tilapia pond infrastructure made it easier for entrepreneurs to go into commercial catfish farming. The private sector took advantage of the high fish market demand and started to develop the sector without government intervention. However, since there was a serious lack of technical expertise in aquaculture within the country, entrepreneurs brought in experienced aquaculture managers from Europe and several local fish farm owners participated in training courses in Holland, Israel and the UK and key investors made visits to fish farms in Europe and elsewhere. This strategy enabled them to avoid failure of most fish farms in Africa where absentee owners hire inexperienced school leavers to manage very big investments.

The growth of aquaculture led to the development of downstream services and industries such as private hatcheries, professional aquaculture consulting services and feed mills. For example, the total capacity for producing floating feed in Nigeria now exceeds 100,000MT per annum. These investments were made using existing trade and investment policies. Later on the government introduced policy changes by drafting the new National Aquaculture development policy to provide a vision and roadmap for the industry. The drafting of this new policy has resulted in a further expansion of commercial aquaculture through youth employment programmes which promote wider engagement of youth in economic activities and attempt to stem the flow of youth into urban populations.

The ultimate outcomes of this immanent development of aquaculture are as follows: 20%/pa sector growth (2005-2010); highly developed value chain of upstream and downstream processors and marketers; development of export market of smoked catfish to Europe and USA targeting ethnic markets and increased vertical integration with other husbandries such as pigs and chickens. The evolution and growth of the African catfish industry therefore provides a very vivid example of the immanent development of aquaculture in the absence of very strong aquaculture policies and the critical role that markets played in catalyzing growth. It further demonstrates that critical government interventions that build institutional capacities are necessary for aquaculture growth to occur.

3. REVIEW OF POLICY, LEGISLATIVE, REGULATORY AND INVESTMENT ENVIRONMENT IN AQUACULTURE PRODUCING COUNTRIES

Results of our review of the status of aquaculture and general policies, strategies, plans and regulations that promote aquaculture development are presented in Appendix 1 and 2 and a summary of our observations is provided below:

- a) Aquaculture production (value and tonnage) is generally increasing rapidly on the African continent.
 - i) Egypt contributes a large share (64%) to total production.
 - ii) The share of other African countries to total production has increased by 10% between 2005 and 2010.
 - iii) The turning point (2004-2006) for African aquaculture development coincided with: (i) a change in aquaculture approaches from aquaculture for poverty alleviation to commercial aquaculture and (ii) the development of NEPAD's Action Plan for Fisheries;
- b) A review of the literature on aquaculture development in Asia suggests that immanent forms of aquaculture development can generate more impacts with respect to fish output, employment generation and economic growth than interventionist forms of aquaculture development that focus on rural food security and economic development. However, certain critical government interventions in institutional and human capacity development and aquaculture technology R&D are required to form the foundation for immanent commercial aquaculture development;
- c) General policies and laws related to trade and investment may be more important for facilitating commercial aquaculture development than elaborate aquaculture sector specific policies, laws and regulations.

4. CRITICAL CONDITIONS FOR AQUACULTURE DEVELOPMENT IN AFRICA

In the next sections below we use results in Appendix 2 (countries ranked according to value of fish produced) to synthesize the common characteristics among each category to distil the key preconditions for aquaculture production and thereafter we identify differentiators that explain differences between the categories. Lastly, we present conclusions of our findings.

4.1. Common characteristics on policies, plans, legislation and aquaculture development approaches to aquaculture development

Appendix 1 presents rankings of countries based on production and performance category and our assessment of the relative strengths of policies, strategic and implementation plans in each country; the extent to which aquaculture policies are mainstreamed into national development policies; the extent to which aquaculture development is driven by market vs. food security objectives; strength of land and water rights and the market orientation (export vs. local). The results are summarized in the following section.

4.1.1. Top performing countries

- a) *Policies and plans*: Except for Nigeria and Republic of South Africa, all top ten producers have weak aquaculture policies or policies that are in draft form and not yet approved for use. However all of them have strong to very strong strategic and implementation plans, aquaculture development is market-driven and these countries have privatized aquaculture services.
- b) *Aquaculture legislation*: Five (Nigeria, Uganda, Madagascar, Zambia and Ghana) had weak aquaculture legislation while Egypt, Kenya, Tunisia and South Africa had strong legislation for aquaculture development.
- c) *Land and water rights*: All top ten performing countries had strong water and land rights in their statutes.
- d) *Mainstreaming of aquaculture into national development plans* e.g. Poverty Reduction Strategic Plans and National Development Strategies: With the exception of Ghana, aquaculture is strongly mainstreamed into national development plans of top ten producers.
- e) *Commercial and food security orientation*: All countries except for Tunisia had strong commercial/market-led and food security objectives for the aquaculture sector
- f) *Export orientation*: South Africa, Madagascar and Tunisia had very strong export orientated aquaculture. This can be explained by the fact that all these countries produce high value species such as abalone and shrimp for export.
- g) *Private service provision*: Except for Kenya, Zambia, Malawi and Ghana, aquaculture services in this category are provided by the private sector.

The common features of the top performers were that all countries in this category had strong to very strong strategic and implementation plans, land and water rights, prioritized market-led aquaculture approaches (immanent aquaculture development) and aquaculture was strongly mainstreamed into national development plans and aquaculture services were strongly privatized (refer to Case Study 3 and 4 for details).

It therefore can be concluded that the absence of weak aquaculture sector policies is not an impediment to development of commercial aquaculture. Further as earlier concluded by Brummett et. al., 2011 and Belton and Little (2011), strong legislation which promotes investments and trade general national development policies that promote aquaculture are adequate preconditions for development of commercial aquaculture. In addition, immanent forms of aquaculture development in these countries appear to predominate due to the presence of a strong private sector which is producing fish for internal and external markets and provides services to the sector along the aquaculture value chain.

