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Development of Commercial Aquaculture and the Role of Policies

A case study on the development of aquaculture as a tool for poverty reduction and food security in Kenya

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Abstract

In Kenya, there is a growing demand for fish food, due to rapid population growth and dwindling fisheries. Aquaculture has been revived, and is now the fastest growing food-producing sector in the country. However, this development has happened in an unprecedented speed whereas the issue with sustainability emerges. The main driver for this growth is by government intervention, heavily involved in the development of the sector. According to the aquaculture policy the goal and objective is to "*enhance aquaculture sub sectors contribution to wealth creation, increased employment for all especially the youth and women, food security and income generation through effective private, public and community partners*". This study is a literature-based study, a theoretical case study. Studying the role of policies in aquaculture development when applied as a tool for poverty reduction and food security, by investigating the development in Kenya. Governance and policies has become the focus of this study, due to this assumed impact on development. Major support services such as; Inputs supply, research and extension capacity as well as marketing linkages can be organized in the private sector; however, when aquaculture development is part of a national development plan, the state needs to take more responsibility and guide the development toward desired goals and objectives. It is in these circumstances the role of policies becomes relevant.

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1 INTRODUCTION

Aquaculture is the art, science and business of culturing or farming of aquatic animals in captivity. The term aquaculture is universal for the culturing or farming of organisms that inhabit most of their life cycle in water. Different from fisheries, which involves the capture of fish from the wild, aquaculture implies a manipulation of natural ecosystems for producing desired species (Folke and Kautsky 1992). As the culture of aquatic organisms usually entails husbandry, meaning the raising of animal in captivity, the term fish farming is widely used, further distinguishing aquaculture from the captured fisheries and perhaps indicating a closer relation to agriculture.

In terms of share in production, it was not until the 1950s that aquaculture production increased to become a significant contributor to the worlds fish food supply. Fisheries where experiencing stagnation and in some areas decrease in catches. Decades of technological advancement in fishing methods, with better processing, transportation systems had caused a negative effect on the resource base, and fish stock began to decline. The lack of potential expansion of the fishery industry and issues of rights to fishing ground is believed to have caused an increased attention to aquaculture, by many nations in the 1950s and 1960s (Pillay and Kutty 2005).

Another contributing factor is the series of biotechnological innovations, including better hatcheries, quality fish feeds and the use of medicine. Productions of certain species have been boosted through hybridization, sex reversal, and more selective breeding (Gupta and Acosta 2004). A turning point was the achievement of artificial spawning of fish by the use of hormones, in 1958 (Hickling 1967, Li 2003). This technology severs all ties with the captured fisheries, by avoiding the need to collect fry from the wild, and enabling farmers to be continually provided with fish seed (Shepherd and Bromage 1988).

In addition to being, a valuable source of food for humans, fish and other aquatic organisms contributes in medicinal research, the pharmaceutical industry, and as an ingredient in animal feeds. Aquaculture is also used for producing fish to be re stocked in rivers, lakes and conservation reservoirs, and the ornamental industry (Huntingford, Jobling et al. 2011).

The degree aquaculture contributes to each country`s economy varies greatly. The priorities determined largely by the nation's priorities for the sector, which again is regulated by the socio economic and environmental conditions in each country and or region (Pillay and Kutty 2005). Developed countries tend to prioritize commercial production targeting international markets, developing countries focus more on food security and employment. Mixed priorities are possible as demonstrated in Asia, where the largest group of fish farmers are smalls scale commercially oriented fish farmers (Subasinghe, Soto et al. 2009), whom target both local and international market. Since the 1970s, aquaculture has grown with an annual growth rate of 10% in the developing world and 3, 7% in the industrialized countries (Frankic and Hershner 2003).

Given the growth of the sector in the developing world, aquaculture has become a highly recognized component in the improvement of the livelihoods of the poor (Edwards 2000). Studies suggest that fish farming can contribute positively to the household's food security in the poorer communities (Russell 2008). However, when aquaculture is commercially driven; it provides additional benefits. A Market –oriented aquaculture sector is linked to markets, creating opportunities for income and employment, generating national revenues through tax and trade (Brummett, Lazard et al. 2008).

Now considered more as tool for development rather than just a source of nutrition, commercial aquaculture is portrayed by many intergovernmental agencies as the way forward, in the fight against poverty and food insecurities.

