

A REVIEW ON THE POTENTIAL OF AQUACULTURE DEVELOPMENT IN KENYA FOR POVERTY ALLEVIATION AND FOOD SECURITY

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ABSTRACT

On the global scene, aquaculture accounts for about 50% of total fish production amounting to about 80 million metric tonnes. It is estimated that another 40 million metric tonnes of aquatic food will be required by the year 2030. Today, fish farming represents the fastest growing sector of food production. Moreover, aquaculture has a major role to play in the achievement of the first three Sustainable Development Goals on poverty, hunger, food security and healthy lives of people from developing countries. This is significant especially in the developing countries where poverty and malnutrition are a reality. However, in sub-Saharan Africa, per capita fish production from aquaculture is still below world production levels. In Kenya, inland capture fisheries accounted for over 90% of the total national fish production while marine capture fisheries contributed about 5% in the last decade. Kenya has one of the fastest growing human populations in the world indicating that the demand for fish and fish products will continue to rise, increasing the gap between supply and demand. Currently, aquaculture only produces about 24,000 metric tonnes of fish annually compared to an annual average of 178,000 metric tonnes from natural fisheries. The dominant cultured species include: Nile tilapia (*Oreochromis niloticus*), African catfish (*Clarias gariepinus*), rainbow trout (*Onchorhynchus mykiss*) and common carp (*Cyprinus carpio*). Culture systems commonly used are static ponds and raceway systems. In addition, the country is endowed with numerous aquaculture resources ranging from favorable climatic conditions to vast water resources. In the year 2009, the Kenyan government took steps to enhance aquaculture production through an Economic Stimulus Programme. This has increased the contribution of aquaculture in Kenya to 11.0% of the total fish production. This paper discusses the growth and development of aquaculture in Kenya during the last 50 years and the impact of government support to the sub-sector. The paper also proposes strategies for ensuring that Kenya becomes one of the leading producers of fish from aquaculture in Africa.

Key words: Fish production, capture fisheries, culture systems, Economic Stimulus Programme, aquaculture



INTRODUCTION

Globally, aquaculture is the fastest growing form of animal husbandry with 11% growth rate recorded over the last decade. In 1973, developing countries produced 58% of the world's aquaculture products, but that share had grown to 89% by 1997 [1]. Sub-Saharan Africa is a minor contributor to global fisheries output especially from aquaculture. For example, in 1994, the continent contributed 3.6% of the world's capture fisheries and 0.13% of world aquaculture output [2]. For some years, aquaculture has been seen as a possible saviour for the overburdened capture fisheries sector, and an important new source of food fish for the poor [3]. Egypt is the leading producer of fish from aquaculture in Africa. Table 1 shows the world's top ten aquaculture fish producing countries [4].

Demand for fish has increased worldwide as populations have grown, incomes have increased and the nutritional benefits of fish have become better known. However, most wild fish stocks have been overexploited or have reached their maximum sustainable yield due to over-fishing [5]. In view of potential shortages, it is important to seek more efficient and cost effective ways of food production, especially in sub-Saharan Africa where hunger and poverty are a reality. By the year 2010, Africa's population was estimated to be over 1.2 billion, 19.4% of the estimated world population of about 6.2 billion [5]. Furthermore, nearly 60% of the above population is suffering from chronic under-nutrition. In many parts of the world, aquaculture has already been very successful in increasing the supply of fish and now provides nearly 30% of the fish consumed worldwide. Thus the scientific advancements in aquaculture have led many analysts to term it the *Blue Revolution*. However, the low contribution of aquaculture in Africa to the world's fish production is highlighted by the fact that within the inland waters of the continent there is a tremendous potential for farming of fish and other animals [6]. It is estimated that the Kenyan population requires about 300,000 metric tonnes of fish per year, based on the protein requirement of 9.5 kg per capita per year [7]. The current national fish production stands at 202,000 metric tonnes. This means that the total fish protein requirements are not met since the demand for fish is higher than the supply.