4.1.2. Middle performing countries

The middle performers generally have poor aquaculture policies and implementation plans; they are dependent on the public sector for services, have poor land and water rights and place equal emphasis on market led and food security approaches. Aquaculture still used as tool for rural food security and economic development. However, a few countries (DRC, Sudan, Zimbabwe and Mali) evolving toward market led aquaculture development. A summary of our observations from the literature and case studies for two top performers (Sudan) are presented below:

- a) *Policies and plans*: These countries are characterized by lack of or poor aquaculture policies and implementation plans.
- b) *Aquaculture legislation*: This is generally strong across all countries.
- c) *Land and water rights*: Except for Mali and Morocco, this category has weak land and water rights.
- d) *Mainstreaming of aquaculture into national development plans*: All countries have mainstreamed aquaculture into national development plans.
- e) *Commercial and food security orientation*: In general countries have equal emphasis in market led and food security approaches to aquaculture development
- f) *Export orientation*: This is poor for all countries except for Zimbabwe and Sudan who are ranked first and third (by value of production) respectively in this category. Export orientation of aquaculture in these two countries is therefore responsible for their strong rankings due to the high value of products relative to those produced under subsistence production
- g) *Privatized services*: Except for Democratic Republic of Congo and Morocco, countries in this category largely depend on the public sector for delivery of services such as extension, technologies, inputs etc.

In summary, the middle performing countries are unable to translate policies and strategies into tangible aquaculture production due to poor planning and. In addition, , these countries cannot attract domestic and foreign private sector investments to the aquaculture sector due to poor legal framework especially with regard to land and water rights. Dependence on the public sector for aquaculture services also suggests that the private sector does not have access to high quality research and extension support necessary for efficient implementation business plans.

Case Study 6: Aquaculture development in Sudan (including South Sudan)

This case study presents an example of the success of an export-led interventionist approach in a politically unstable country where government efforts focused in a relatively safe site was able to achieve relatively high aquaculture production. The example further shows the negative impacts of political instability on aquaculture growth in a country with huge aquaculture potential with respect to land and water resources.

Sudan's aquaculture comprises of freshwater pond aquaculture of Nile tilapia and mariculture of high value species such as oysters, pearl and shrimp which are cultured in shallow coastal zones using hanging methods, bottom and off-bottom systems as well as ponds(especially for shrimps). Production from small-scale freshwater aquaculture is estimated at not more than 1000 tons/per year with mariculture producing 1200 tons of aquaculture products/yr. Sudan is the top ranked country in the middle performing countries with total production valued at US\$7.7 million in 2010.

Development of mariculture has occurred along the politically stable coastal regions. The development of the mariculture sector has benefitted from strong market demand of high value species and strong research linkages with Sudan University of Science and Technology and. Long-term research to improve oyster culture methods that have paved ways for economically viable expansion of oyster farms by the private sector. Freshwater fish culture has not as yet developed into a vertically- integrated economic activity, despite the fact that the prerequisites such as peri-urban markets and infrastructure. Several state and private sector farms were established around the capital, Khartoum and other towns in various states.

Overall, Sudan has the necessary natural resource base of water (freshwater and marine), population and land resources to support a large aquaculture industry. However, political instability in the high potential production regions and poor planning has constrained growth. However, the development of mariculture industry through strong partnerships between local university and industry and the specialization in high- value marine species in a stable region of the country provides useful lessons to other African countries which are recovering from conflict.

Case Study 7: The role of general policies and regulations in the development of aquaculture in Zimbabwe

Zimbabwe offers good natural competitive advantages to commercial tilapia and catfish farming (Blow and Leonard, 2007). However, growth of this sector is however constrained by the harsh economic environment that has been prevalent in Zimbabwe for the last 10 years, lack of planning and legal frameworks for the sector and absence of policies responsive to the needs of the sector.

Zimbabwe's aquaculture sector consists of subsistence aquaculture which is carried out at household level and commercial aquaculture undertaken by private investors who mainly produce fish for export and urban markets. The subsistence sector is limited to a few pond-based enterprises where farmed fish provides a cheap source of protein for domestic consumption. Commercial aquaculture production is monopolised by the Lake Harvest Aquaculture (Pvt) Ltd which produces Nile tilapia (*Oreochromis niloticus*) for export. Lake Harvest Aquaculture was established in Zimbabwe in 1997 with the sole purpose of producing fish for export. Its establishment was facilitated by the Department of Parks and Wildlife using the Parks and Wildlife Act and other general trade and investment policies. Lake Harvest Aquaculture was the first investor to establish "proof of concept" of viability of commercial cage aquaculture in African freshwater lakes and its successful model has been replicated in Malawi, Ghana and Uganda.

Due to unfavourable macro-economic conditions, commercial producers have not been able to procure raw materials at a cheaper price and reduced government services to the subsistence sector. In response to these conditions, total aquaculture production dropped by 13% within a 5-year period from 3000 tons in 2005 to 2702 tons in 2010. (FAO, 2011).

For aquaculture to grow beyond Lake Harvest Aquaculture and the few commercial producers there is need for an enabling legal framework for aquaculture to make it easier for potential investors to join the sector (Blow and Leonard, 2007).