1.1 Problem statement

Kenya, is a developing country whose economy is depend on agriculture as main source for food and national revenue. The major export commodities are cash crops of; tea, coffee and horticulture, but also food crop such as wheat and legumes and fish products. The sector comprises; industrial crops, food crops, and sub sectors such as; livestock, fisheries, horticulture and forestry. The sector accounts for over 18 % of formal employment in different sectors of production. The informal employment however is as high as 70 % in the rural areas, making agriculture the largest employer in the country.

Despite the large engagement in agriculture, Kenya is not self-sufficient in terms of food supply. Since independence in 1963, small-scale family subsistence farms have dominated the production, with little application of modern science and technology (Chauvin, Mulangu et al. 2012). During the 1980s and 1990s the population in Kenya increased rapidly, causing farm sizes to decline, decreasing the farmer's ability to produce sufficient foods to support the growing population. Today, the population growth is 2, 11 % and the over 40 % of Kenyans are permanently food insecure; another 40 % are normally self-food sufficient but are vulnerable to seasonal shocks.

There are several factors affecting the high poverty rates and persistent food insecurity in Kenya. however decades of low investment and dedication by governments combined with a rapid population growth, and a diminishing natural resource base, due to the impacts of climate change, seems to be the most dominant forces, undermining efforts made to increase the country's food production over the last two decades (Mutunga, Zulu et al. 2012). It is acknowledged that growth and intensification in agriculture is the primary cause for poverty reduction in agricultural based economies (Salami, Kamara et al. 2010). Given the central role agricultural sector plays in the economy, the government pursues strategies, which aims to increase food availability and access with the overall goal of attaining self-sufficiency (Kilonzi).

Since the late 1990s, the government of Kenya embarked on a strategy to transform the agricultural sub - sectors into a more commercially driven sector. With the overall goal to revitalize the agricultural sector, the government vision is to transform all agricultural sub - sectors from subsistence level to a "*commercially oriented, international, and regional competitive sector. Creating wealth and employment to Kenyans, as means to reduce poverty and food insecurities".* By the year 2000, several strategies targeting sub sectors where in place. One sector, which gained attention in this process, was the aquaculture sector.

1.2 Why aquaculture?

Fish food, is considered a cheap source of protein for the people living adjacent rivers, lakes and coastal zone in the country. However, Fisheries show similar trends as

agriculture, with the major source for fish food supplied through artisanal traditional fisheries. The recent combination of climate change and a rapid population growth has put pressure on the water resources, and coastal and inland fisheries are experiencing stagnation (Eknath and Hulata 2009). With the increased pressure on the fisheries resources, it is to a great extent accepted by government, that fish supplied from traditional fisheries are unlikely to increase considerably, and that the anticipated gap in demand and supply can only be met by and expansion within the aquaculture sector (SOFIA 2013). Although aquaculture has been operating in Kenya since the late 1800s, the sector has contributed little to the national fish food supply. According to the report: Strategic Reassessment of Fish farming Potential in Africa, published in 1998; Kenya have about 30 % of land surface highly suitable for commercial fish farming (Aguilar-Manjarrez and Nath 1998). With these estimates, and a declining fisheries it became clear that the potential for fish food production in Kenya was not only underutilized, but essential to supply the national fish demand (Jamu and Ayinla 2003).

In recent years, the potential expansion of the sector has been receiving government attention as means to reduce the shortage of fish food in the country. The additional role of aquaculture as an instrument to reduce poverty through generating income and creating employment, has furthered international and national investments in the expansion of the sector towards commercial productivity (Brummett, Lazard et al. 2008).

During the preparation of the Poverty Reduction Strategy Papers (PRSP) in 2001, Kenya recognized aquaculture as one of the core activities that can contribute to rural food security and poverty alleviation. Since the year 2000, the production from freshwater aquaculture increased from an annual 1,000 metric tons in 2000 to over 4,452 MT in 2007. In 2009, the culture of Nile Tilapias and African Catfish was incorporated in the GoKs Economic stimulus program ESP. One of the components in the ESP is the **Fish Farming Enterprise Support Program FFESP.** By promoting and supporting commercial aquaculture enterprises, The Kenyan government aims to utilize its aquaculture potential, targeting the rural poor, generate household incomes, create employment and reduce national food insecurity. The FFESP program subsidizes pond constructions, fish feed and fingerlings for farmer startups. In addition, the program also facilitates training programs through governmental research farms and local extension service. As a result of the FFESP the Production has more than quadrupled to over 22345

metric tons in 2011 (2007). The growth of the sector is by far a result of government intervention, creating great enthusiasm to future prospect for the sector.