Although aquaculture is the fastest growing food production sector in the world [8], Kenya's aquaculture potential has largely been underexploited. Current production of fish from aquaculture in Kenya is estimated at around 24,000 metric tonnes, accounting for about 11 % of total fish production. The prevalent types of production systems include semi-intensive and extensive systems characterized by low inputs and low yields. Improvement in these systems and introduction of other more efficient highly productive systems is one of the challenges to be overcome by the sector [9].

Nutritive Value of Fish

Where its rich nutrient content is preserved, fish provides protective effects on a wide range of health issues including obesity, stroke, high blood pressure, coronary heart disease and malnutrition caused by high intake of energy combined with lack of balanced nutrition [10]. In poor countries where high levels of cereals are eaten, the challenge is shortage in both energy and other essential nutrients, resulting in illness [11]. Small fish eaten whole secures the intake of these minerals and, therefore, could be an important part of a healthy diet. Fish is an excellent source of high quality animal protein, highly



digestible energy, a rich source of omega-3 polyunsaturated fatty acids (PUFAs) and vitamins [12]. Therefore, if there is a single food that could be used to address all of the different aspects of world malnutrition, it may be fish. Unfortunately, fish has so far been only marginally included in the international debate on food security and nutrition [13]. For example, in Kenya, fish is notably absent from strategies to reduce micronutrient deficiency, which is precisely where it could potentially have the largest impact. Consequently, promoting and increasing aquaculture productivity will not only contribute towards increased food security, but could possibly allow the country to produce a surplus for export [14].

Historical Background

Fish farming in Kenya dates back to as early as the 1900s when British colonialists stocked trout into rivers for sport fishing [15]. Static water pond culture was introduced in the early 1920s starting with different species of tilapias followed by common carp (*C. carpio*) and the African catfish (*C. gariepinus*). In 1948, the Sagana and Kiganjo fish culture farms were established by the colonial government for the production of seed for warm and cold-water fish species, respectively. The establishment of these stations sparked an interest in rural fish farming. The **eat more fish** campaigns by the Fisheries Department in the 1960s led to the rapid spread of rural pond fish farming to other parts of the country. It is estimated that Nyanza and Western provinces alone had over 30,000 fish ponds by the early 1970s [16]. Mariculture, which is the culture of marine organisms, was introduced in the country in 1980s with the establishment of the Ngomeni Prawn culture pilot project along the coastal region. Unfortunately, the number of fish ponds over the years did not translate into increased fish production due to low output from the ponds.

Fish culture did not make much progress and in many cases even declined resulting in the abandonment of fishponds by discouraged farmers. However, potential for development and expansion of aquaculture exists in western Kenya, southern and central Rift valley, central and eastern Kenya and the coastal region. These areas receive adequate rainfall and underground water sources and the soils have good water retention capacity. These areas have many rivers, streams, springs and dams, whose waters could be used for aquaculture development. Moreover, the climatic conditions in these areas are also conducive for fish growth throughout the year.

The shrimp culture pilot project at Ngomeni in the early 1980's demonstrated the economic viability of shrimp farming in the coastal zone. Trials have also been carried out on the culture of oysters, seaweeds and mangrove crabs with varying levels of success. Currently, the most commonly cultured freshwater fish species include *O. niloticus*, *C. gariepinus* and *C. carpio*. By the year 2004, there were over 7,500 small scale fish farmers with 10,371 fish ponds covering a total area of 168 hectares. Many farmers still considered aquaculture to be a risky enterprise, producing low fish yields and a poor economic return on cash and labor investments. Likely reasons include lack of experience in fish breeding and the slow uptake of the technology needed for pond fish production by farmers.

Past Performance of Fish Farming in Kenya

Aquaculture has in the past contributed minimally to fish production in Kenya. Figure 1 and Table 4 illustrate the stagnation of aquaculture fish production at around 1,000 metric tonnes in the 1990s through the mid-2000s. This production represented a contribution of less than 1% to the national fish production, which averaged around 160,000 metric tonnes. Although there was considerable increase in aquaculture fish production from the 1990s by about 50% compared to the preceding decades, this did not translate into a significant contribution to overall national fish production. Figures 1 and 2 show fish production from capture fisheries compared to aquaculture, respectively, between 1950 and 2007. The two figures show the obviously insignificant contribution of fish production from aquaculture during this period as exemplified by the minimal difference in the graphs. There was, however, a momentous rise in aquaculture fish production from 2007 as shown in Figure 1. This rise in production raised the contribution of aquaculture to national fish production to about 3% just before the Economic Stimulus Programme (ESP). The increase was occasioned by the entrance of a few commercial fish farmers. However, this drive faced a number of challenges including lack of sufficient sources of fish seed and commercial feeds.