4.1.3. Low performing countries

- a) *Policies and plans*: These countries are characterized by lack of or poor aquaculture policies and implementation plans. Only Namibia has very strong aquaculture policy, strategic and implementation plans.
- b) *Aquaculture legislation*: Generally poor. Legislation is strong in Namibia, Rwanda and Gabon.
- c) *Land and water rights*: Generally weak except for Lesotho.
- d) *Mainstreaming of aquaculture into national development plans*: All countries have mainstreamed aquaculture into national development plans.
- e) *Commercial and food security orientation*: In general this group's aquaculture development is oriented towards food security. Namibia and Mauritius' aquaculture however is strongly focused on commercial production
- f) *Export orientation*: Aquaculture is oriented towards internal market. Mauritius and Namibia's aquaculture is however is export-oriented.
- g) *Privatized services*: Most (60%) countries have privatized aquaculture services

This group is generally characterized by countries which are small in size and/or population and hence have low internal demand or low natural resource base to support large aquaculture production. The three top producing countries (Namibia, Rwanda and Mauritius) had strong to very strong ratings across all assessed parameters. Namibia and Mauritius top this group largely due to their focus on export markets but also strong government commitment to develop aquaculture. Rwanda's performance is largely due to the performance of small-scale sector which is well established and the privatization of government aquaculture stations.

4.1.4. "Bottom of the ladder" category

This group generally had weak rankings in all the parameters that we assessed. Except for Senegal and Ethiopia, this group is characterized by countries which are small in size and/or population and countries in conflict or recovering from conflicts (Burundi, Sierra Leone, Guinea, and Niger). Ethiopia has limited internal demand (due to cultural beliefs regarding fish consumption) to support aquaculture production. However, the resource base with respect to Lake Surface and fish species (e.g. Nile tilapia) has potential to support a large aquaculture sector than the present. Senegal has a very large export based fishery; hence aquaculture is not prioritized in national policies and plans. A case study (Case Study 7) for Ethiopia is used to illustrate the typical status and potential for aquaculture of countries in this category and examine factors contributing to the low productivity and potentials for growth.

Case Study 6: Strategic planning for aquaculture development in Namibia (a low performing country)

Namibia's case study is intended to provide an example of how a country with low production (Low performing country), low population (2.1m people) and low internal market but with vast potential for freshwater and mariculture is taking steps to develop its aquaculture sector towards supplying farmed fish products to internal and export markets. It has done so by developing a framework that combines human and institutional capacity development and explicit private sector interventions to support market-driven aquaculture development.

Namibia's aquaculture sector is in its infancy, Oyster farming is the most established aquaculture activity with six farms currently in operation where both Pacific oysters (*Crassostrea gigas*) and European oysters (*Ostrea edulis*) are grown. Abalone, Rock lobster and Sea weed are also cultured in the marine waters. Commercial tilapia, catfish and crayfish farming is also being undertaken in the country. Production in 2010 was estimated at 675MT putting Namibia on top of the low performing category.

Namibia has developed a comprehensive aquaculture policy to support further development of the sector. To ensure that seed money is made available to stimulate the industry. Through this framework, other ministries such as Trade are now involved in supporting and promoting aquaculture activities. For example, the Ministry of Fisheries and Marine Resources and the Ministry of Trade and Industry have developed six community-based intensive freshwater aquaculture facilities in Omusati, Okavango and Caprivi region producing tilapia and catfish for local distribution. Government is also supporting research on high value marine species and has, together with commercial banks, provided funding to develop the sector. The main challenge for the Namibian government is now to work more closely with private sector and to grow production by attracting new investors (local and international) into the aquaculture sector.

Case Study 8: Aquaculture development in Ethiopia

This case study seeks to illustrate the typical status and potential for aquaculture of countries in this category and examine factors contributing to the low productivity and potentials for growth.

Ethiopia is the second most populous country in Africa (population: 80million). Its economic and human development which has in the past been hampered by drought, famine and political conflicts is now on the ascendency. The country has the required natural resource base (about 7300km² of lake surface, artificial lakes and small water bodies) and socio-economic conditions (high population and economic growth rates) to support a vibrant aquaculture sector.

Aquaculture production of about 25 tons/year in 2010 is one of the lowest for a country of its size and potential. Fish consumption is low (240g/person/yr) in Ethiopia due to religious and cultural factors. Fish demand in the country is seasonal and is high during lent when orthodox Christians (the majority of Ethiopians) abstain from eating meat, milk and eggs and are allowed to eat fish only. The other major constraints to growth of aquaculture are: (i) the low priority that the sector has been given on government development agenda; (iii) the history of conflicts and natural disasters which has affected infrastructure and human development growth necessary for private sector growth; (ii) the lack of a sector strategy and legal framework. Although there is currently no fisheries policy document in Ethiopia, a range of national development documents such as the Rural Development Policy identify fisheries as being a sector in need of support to enable it to increase production and contribute to the food security of the growing population (ACP Fish II, 2011).

The fortunes of aquaculture are, however, beginning to change in response to increasing demand for fish (fish demand is projected to increase to 94,500 tons by 2015,) and improved socio-economic conditions which taken together have renewed public and private sector interest to support aquaculture investments. Since 2009, twenty-seven investors have received commercial aquaculture licenses for cage aquaculture, trout and lobster farming. This development is in line with the current administration is actively encouraging large scale fish farming developments through provision of investment incentives in line with the 2009 National Aquaculture Development Strategy (NADSE).

4.2. Differentiators between the four aquaculture production categories

Results of key differentiators of aquaculture production categories are presented in Table 1 and a summary of the results is presented below:

- *High performers vs. medium performers:* High performers have strong strategies and implementation plans, privatized aquaculture services and strong land and water rights than medium performers. They also prioritize market-led/commercial aquaculture approaches (immanent aquaculture development) over using aquaculture as a tool for rural food security and economic development (interventionist development);
- *Medium performers and low performers:* Medium performers have strong aquaculture legislation and tend to place equal but strong market-led/commercial and aquaculture for rural food security and economic development approaches than low performers.
- *Low performers vs. “Bottom of the ladder” category:* Low performers have mainstreamed aquaculture policies and plans into national development plans and have strong privatised sector services than the “bottom of the ladder” category.