1.3 Research objectives

The level of which aquaculture can contribute to alleviate poverty and increase food security is argued by many to be largely a policy issue (Edwards 2000, Ridler, Hishamunda et al. 2001, Hishamunda, Ridler et al. 2009). In both industrialized and developing countries, the need for a clear and well-planned policy is becoming widely recognized for the management of the sector (Pillay and Kutty 2005).

Policies can provide enabling environments for the sector to prosper, while also ensure that the negative externalities that may arise with increased production is reduced or all together avoided. Nevertheless, policies, rules, regulations and management structures can also discourage growth and development. Previous governmental led support programs to expand and intensify aquaculture sector in Kenya, has proven not to be sustainable. Top- down structured strategies resulted in a larger dependency on the government to cover the cost and development of supply and input chains of the sector, causing the sector to stagnate without continuous governmental or foreign agency funding (Ngugi and Manyala 2009).

Commercial enterprises are dependent on its feasibility, which involves market accessibility, engagement by the civil society, which includes suitable and available Technical and human resources, legal regulations and guidelines from government to be sustainable (Ridler, Hishamunda et al. 2001).

In addition to a larger engagement by public sector, commercial enterprises has to be able to operate on a self-financing basis. Meaning the role of government monetary support, in terms of subsidies, and direct free assistance should not be long term, in order for the sector to become entirely sustainable. Learning from the past, Kenya have fostered a policy framework to the management of the sectors growth with the objective to secure a sustainable development post FFESP.

This paper aims to study the role of policies in aquaculture development when applied as a tool for poverty reduction and food security by investigating the development in Kenya. The primary objective is to explain, why the chosen policy and to discuss against research literature what role a policy may have and how this policy addresses the challenges faced by the sector. By describing the sectors governance in the past, present and future, I aim to identify the challenges and constraints that needs to be addresses. Then by presenting the new policy, I aim to analyze how the policy addresses these challenges, and finally elaborate on potential causes and reasons for its success or failure.

1.4 Research questions

- What are the main challenges for aquaculture development in Kenya?
- How Does the Kenyan aquaculture policy address the major challenges for development of aquaculture?
- What can be learned, by this approach to development?

1.5 Structure of the study

Chapter 2 is a theoretical framework for the study, accounting for the major development theories relating aquaculture development in the Sub Saharan Africa. Then Describing the concepts, principles and terminologies with its current understanding and measurements. **Chapter 3** contains the research methodology, the research purpose, strategy, limitations and source; validity; reliability of data collected. **Chapter 4** is a literature review, a historical account of aquaculture development, from its earliest documentation to present time focusing on the development interventions implemented in the SSA. **Chapter 5** is a country profile of the case in question. A short guide to Kenya's history, politics and economic background, climate, demography development, then the rationales for aquaculture development will be accounted for. **Chapter 6** describes the performance of aquaculture sector in Kenya, accounting for the sectors stakeholders and the governance and the policy of the sector is presented. **Chapter 7** examines the

challenges identified by the Fisheries Department; this chapter forms the main discussion of my study, relating the findings to the research objectives and questions. Then finally, **Chapter 8** contains recommendation and some reflections on the role of polices, and statement on what has been learned during this process.

2 THEORETICAL FRAMEWORK

In this chapter, the evolution of the major development paradigms with its impact on the socio economic growth in sub Saharan Africa will in short be described. Then the concepts of " aquaculture ", " commercial aquaculture ", " sustainability ", "governance and policies "will be defined and explained in relations to the prerequisites for commercial aquaculture.

2.1 Development theories

For the purpose of this thesis, development is understood as a socio economic condition, referring to the interactions between the social and economic factors, within a country, by this development can be understood as economic growth, which leads to an increased capacity of people to influence their future (Bryant and White 1982). Social development is according to Woods (2006, p 4) an "ongoing process, meaning it never ends nor arrives" so as an outcome development can only be measured based on the anticipated effect from an action or event.

Cowen and Shenton (1995) termed development as either immanent or interventional. The former referring to, development that occurs naturally, without human planning or deliberate intent. Interventional or intentional development is however something that is introduced to the people by the people, with an intention, aim and objective. One recognizes Intentional development in the deliberate policies and actions of governing states, often as a response to issues within a society (Larrain 1989).