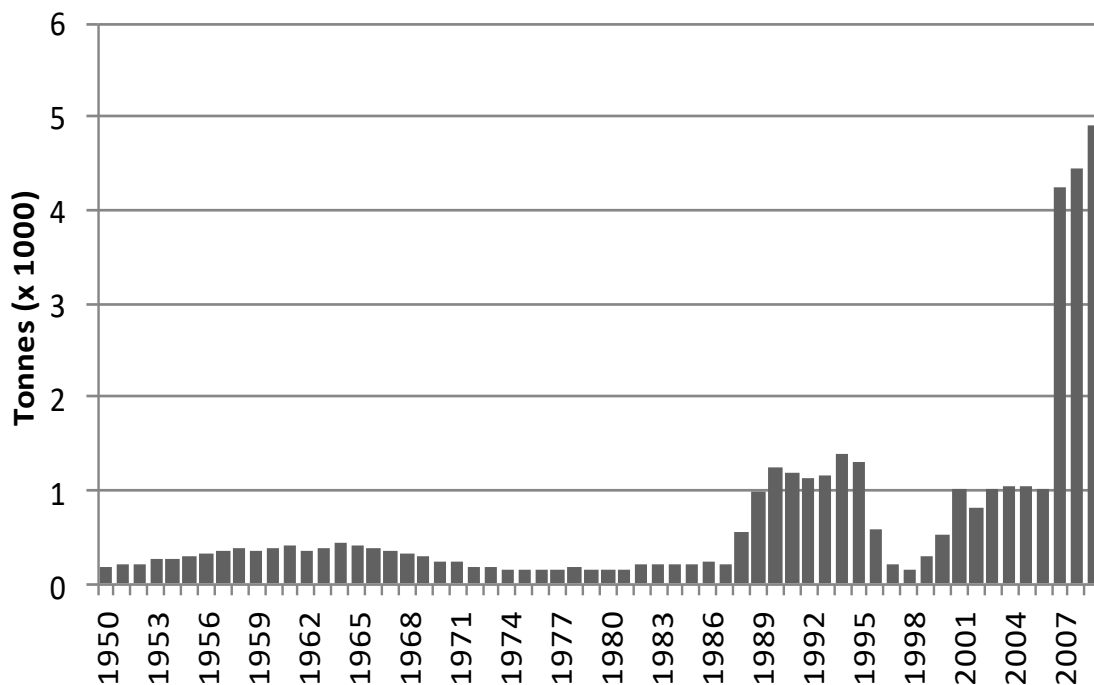


Figure 1: Kenya's Aquaculture Production between 1950 and 2007 [4]