1 Table 4: Summary of qualitative assessments on key preconditions/factors separating countries in the four aquaculture production categories

Production category	Policy	Strategic plans	Implementation plans	Legislation	Policy mainstreaming	Market led approach	Food security approach	Export	Private services	Land and water rights	2010 Production (tons)
High performers	+	+++	+++	++	+++	+++	+	++	+++	+++	1276557
Medium performers	+	+	+	++	+++	++	++	+	+	+	20501
Low Performers	+	+	+	+	+++	+	+	+	++	+	3911
Bottom of the ladder	+	+	+	+	+	+	+	+	+	+	463

2 +++= Very Strong; ++= Strong; +=Weak

- Main differentiators between High and medium performers
- Main differentiators between medium and low performers
- Main differentiators between low performers and “bottom of the ladder”

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4 **4.3.The Role of Governance in Aquaculture Development**

5 The assessment further sought to establish the contribution of governance to the
6 development or lack thereof aquaculture across the continent. According to Araujo, et al.,
7 (2004), governance matters a great deal because policies’ chance of success or failure
8 cannot be judged abstractly on the basis of their theoretical or technical attributes without
9 considering the institutional, political and cultural context in which they applied.

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11 Governance is quite a complex notion. It means different things to different people. As a
12 way to facilitate the assessment, we used the Mo Ibrahim Index which ranks countries on
13 the African continent with regard to the quality of their governance. For this assessment,
14 the 2011 Mo Ibrahim Index results were used. The Mo Ibrahim Index is a composite index,
15 constructed by combining indicators in a standardized way to provide a statistical measure
16 of governance in all African countries. It is summarized by four dimensions, namely: safety
17 and rule of law, participation and human rights, sustainable economic opportunity and
18 human development.

19

20 As stated earlier, countries on the continent are distinguished into four categories on the
21 basis of their performance in aquaculture using the overall value of production. These
22 categories are high, medium, low and bottom performers. Tables 1 and 2 compare high
23 aquaculture performers with high performers in governance and bottom aquaculture
24 performers to bottom performers in governance according to the Mo-Ibrahim Index
25 respectively.

26 Table 2: Top 10 high aquaculture (value of production) and governance performers (Mo
27 Ibrahim Index) in descending order (N= 53 countries). Mo Ibrahim governance ranking
28 shown in parenthesis.

High Aquaculture Performers	High Governance Performers
Egypt(10)	Mauritius (1)
Nigeria (41)	Cape Verde(2)
Uganda (20)	Botswana(3)
South Africa(5)	Seychelles(4)
Zambia (16)	South Africa(5)
Kenya (23)	Namibia(6)
Tunisia (9)	Ghana(7)
Ghana (7)	Lesotho(8)
Madagascar (33)	Tunisia(9)
Malawi (16)	Egypt(10)

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Table 3: Bottom Ten (value of production) and Low governance performers (Mo Ibrahim Index) in descending order (N=53 countries). Mo Ibrahim governance ranking is shown in parenthesis.

Bottom Aquaculture Performers	Low Governance Performers
Togo (35)	Guinea Bissau (44) Congo (40)
Senegal (15)	Equatorial Guinea (45))
Niger (39)	Cote d'Ivoire (46)
Congo (40)	Eritrea (47)
Guinea(43)	Sudan (48)
Burundi(37)	Central African Republic 49
Sierra Leone (30)	Congo, Democratic Republic (50)
Ethiopia (34)	Zimbabwe (51)
Liberia (36)	Chad (52)
	Somalia (53)

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The comparisons from these two tables do not offer much in terms of the role of governance in the promotion of aquaculture development. This raises more questions than answers with respect to the bottom performers. There is completely no overlap between these two sets of countries. In fact, some of the countries such as Sudan, Zimbabwe and Cote d' Ivoire are among the medium performing countries in aquaculture development. It is nevertheless important to note that although some of the countries do not fall into the category of the bottom ten governance performers, they have just emerged from several years of protracted civil conflict. Notable countries in this regard include Burundi, Siera Leone and Liberia. This could, inter alia, suggest that they do not as yet have viable infrastructure to support progressive aquaculture development in their countries.

There is at least some overlap between high aquaculture and governance performers. Four of the high governance performers are also high aquaculture performers. This suggests that the quality of governance matters in fostering aquaculture development although it is not a definitive determinant. The foregoing qualification is necessary because some of the high aquaculture performers are very weak on governance. A very good example is Nigeria which ranks second in aquaculture performance but it is on position 41 on the 2011 Mo Ibrahim Index of governance.

The disaggregation of the Mo Ibrahim Index offers some insights which are supported by the findings of this assessment. When disaggregated according to the constitutive elements

56 of the index, the majority of countries have improved in both sustainable economic
57 opportunity and human development but this progress is not mirrored in safety and rule of
58 law and participation and human rights. This means that most countries have taken
59 concerted efforts to improve their economic and human development but have not made
60 much progress on the political dimension of governance.

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62 As stated earlier, the benchmarks used to classify the countries into the four different
63 categories indicate that high and medium performing countries have strong trade and
64 investment policies as well as high levels of human capital development. However, some
65 measure of political stability is necessary to facilitate steady and sustainable aquaculture
66 development.