The evolution of aquaculture pre and post-colonial Africa can be viewed within the context of the prevailing development theories, changing and developing from one paradigm to another, since aquaculture first was established in the sub Saharan Africa.

This is because most aquaculture projects and interventions initiated in the region are a blueprint of western ideology and more or less governed by bilateral and multilateral western donor agencies.

2.2 Theory of modernization

The theory of modernism is the most influential development theory, relating to development in Kenya and the sub Saharan Africa. Although strategies and entry points have been modified, the core objective of many African development plans and policies today, is to develop towards modernization (Matthews 2004).The modernism paradigm dates back to the 1940s and 1950s. Modernity, meaning: "up to date "or the most recent. The concept of development, at that time was largely an economical question, based on the measurement of GNP. Economic growth was driven by industrialism, where transformation from subsistence farming to cash crop agriculture, urbanization and technological sophistication, where considered to be the pathways to positive development.

The reasoning for modernization is largely based on the belief that people living in modern societies such as the industrialized countries are better off, both in terms health, welfare , life expectancy, and in general an increased standard of living (Reyes 2001). Modernization scholars viewed traditional societies as incompatible to modernization, therefore a transformation from traditional into modern society required a multidimensional process of changes in; political, cultural and social institutions for economic growth to occur. This was to be achieved in a linear process of change, gradually transforming traditional societies, to resemble the more modern political, social and cultural structures of the west (Rostow 1990). Strongly linked to the birth of the aid industry, modernization models where promoted through international aid in the form of capital, technology and expertise, throughout the 1960s, 1970s and 1980s (Matunhu 2011). Through international economic institutions, such as the International Monetary Fund (IMF) the World Bank, and the multilateral agencies such as the Food and Agricultural Organization (FAO), Industrial and infrastructure projects where launched with technological assistance, loans and aid (Gardner 1996)

Since then the aid has played an increasing role on the development of agriculture and aquaculture sector in sub Saharan Africa (Bräutigam and Knack 2004). The assumption was that through Investments in industrialized projects, economic growth would indirectly encourage expansion of the economy. As wealth generated from industrial production grew, it would" trickle down" to other sectors and expand to the rest of the economy, indirectly lead to the improvement of livelihoods, even for the poorest (Willis 2011).

During the 1960s the modernization theory was increasingly being criticized, both on a theoretical and practical level, mainly due to the shortcomings in achieving economic growth (Bryant and White 1982). Firstly, to measure development strictly by the use of GNP, was proven to give a false perception of positive socioeconomic development GNP/capita is the total national income divided by the number of people in the country. In other words, GNP/capita is only a measure of national income per person, thus it does not disclose anything on the actual distribution of wealth in a nation. Secondly, the "trickle-down "effect was based on the assumption that wealth would automatically be distributed equally, embracing all citizens of a society. The notion of homogeneity within a society was however a western concept, which had evolved through decades of industrialism. Developing countries where not familiar with capitalistic culture and systems as the societies where largely multicultural, thus the rate and level adaptability to modernistic values became uneven. This played out in an unequal share of political power, and access to resources between ethnic groups and regions in many countries (Ndulu and O'Connell 1999).

2.3 Theory of dependency

With the critiques of modernization theory, a theory of dependency, emerge as a contrast, in the 1950s and 60s. Dependency scholars argued that developing countries where not developing, as in on the path to become developed, but rather they were underdeveloped. Underdeveloped as a persistent condition, not due to internal factors as portrayed in previous section, but due to unequal relations in terms of trade and western protectionism. Dependency theoretic also brought to light the historical and political factors, which had played out in the developing world, as opposed to the industrial revolution in the western countries. The classical modernistic ideology largely rejects the

complexity of historical heritage, and assumes the world as more or less homogenous. This led to misdiagnosis of the level of development in developing countries to resemble earlier stages in the history of the now developed countries (Frank 1969).The argument by dependency scholars is that modernization would never contribute to positive development in the poorer countries, because developing countries where integrated into capitalism on an inherently unequal basis, through decades of imperialism (Namkoong 1999). The theory of dependence, similar to the modernization theory views development from a "top down" perspective (Matunhu 2011). Modernization ideology argues the need for external expertise, while the ideology in dependency argues that the premise for external forces to contribute to the growth and development in developing countries is flawed, based on the distortion of the true motive for external aid and loans. According to Rodney (1972), the exploitation of African resources has continued post colonialism, through a dependency of trade policies, aid and loans. As European and the USA have been able to accumulate capital, and invested in their national wealth, African countries where increasingly becoming dependent on the western countries both politically and economically. The issue of failure to eradicate poverty and hunger in the developing countries have led to a highly debatable issue regarding the role of development theories (Matthews 2004), but more importantly the approach to development.