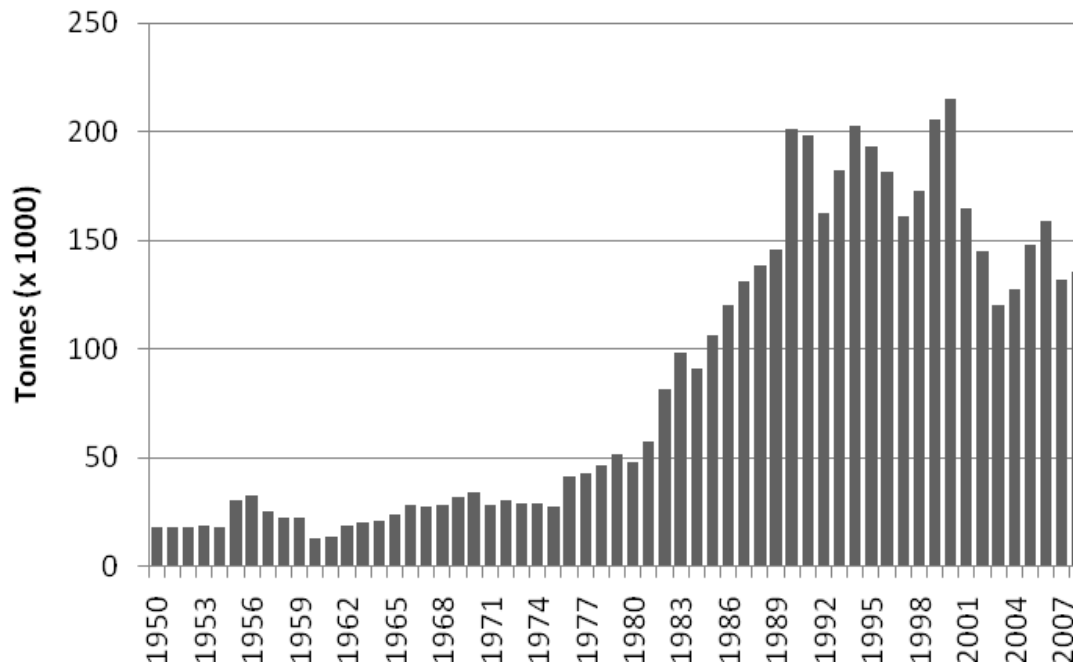


Figure 2: Kenya’s Capture Production between 1950 and 2007 [4]

Aquaculture Management Practices

Management and ownership of fish ponds is mainly by individual fish farmers while self-help groups are the ones who manage dams/reservoirs in the country. Fisheries extension staff occasionally assist farmers in the best pond and dam/reservoir management practices. The Government policy on shifting fish farming from subsistence to commercial enterprise demands increased extension services and reliable fish seed and feed production for the farmers. Figure 3 below shows the production trends in aquaculture from the year 2002-2011.