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68 **5. AQUACULTURE DEVELOPMENT MODELS FOR AFRICA**

69 In this review, we have identified 4 models of aquaculture development that have
70 purposely or fortuitously been used in Africa over the past 30 years which can be
71 considered for wider application in Africa. Descriptions of the models together with
72 diagrams on where they are positioned on the immanent and interventionist aquaculture
73 development approach continuum are presented below:

74 a) **Egypt Commercial Tilapia Model (Mixed interventionist/immanent model):**

75 i) Interventionist investments by government in human and institutional capacity
76 (research stations, public hatcheries) followed by market-driven development of
77 aquaculture (immanent development) anchored by good infrastructure and the
78 existence of a pool of highly qualified aquaculturists who act as investors or
79 managers.

80 ii) Comprehensive strategic and implementation plans and legal framework available
81 to guide and protect investments.

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83 b) **Nigeria Commercial Catfish Model.**

84 i) Market-driven commercial aquaculture development built on a foundation of
85 aquaculture infrastructure developed through interventionist programmes.

86 ii) Human capacity gaps filled by international experts and technologies required for
87 effective and efficient commercial aquaculture brought in from outside the country.

88 iii) Existing subsistence aquaculture infrastructure transformed for commercial
89 aquaculture production by entrepreneurs.

90 iv) Sector policies and strategies developed after take-off of commercial catfish farming
91 support equitable participation of all citizens by focusing on the inclusion of youth
92 and development of village centers.

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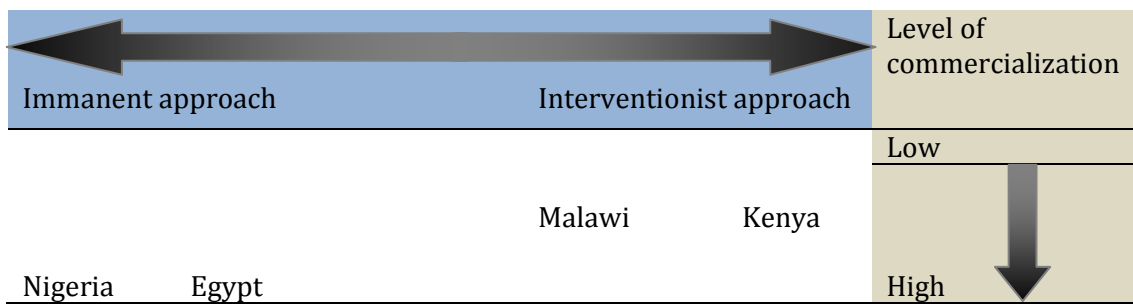
c) Malawi Evolutionary Approach Model

- i) Evolutionary interventionist approach where aquaculture development is achieved through gradual evolution towards high productivity and commercialization and increased levels of sustainability in tandem with increased farmer capacity, new technologies and changing market demands.
- ii) Centralized planning
- iii) Aquaculture development funding mainly dependent on donor resources.

d) Kenya High Input Interventionist Model

- i) Home-grown interventionist approach focused on achieving rapid increases in aquaculture production and establishing commercial aquaculture value chain in the shortest time possible
- ii) Large public sector funding to support development of aquaculture value chain.
- iii) Political will and good organizational and implementation capacity to support effective and efficient roll-out of programme in the absence of strong sector policies, strategies and regulatory framework.
- iv) Promotion of equitable participation of socio-economic groups, creation of employment and input and output markets for aquaculture products and services.

Table 4: Position of the four models in the immanent and interventionist aquaculture continuum



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Out of these four models, we have selected the Nigerian Commercial Catfish and the Kenya High Input Interventionist models as the ones which have the necessary ingredients for fostering rapid aquaculture growth in key countries or regions of aquaculture innovations on the African continent. In addition, elements and approaches in these models can be used to jumpstart aquaculture development in countries where aquaculture has potential but current production is low. The models have been selected due to the following underlying reasons:

- 126 i) *Private sector and Market driven approach*: The major successes of aquaculture
127 development have been achieved through the critical role of the private sector in
128 mobilizing investments to produce for the market and developing innovative
129 approaches such as importation of technologies and managerial capacities
130 required to profitably produce large quantities of fish from commercial
131 aquaculture. The Nigerian commercial catfish model is a very good example of
132 the importance of this approach.
- 133 ii) *African countries have existing public and private infrastructure built in the era of*
134 *interventionist approach that can be transformed into commercial aquaculture*
135 *farms*: The Nigerian commercial catfish model provides lessons on how derelict
136 public aquaculture infrastructure and abandoned farms can be transformed by
137 the private sector for commercial aquaculture in response to growing demand
138 for fish.
- 139 iii) *Rapid response to rising market demand for fish*: Many countries in Africa (e.g.
140 Nigeria, Zambia, Malawi, Kenya, and Uganda) are faced with rapid increases in
141 market demand for fish and have resorted to fish importations from Asia,
142 Europe and other African countries to meet the supply gap. Therefore, most
143 governments in Africa have been promoting aquaculture with the objective of
144 using aquaculture to compliment fish supply from capture fisheries. However,
145 except for Egypt and Nigeria, no African country has been able to develop
146 aquaculture to a scale that could ramp up fish production to meet growing
147 national demand for fish. Kenya's high input interventionist model has shown
148 that more focused large public investments into aquaculture can lead to rapid
149 increases in aquaculture production within relatively short-time frames thereby
150 enabling aquaculture to respond quickly to fish supply gaps in local markets and
151 reducing or eliminating the need for fish imports.
- 152 iv) *Equitable aquaculture development*: Both models have demonstrated that it is
153 possible to promote equitable participation of vulnerable and marginalized
154 members of the society in commercial aquaculture and to create employment for
155 these groups. Such outcomes respond to public policy objectives of many
156 African countries and could assist in mainstreaming of aquaculture in national
157 development plans.
- 158 v) *Mainstreaming aquaculture into general government development policies can*
159 *unlock public resources that can jumpstart aquaculture development in Africa*:
160 Both models demonstrate that it is important to mainstream aquaculture into
161 national development policies so that national financial resources are made
162 available to the aquaculture sector to facilitate rapid aquaculture development in
163 Africa. Therefore, these two models provide good examples to other African
164 countries on the importance and benefits of mainstreaming aquaculture into
165 national development plans

166 vi) *Strong strategic and implementation plans are critical to achieving impact at*
167 *scale:* Both models demonstrate the importance of developing strong strategic
168 plans and the disciplined execution of these plans in achieving impacts at scale.
169 The Nigeria Commercial Catfish Model demonstrates the importance of strong
170 private sector planning while the Kenya High Input Interventionist Model
171 demonstrates the importance of this attribute for the public sector.