2.4 Alternative approaches

Alternative approaches to development, emerged as an alternative to the mainstream development approaches, like the modernization and the dependency theory, which both had failed to address the persistent, and in many cases increased poverty in developing countries. The World Bank President Robert McNamara (1968 – 1981) acknowledges this when stating that: the growth was not equitably reaching the poor'. Further adding that 'growth had been accompanied by greater mal-distribution of incomes in many developing countries' (McNamara 1980). Alternative development tends to be more practical oriented rather than rooted in a specific theory, hence alternative development can be understood as reassessing goals and introducing alternative practices, but still maintaining existing development objectives (Pieterse 1998). The World Bank promoted

the basic needs approach, emphasizing the needs of the poor, rather than macro level policies, which aimed at indirectly helping the poor (Willis 2011).

Basic needs are understood as a set of social claims or entitlements such as; clothes, housing, social inclusion, access to health services, education and security (Friedmann 1979). The inclusion of a wider set of basic need open up for development agencies to design alternative approaches to address the challenges faced by development officials on the ground. One of the main obstacles observed by development agencies was the lack of involvement by the communities who's development interventions where aiming to help. It became clear that without considering the perspectives of the people living in the communities, agencies could not design appropriate approaches to be successfully incorporated into the community (Mosse 2001). This led to a series of participatory approaches.

2.5 Participatory approach

Participation can be understood as "empowering people to mobilize their own capacities, to be social actors, rather than passive subjects, managing their resources, make decisions, and control the activities that affect their lives" (Duraiappah, Roddy et al. 2005). There are various definitions and interpretations of participation (Swiderska 2001), however the common feature is the priority and value given to the inclusion of all stakeholders in the developing process. Different from prior approaches, participatory approach assumes development agencies to consider cultural values and local knowledge and to include the public in the project planning and decision making (Brohman 1996). Development professionals argue that development intervention should come from the bottom-up, instead of the top-down implementation of policies. Further stressing that "*only when the supposed beneficiaries of the development interventions participate in the planning and implementation of the projects, will they have a real interest in making the projects succeed*" (Gardner 1996). The findings in the World Bank Annual review of development effectiveness in 2000 suggested that participation brings out attention to human rights issues such as gender equality, improves community's self-reliance, improves ecological sustainability of development projects, and promotes learning and

result-based orientation (Nagy Hanna 2000). Participation is there for viewed by many development academics an essential component in sustainable development.

2.6 Scaling up participation

In 1992, the United Nations In a conference on environment and development urged all countries to involve individuals as well as communities at all levels in decisions making. This includes establishing mechanisms that supports and enables participation of all stakeholders (Sen 2000). This new perception on development is presented in the Millennium development goals (MDGs) The Millennium Development Goals (MDG) adopted by all United Nations member states in 2000, refers to a shared vision by all UN member states to raise human development standards of the poorest countries and provide a pathway towards global equity between developed and developing countries. The Millennium development targets and indicators reflects the new agenda on fight against poverty from a structural and economic development intervention to a more multidimensional approach, putting more emphasis on wellbeing needs, social and political empowerment needs, putting participation approach in the forefront in development intervention. This involved on a macro level, adoption of decentralization policies both political and economic. Political decentralization includes transferring decision making to more local arenas (Willis 2011). In economic terms, it includes decreasing the government role in the economy, by removing price controls and privatizing more state owned enterprises, enabling market forces to gain greater influence.

In the latter 1990s participation was a part of mainstream development interventions, both as assessment tools, identifying the cause of poverty and needs of the poor not easily detected from an administrative angle. However development programs where still in large designed by foreign lending agencies, thus the lack of ownership by governments has been pointed out as the main reason for why initial successful Industrial and infra-structure projects that were developed failed to sustain productivity, ones left in the hands of its receiver (Gardner 1996). Brenton Wood institutions such as the World Bank and The IMF, with an attempt to acquire more accountability and transparency of the efforts made promoted Poverty Reduction Strategy Papers (PRSP). PRSPs describe

macroeconomic, structural, and social policies and programs to promote economic growth and reduce poverty, as well as associated external financing needs and major sources of financing.