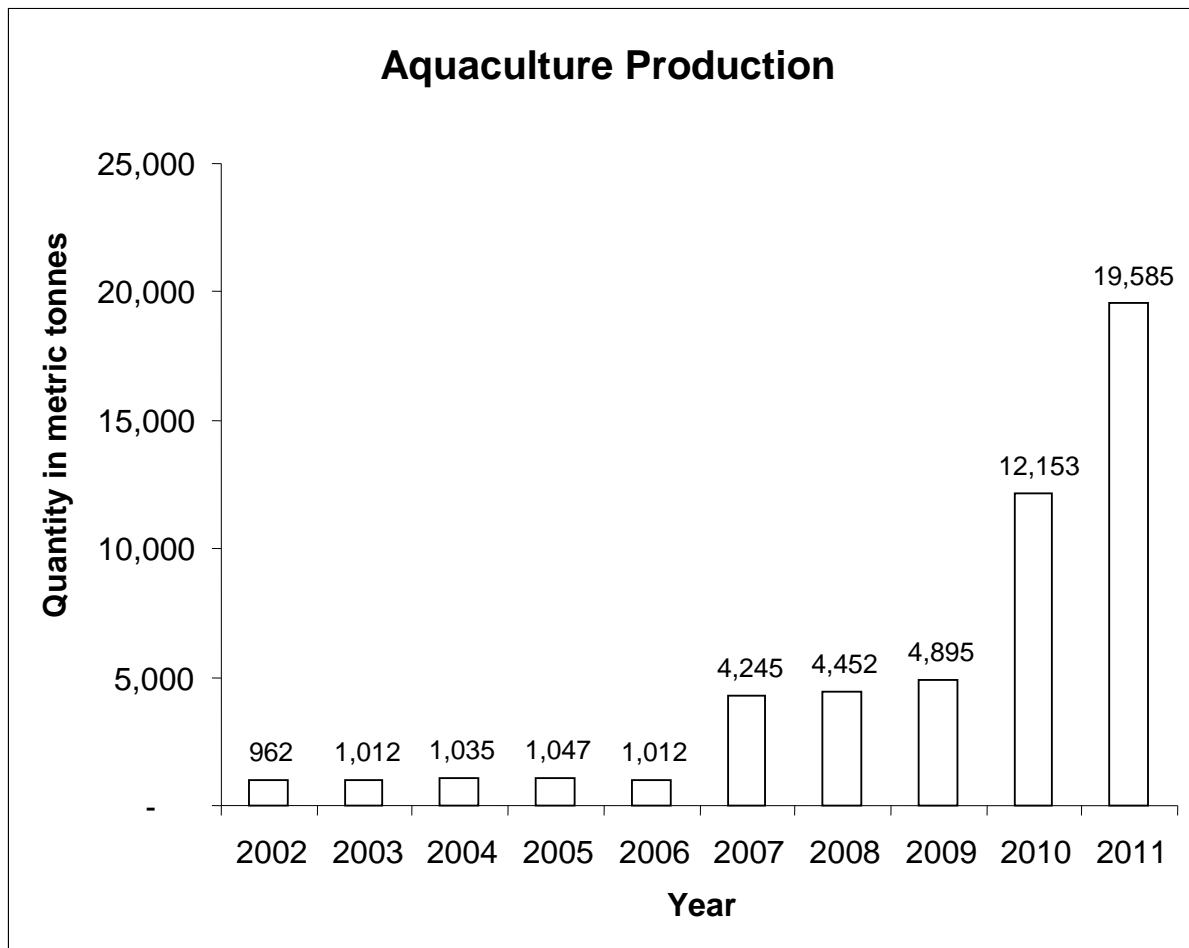


Figure 3: Aquaculture fish production trend for the last ten years

Source: [17]

Current Status of Aquaculture in Kenya

Recent Government Intervention Strategies

Among the recent government efforts to promote aquaculture was the formation of the Ministry of Livestock and Fisheries Development in 2002 and the later formation of a fully-fledged Ministry of Fisheries Development in 2008, when aquaculture received major attention. The government identified the fisheries sector as one of the key drivers for the achievement of the economic pillar of the Vision 2030, which is the national government's blue print for development. These interventions led to the selection of the Ministry of Fisheries Development through the Economic Stimulus Programme to revamp the then ailing national economy at the grassroots level. During the first phase of the programme in fiscal year 2009/2010, Kenya shillings (Ksh.) 1.12 billion was allocated to construct 28,000 fish ponds in 140 constituencies across the country, as well as to provide input such as fish seed, feed and fertilizers to individual farmers organized in clusters at the village/constituency level. Encouraged by the pace of the first phase of the programme, the government allocated an additional Ksh. 2.86 billion for continuation

of the programme under the Economic Recovery Poverty Alleviation and Rural Development Programme (ERPARDP) during the fiscal year 2010/2011.

Impacts of the Economic Stimulus Programme on Aquaculture

Before the onset of the Economic Stimulus Programme, there were about 7,477 production units covering about 722 Ha and owned by about 7,500 fish producers. The majority of these were small scale subsistence farmers found mostly in the former Central and Western Kenya provinces and some parts of the Rift Valley and Coast provinces. By 2007, the mean yield from fish farming was approximately 5.84 metric tonnes/ha/year, while the annual fish production was 4,450 metric tonnes of various species; valued at Ksh. 917 million [17]. This accounted for about 3% of the total national fish production before the increase in aquaculture fish production from the Economic Stimulus Programme. The current total national aquaculture production encouraged by the Economic Stimulus Programme and other private farms is estimated at 24,000 metric tonnes valued at Ksh 2.6 billion and this is bound to increase in the next few years (Table 2).

The most commonly farmed fish species in Kenya are the Nile tilapia (*O. niloticus*), which comprises about 70% of farmed fish, followed by the African catfish (*C. gariepinus*), which contributes about 21% of aquaculture production (Plate 1). Other farmed species are black bass, Koi carp and gold fish, but their overall contribution is minimal (Table 3).



Oreochromis niloticus



Cyprinus carpio



Clarias gariepinus



Onchorhynchus mykiss

Plate 1: Commonly farmed fish species in Kenya

The first phase of the Economic Stimulus Programme (ESP) made a noteworthy contribution bringing the total aquaculture production to over 12,000 metric tonnes in 2009, representing 7% of national fish production up from the previous 3% in 2007. The second phase from 2010-2011 was expected to raise the stake of aquaculture fish

production to at least 10% of national fish production, based on conservative estimates of production of between 18,000 to 24,000 metric tonnes of fish from the aquaculture sector. This target has been met with the current production accounting for 11.0% of the total fish production [17]. The figures for fish production from aquaculture is expected to increase significantly in the coming years, considering the great interest the stimulus programme has generated among fish farmers (Plate 2).