172 In proposing these models we are aware that the selected are not mutually exclusive and
173 hence can be used simultaneously and in different combinations to suit existing
174 aquaculture development settings and contexts.

175 **6. CONCLUSIONS**

- 176 a) Rapid aquaculture development is occurring in countries where market, governance
177 and investment conditions are conducive for economic growth and where national
178 governments have demonstrated political will to support the aquaculture sector
- 179 b) Immanent aquaculture development approaches offer the best options for
180 accelerating aquaculture growth in Africa
- 181 c) Interventionist approaches can be applied by governments to jump-start
182 commercial aquaculture development provided that this approach is supported by
183 strong strategic and implementation plans.
- 184 d) Good policies are not an indispensable and essential condition for commercial
185 aquaculture development in Africa.
- 186 e) In order for countries to achieve high rates of aquaculture production and
187 development in the absence of sector policies, they must have strong strategic and
188 implementation plans, privatized services that provide efficient and high quality
189 support to investors, strong land and water rights to protect investor and farmer
190 investments and adopt market-led aquaculture development approaches. However,
191 some measure of political stability is necessary to facilitate steady and sustainable
192 aquaculture development such as that observed in the high and medium performing
193 countries.
- 194 f) Although not a definitive determinant, our review suggests that the quality of
195 governance matters in fostering aquaculture development.

196 **7. ROAD MAP FOR IMPLEMENTATION OF CAADP-LINKED NATIONAL** 197 **AQUACULTURE STRATEGIES.**

198 In this section we present recommendations on an indicative way forward and strategies
199 and approaches that NEPAD through the Aquaculture Working Group must promote and
200 disseminate to governments, private sector and development banks in order to garner
201 support for aquaculture development in Africa. These recommendations are informed by
202 our review and have been made on the basis that market-led commercial aquaculture

203 development is crucial to the attainment of large increases in aquaculture production by
204 African countries. It is also our understanding that the critical investment areas and
205 approaches contained in the NEPAD Fish for All Action Plan (NEPAD, 2005) and their
206 subsequent updating by CAMFA (NEPAD, 2010) remain relevant as blueprints for
207 aquaculture development in Africa. These are described below:

208 **7.1. Focus on countries and regions where market-led aquaculture investments**
209 **and developments are underway and accelerated rates of aquaculture**
210 **production are being achieved.**

211 There are relatively few countries in Africa where key innovations and approaches have in
212 the past 10 years shown remarkable progress either through immanent forms of
213 aquaculture development or through interventionist approaches introduced after the
214 Abuja NEPAD Fish for All Summit. Further, within and between categories, the disparities
215 in tonnage and value of aquaculture production are high such that some prioritization of
216 effort is required. It is therefore recommended that continental (AU) and regional
217 (Regional Economic Communities) efforts should focus on the countries in the top
218 performing category (ranked according to value). The proposed list of priority countries is
219 as follows: Egypt, Nigeria, Uganda, South Africa, Zambia, Kenya, Tunisia, Ghana,
220 Madagascar and Malawi. This approach will ensure that efforts of various stakeholders
221 such as continental, regional bodies and national governments are concentrated on
222 countries with high potential and that visible success is demonstrated to policy makers and
223 development partners for scaling up.

224 **7.2. Mainstream aquaculture strategies and plans into national development plans**

225 National governments through the CAADP made commitments in Maputo to allocate 10%
226 of their annual budget to agriculture sector. However, African governments' allocation to
227 the sector is still low. One strategy for increasing the proportion of the agriculture sector
228 budget is to ensure that aquaculture strategies and plans are mainstreamed and reflected
229 in national development plans. This synthesis study has revealed that mainstreaming of
230 aquaculture strategies and plans into national development policies and plans can unlock
231 substantial public sector funding that can jumpstart aquaculture development in Africa.

232 Thus, we recommend that the Aquaculture Working Group should use outputs of this study
233 to engage in policy dialogue with the priority countries on how aquaculture can be
234 mainstreamed into national development plans and actively engage in a process of
235 mainstreaming through the CAADP process as well as national development plan
236 formulation processes.

237 **7.3. Strengthen private and public sector capacity to develop and implement**
238 **strategic plans**

239 Our results have shown that good policies are not an indispensable and essential condition
240 for commercial aquaculture development in Africa. The study has also shown that for
241 commercial aquaculture to develop in the absence of strong policies, national governments
242 and the private sector must have strong strategies and implementation. However, most

243 countries in the top performing category have weak to strong implementation plans.
244 Therefore there is need to strengthen planning and implementation capacities of the
245 private and public sector, if the sector is to achieve the high levels of growth observed in
246 Egypt, Nigeria, Kenya and Asia.

247 It is therefore recommended that the Aquaculture Working Group should lobby
248 appropriate regional and national bodies to support capacity building programmes in
249 strategic and operational planning for the aquaculture sector and other private and public
250 institutions involved in aquaculture development.