Plate 2: Typical fish ponds

Challenges Facing Aquaculture Development in Kenya

Over the last ten years, fish production from aquaculture has increased from as low as 962 metric tonnes produced in the year 2002 to the present production of 24,000 metric tonnes. However, fish farming in Kenya is still facing a number of challenges. These include:

- a) Inadequate capacity;
- b) Weak linkages between research and extension;
- c) Shortage of good quality seed and affordable feeds;
- d) Weak outreach/dissemination channels;
- e) Subsistence mentality among farmers;
- f) Poor extension services;
- g) Inadequate market information for use by fish farmers;
- h) Lack of good credit facilities and schemes for fish farmers.

Inadequate capacity

There is serious lack of capacity within the sub-sector. For example, human capacity is inadequate and very few aquaculture scientists and managers are available in Kenya. Besides, the National Aquaculture Development and Research Center at Sagana lacks basic aquaculture research equipment. The Kenya Marine and Fisheries Research Institute (KMFRI), which is the government institution mandated to carry out such research, has inadequate laboratory space and the available laboratories are not adequately equipped. This puts great constraints on the quality of the research conducted.

Similarly, the State Department of Fisheries and the counties do not have adequate numbers of trained aquaculture extension service providers, which suggests that fish farmers, hatchery managers and feed producers are not being adequately trained.

Weak linkage between research and extension

Research findings are not readily available to fish farmers due to disjointed interactions between researchers and managers. In 2009, there were efforts by the government to enable researchers and extension officers to work together through the formation of the Aquaculture Development Working Group. This brought together officers from research and management including extension services. This improved the link between research and extension services but more needs to be done to create greater synergy between the two arms of government.

Shortage of good quality seed and affordable feeds

There are few government seed production centers, and these do not produce adequate amounts of quality seed. Additionally, there is so far no programme for certification of seed quality. In addition, there is no established aquaculture feed production center and although standards have been set for feed production and certification, enforcement has not been supported with sufficient funding.

Weak outreach/dissemination channels

There is need for aquaculture materials for dissemination, learning tools, training manuals and aquaculture programmes in both print and electronic media. This will be most effective if it features successful fish farmers to encourage others to learn from their experiences.

Subsistence mentality among farmers

There has been a failure to popularize fish farming as a business opportunity. Consequently, the economic potential of aquaculture has not yet dawned on many people. Potential investors lack adequate investment information. With fish farming being a non-traditional practice in Kenya, more effort is needed to popularize it among the populace to change their attitude from subsistence to commercial aquaculture.

Poor extension services

Fish farmers require quality, relevant and timely information on various aspects of production. It is imperative that adequate extension services are provided to them in a timely fashion. This will require providing extension workers with funding and access to transportation. The challenge of poor extension services is likely to increase given the devolution of aquaculture extension services. This seems to be happening because of the inadequate resources at the county governments that may give aquaculture low priority since they do not appreciate the history and potential of aquaculture in the country.

Inadequate market information for use by fish farmers

Most fish farmers lack information on available markets for the fish. Kenya was listed as an exporter of farmed fish to the European Union (EU). Sufficient efforts are required to ensure that the market is organized to deliver fish required for this market and other emerging markets including the domestic one. The State Department of Fisheries should encourage farmers to form groups so they can address market issues collectively. County governments should negotiate external markets for the farmed fish.

Lack of good credit facilities and schemes for fish farmers

Fish farmers, unlike coffee or tea farmers, face challenges when accessing credit facilities. The main reason is the fact that the banks cannot quantify the credit risks for fish farms. Many banks do not understand the concept of fish farming thus disadvantaging fish farmers. This should be overcome by the formation of strong fish farmer groups which can lobby the banks. Farmers should be encouraged to venture into commercial aquaculture which will enhance their bargaining power for credit facilities [15].

CONCLUSION

Fish production from Kenyan natural waterbodies has not increased to match the demand and in many cases, the natural fisheries have shown declining trends. Therefore, this paper proposes aquaculture development as the best option to complement the declining wild fish stocks, as it will reduce pressure on capture fisheries, create employment, increase fish protein and improve standard of living of rural communities. Although aquaculture currently contributes 11% to the total fish production in Kenya, there is huge potential for fish farming across the country which has not been fully utilized. More concerted efforts are required from the government and stakeholders to increase fish production from aquaculture for poverty alleviation and improved livelihoods. In conclusion, it is imperative for both national and county governments to come up with sustainable funding for aquaculture development.

RECOMMENDATIONS

This paper has given an overview of the development and growth of aquaculture during the last 50 years. Although a lot of effort has gone in to revamping fish production from aquaculture, more needs to be done. Kenya has huge potential for aquaculture development if the following areas can be addressed:

- 1) Creation of the Ministry of Fisheries Affairs to deal with fisheries matters including aquaculture;
- 2) Establishment of centers of excellence for seed and feed production with complete certification facilities across the country;
- 3) Establishment of a competent authority to coordinate the sub-sector;
- 4) Development of quality programmes in aquaculture to produce the required manpower for aquaculture development;
- 5) Promotion of research and development in the sub-sector;
- 6) Establishment of collaborations and Public-Private Partnerships;

- 7) Establishment of synergy between research and extension;
- 8) Promotion and facilitation of aquaculture investment through mainstreaming aquaculture into integrated development plans of counties;
- 9) Transfer of appropriate fish farming technology to the fish farming communities;
- 10) Sensitization of fish farmers to change from the subsistence mentality to a more commercial approach to aquaculture;
- 11) Strengthening the fish farmer cluster groups to enhance experience sharing;
- 12) Revision of aquaculture policy to embrace more intensive production technologies such as cage culture and recirculation aquaculture systems;
- 13) Popularization of aquaculture through print and electronic media
- 14) Provision of assistance to farmers to access bank credits and markets;
- 15) Strengthening extension services to provide quality, relevant and timely information to fish farmers.

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Table1: World's top ten aquaculture fish producing countries

Country	Approximate production (metric tonnes)
China	36,700,000
India	4,650,000
Vietnam	2,670,000
Indonesia	2,304,000
Bangladesh	1,300,000
Thailand	1,280,000
Norway	1,000,000
Egypt	900,000
Myanmar	850,000
Philippines	744,000

Source: [4]

Table 2: Approximate aquaculture fish production per region before and after the government sponsored Economic Stimulus Programme (ESP)

Province	Total production before ESP	Actual production to date	Projected production ESP I (kgs)	Projected production ESP II (kgs)	Projected production ESP i&ii	Projected total national production
Central	2,209,911	9,481	870,000	435,000	1,305,000	4,068,534
Coast	35,473	30,000	149,000	465,000	614,550	1,252,512
Eastern	480,888	15,529	638,000	540,000	1,178,000	2,673,386
Nyanza	421,922	62,654	842,000	525,000	1,367,550	3,013,568
Rift valley	3,706,797	141,252	840,000	517,000	1,357,500	5,161,486
Western	421,086	59,779	720,000	360,000	1,080,000	2,437,916
Nairobi	-	-	30,000	90,000	120,000	240,000
TOTAL	7,276,077	323,695	4,090,100	2,932,500	7,022,600	18,847,402

Source: [17]

Table 3: Impact of the Economic Stimulus Programme (ESP)

	Area Hectares	Metric Tonnes
Pre-ESP Production	722.000	4,220.000
Phase I	8,217.000	12,154.000
Phase II	14,076.000	19,337.000
Post ESP	-	24,000.000

Source: [17]

Key

Phase I: 2009-2010

Phase II: 2010-2012

Post ESP: After 2012

Table 4: Trends in total fish production and the percentage contribution of aquaculture to annual fish production from 1980 to 2003

Year	Total Fish Production (m. tonnes)	Aquaculture Production (m. tonnes)	% contribution of aquaculture to the total fish production
1980	42,218	596	1.41
1985	10,597	1,085	10.42
1990	210,778	973	0.46
1995	193,789	1,083	0.56
2000	202,639	967	0.48
2003	120,242	1,012	0.84

Source: [15, 16,18]

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