251

252 **7.4. Mobilize funding to strengthen the technological basis for commercial** 253 **aquaculture and to support nascent private sector investments.**

254 Key technological and aquaculture infrastructure are critical for market-led commercial
255 aquaculture development (immanent forms of aquaculture development) to occur. From
256 the study, we have shown through the case studies that development and application of
257 technologies (e.g. fast growing improved tilapia strains, mono-sex tilapia culture,
258 recirculating catfish rearing systems) require public and private sector funding. Further,
259 the synthesis study has shown that in countries where these technologies were already in
260 existence, there was rapid take off of market-led aquaculture growth as investors had a
261 technological foundation on which to build their investments.

262 In the top ten performing countries, market conditions are conducive to the take off of
263 commercial aquaculture but the technological basis and infrastructure to support
264 innovations may be weak for effective development of the sector. Recognizing that some of
265 the investments necessary for rapid take-off of the commercial aquaculture sector cannot
266 be met entirely private investments; we recommend that the Aquaculture Working Group
267 should assist regional and national bodies in lobbying development banks such as African
268 Development Bank, PTA Bank, The International Finance Corporation and the Development
269 Bank of Southern Africa to review their portfolio's in line with recommendations made at
270 the CAMFA meeting so as to increase allocation of funds to the fisheries sector.

271 **8. ROAD MAP FOR UP-SCALING THE IMPLEMENTATION OF THE** 272 **SYNTHESIS REPORT VIA AFRI-FISHNET AT REGIONAL AND NATIONAL** 273 **LEVELS**

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275 8.1. Engage national and regional policy makers in policy dialogue to communicate the
276 need for substantial investments into aquaculture sector in the selected priority
277 countries. This engagement should include presentations of results of this synthesis
278 study to national and regional policy makers; attendance of aquaculture working
279 group members/Fish Node in key regional fora (summits, workshops) to present

- 280 results of this study and discuss implications of recommendations on aquaculture
281 development with policy makers and development partners
- 282 8.2. Conduct national and regional workshops to disseminate outputs of the study and
283 develop scenarios for policy makers
- 284 8.3. Develop policy working papers and policy briefs for dissemination to a wide range
285 of stakeholders via the Afri-FishNet and NEPAD website
- 286 8.4. Develop plans for peer to peer learning where policy makers, private sector and
287 technical experts can visit centers of innovation and success (e.g. Nigeria for Catfish,
288 Egypt for Tilapia and Kenya for demonstrations of role of public investment in
289 jumpstarting commercial aquaculture)
- 290 8.5. Mobilize and secure adequate resources to support the scaling up process.

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331 Appendix 1: Analysis of policies, laws and regulations in aquaculture producing countries ranked by total production (tons)

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333 Appendix 1a: Assessment of policies, plans, legislation and aquaculture development approaches in high (5000 to 1 million tons) producing countries using 2010
 334 FAO data

Country	Policy	Strategic plan	Implementation plan	Legislation	Policy mainstreaming	Market led approach	Food security approach	Export	Private services	Land and water rights	Production (ton)
Egypt	+	+++	++	++	+++	+++	+++	+++	+++	++	919585
Nigeria	+++	++	++	+	+++	+++	++	+	++	++	200535
Uganda	+	++	++	+	++	++	++	++	++	++	95000
Kenya	+	++	+++	+++	++	+++	++	++	+++	++	12154
Madagascar	+	++	++	+	+++	++	++	++	++	++	10886
Zambia	+	++	++	+	+++	+++	++	++	+++	++	10290
Ghana	+	++	++	+	+	++	++	++	+	++	10200
Tanzania	++	++	++	++	++	+++	++	++	+++	++	7338
Tunisia	+	++	++	++	+++	++	+	+	++	++	5421
South Africa	+++	+++	+++	+++	+++	+++	+++	+++	+++	++	5148
Total Production											1276557

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342 Appendix 1b: Assessment of policies, plans, legislation and aquaculture development approaches in medium (800 and 4000 tons per annum) producing countries
 343 using 2010 FAO data

Country	Policy	Strategic plan	Implementation plan	Legislation	Policy mainstreaming	Market led approach	Food security approach	Export	Private services	Land and water rights	Production (ton)
Malawi	+	++	++	++	+++	++	++	++	++	++	3163
Dem Republic of Congo	+	+	++	++	++	++	++	+	++	+	2970
Zimbabwe	+	+	++	+	++	+++	++	++	+	+	2702
Sudan	+	+	+	++	++	++	++	+	+	+	2200
Mali	+	++	++	++	++	++	++	+	+	++	2083
Algeria	+	++	++	+	++	+	+	+	+	+	1759
Cote d'Ivoire	+	++	++	+	++	+	+	+	+	+	1700
Mozambique	+	+	++	++	++	+	+	+	+	+	1564
Morocco	+	++	++	++	++	++	+	++	++	++	1522
Cameroon	+	++	++	++	++	++	+	++	+	+	838
Total Production											20501

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Appendix 1c: Assessment of policies, plans, legislation and aquaculture development approaches in low (100 and 700 tons) producing countries using 2010 FAO data

Country	Policy	Strategic plans	Implementation plans	Legislation	Policy mainstreaming	Market led approach	Food security approach	Export	Privatized services	Land and water rights	Production (tons)
Namibia	+++	+++	+++	++	++	+++	++	+++	++	++	675
Rwanda	+	++	++	++	++	++	++	+	++	++	628
Mauritius	+	++	++	++	++	++	++	++	++	++	568
Benin	+	+	+	+	++	++	++	+	+	+	461
Burkina Faso	+	+	++	+	++	++	++	++	++	+	370
Seychelles	+	++	++	+	++	++	++	++	++	+	300
Lesotho	+	+	+	+	+	++	++	+	+	++	300
Libya	+	+	+	+	+	++	++	+	+	+	240
Swaziland	+	+	+	+	+	+	+	+	+	+	209
Gabon	+	++	++	++	++	+	++	++	++	+	160
Total Production											3911

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358 Appendix1d: Assessment of policies, plans, legislation and aquaculture development approaches in "bottom of the ladder" (>100 tons) producing countries using
 359 2010 FAO data

Country	Policy	Strategic plans	Implementation plans	Legislation	Policy mainstreaming	Market led approach	Food security approach	Export	Private services	Land and water rights	2010 Production (tons)
Togo	+	+	+	+	+	+	++	+	+	++	100
Senegal	+	+	+	+	+	+	++	+	+	+	80
Niger	+	+	+	+	+	+	+	+	+	+	70
Congo	+	+	+	+	+	+	++	+	+	++	58
Burundi	+	+	+	+	+	+	++	+	+	+	50
Sierra Leone	+	+	+	+	+	+	+	+	+	+	40
Ethiopia	+	+	+	+	+	+	+	+	+	+	25
Liberia	+	+	+	+	+	+	+	+	+	+	20
Guinea	+	+	+	+	+	+	+	+	+	+	20
Total Production											463

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363 Appendix 2: Analysis of policies, laws and regulations in aquaculture producing countries ranked by total production value
 364 (US\$ '000)

365 Appendix 2a: Assessment of policies, plans, legislation and aquaculture development approaches in high producing countries (5000 tons to 1 million tons). Data
 366 sorted by value of production in US\$ '000

Country	Policy	Strategic plan	Implementation Plan	Legislation	Mainstreaming sector policies and plans into national plans	Market led	Food security	Export	Private services	Land and water rights	2010 Production value
Egypt	+	+++	++	+++	+++	+++	+++	+	+++	++	1546090
Nigeria	+++	++	++	+	+++	+++	++	+	++	++	576485
Uganda	+	++	++	+	++	++	++	+	++	++	170688
South Africa	+++	+++	+++	+++	+++	+++	+++	+++	+++	++	56582
Zambia	+	++	++	++	+++	+++	++	+	+++	++	34363
Kenya	+	++	+++	+++	+++	+++	++	+	+++	++	33102
Tunisia	+	++	++	++	+++	++	+	+	++	++	32892
Ghana	+	++	++	+	+	++	++	+	+	++	28516
Madagascar	+	++	++	+	+++	++	++	++	++	++	25643
Malawi	++	++	++	++	+++	++	++	+	++	++	9465
Total Value											2513826

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373 Appendix 2b: Assessment of policies, plans, legislation and aquaculture development approaches in high producing countries (4000 to 800 tons). Data sorted by
374 value of production in US\$ '000

Country	Policy	Strategic Plan	Implementation Plan	Legislation	Mainstreaming sector policies and plans into national plans	Market led	Food security	Export	Private services	Land and water rights	2010 Production value
Sudan	+	+	+	++	++	++	++	++	+	+	7700
DRC	+	+	++	++	++	++	++	+	++	+	7435
Zimbabwe	+	+	++	+	++	+++	++	++	+	+	6754
Mali	+	++	++	++	++	++	++	+	+	++	5688
Morocco	+	++	++	++	++	++	+	++	++	++	5485
Cote d'Ivoire	+	++	++	+	++	+	+	+	+	+	5194
Mozambique	+	+	++	+++	++	+	+	+	++	+	4366
Algeria	+	++	++	+	++	+	+	+	+	+	3388
Mauritius	+	++	++	++	+++	++	+	+	++	++	3256
Lesotho	+	+	+	+	+	++	++	+	+	++	2874
											52140
Total											

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380 Appendix 2c: Assessment of policies, plans, legislation and aquaculture development approaches in high producing countries (700 to 100 tons), Data sorted by
 381 value of production in US\$ '000

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Country	Policy	Strategic Plan	Implementation Plan	Legislation	Mainstreaming sector policies and plans into national plans	Market led	Food security	Export	Privateservices	Land and water rights	2010 Production value
Tanzania	++	++	++	++	++	+++	++	++	++	++	2582
Cameroon	+	++	++	++	++	++	+	++	+	+	2534
Seychelles	+	++	++	+	++	++	++	++	++	+	1742
Benin	+	+	+	+	++	++	++	+	+	+	1288
Burkina Faso	+	+	++	+	++	++	++	++	++	+	1250
Libya	+	+	+	+	+	++	++	+	+	+	1110
Rwanda	+	++	++	++	++	++	++	+	++	+	1021
Namibia	+++	+++	+++	++	++	+++	++	+++	++	+	619
Gabon	+	++	++	++	++	+	++	++	++	+	550
Swaziland	+	+	+	+	+	+	+	+	+	+	429
Total											13125

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390 Appendix 2d: Assessment of policies, plans, legislation and aquaculture development approaches in high producing countries (production < 100 tonnes), Data
 391 sorted by value of production in US\$ '000

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Country	Policy	Strategic Plan	Implementation Plan	Legislation	Mainstreaming sector policies and plans into national plans	Market led	Food security	Export	Private services	Land and water rights	2010 Production value
Togo	+	+	+	+	+	+	++	+	+	++	240
Senegal	+	+	+	+	+	+	++	+	+	+	202
Niger	+	+	+	+	+	+	+	+	+	+	149
Congo	+	+	+	+	+	+	++	+	+	++	100
Guinea	+	+	+	+	+	+	+	+	+	+	76
Burundi	+	+	+	+	+	+	++	+	+	+	75
Sierra Leone	+	+	+	+	+	+	+	+	+	+	60
Ethiopia	+	+	+	+	+	+	+	+	+	+	60
Liberia	+	+	+	+	+	+	+	+	+	+	41
Total											1003

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