The process of developing a PRSP starts with a country-based diagnosis of poverty. It then defines the poverty reduction outcomes a country wishes to achieve and the key public actions needed. The PRSPs should be conceived and authored by the government, which will outline its own development priorities and the strategies needed to achieve them. The process shows a greater emphasis on ownership, transparency and participation than previous approaches. In the annual meetings with the World Bank Group and IMF, in September 1999, it was agreed that future lending's and depth reliefs should be based upon PRSP proposed by the countries governments (Ellis and Freeman 2004). PRSP aims to approach this issue to create greater involvement by governments in their own development.

2.7 Development intervention and aquaculture development

As mentioned in the sections above development of aquaculture in Kenya and the sub-Sahara in general can be viewed within the context of the prevailing development theories. In the sub Saharan Africa, modernization policies established itself during the colonial rule. Traces of modernization in the colonial Africa are the concept of private land ownership and the introduction of cash crops aimed at exports such as tea, tobacco, sugar, cocoa and coffee (Keriga and Bujra 2009). In the 1960s, most African countries gained back their independence. According to the economic indicators (GNP) African countries where; poor; with little or no human capital, and an economy largely dependent on traditional and subsistence agriculture sector. As part of the policy responses to modernistic thinking; financial aid, western technology and expertise where exported from the western world to sub Saharan Africa with the main purpose to support economic development (Ndulu and O'Connell 1999). Scientists with a technology-centered approach introduced aquaculture, initially a colonial activity. Chambers and Trupp (1994) Explained" *Priorities where determined by scientist, who generate technology on research stations or laboratories, to be transferred through extension services to the farmers"* . During the late 1970s, there was a paradigm shift from the "*one size fits all*"

blue print technology packages, to more alternative approach, where the main objective was to empower farmers to learn, adapt, and do better (Chambers and Thrupp 1994).

This opened up for various development projects not as uniform, encouraging development agencies to design more appropriate approaches considering cultural values and local knowledge and to include the public in the project planning and decision making (Brohman 1996). This represented a shift in the perception of development, from the modernization ideology with a "top down "approach, infrastructure technical, and economic oriented growth, to more participatory "bottom up" approach to development, with emphasis on social and human capital empowerment. Indeed, development evolved to mean more than just economic growth , and can be regarded as change that improves livelihoods wellbeing towards conditions where economic and social needs are equally being met (Chambers 1997, Sen 1999).

In the early 2000s, the phrase "Aquaculture *for development* "emerged (Little, Barman et al. 2012). Funge and smith (2002) argues that " *Rather than focusing on the development of aquaculture, the emphasis is put more on the potential contribution fish farming can provide to poverty reduction, and increased food security. In order to effectively address poverty alleviation, poverty and poor people's livelihoods need to be placed as the starting point for intervention*". The focus on resource poor farmers as target beneficiaries to aquaculture interventions, has however, not manifested in any significant increase of livelihood or economic development , this has been pinned on the recipients lack of capacity to make use of the technology provided and in many cases lack of resources such ownership of land. The more recent opinion by many scientist is that in order to capitalize on the development potential development interventions should be visited on the more resource-full farmers, in order to achieve sustainability and growth (Martinez-Espinosa 1997). Today, there is consensus that for aquaculture to play a significant role in the fight against poverty and food insecurities the sector needs to be profitable or driven as a commercial enterprise. The FAO Fisheries and Aquaculture Department encourages commercial or business – oriented aquaculture as a means of increasing food availability and accessibility, employment and income (Hishamunda, Cai et al. 2009).

To achieve sustainability in a commercial sector, it is dependent on a number of factors, including; access to natural resources, available technical "*know how*", and human resources, surrounded by a suitable legal framework and management system. In addition, the sector requires provision of capital, seed, feed technical support and monitoring. This capacity may be provided or managed by governments; however, one of the definitions of commercial enterprises is the enterprises ability to operate on a self-financing basis. Therefor a larger engagement of private sector is recommended and in most cases essential to attain sustainability.

Before describing the role of policies and implications development theories may have had on the success or failure of aquaculture development, the terminology used needs to be explained with proper definitions .The section below consists of important concepts used in this study. Their meaning and current understandings relating to research will be explained.

2.8 Aquaculture

Aquaculture is defined by the FAO: as the farming or culturing of aquatic organisms: fish, mollusks, crustaceans, aquatic plants, crocodiles, alligators, turtles, and amphibians. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. The term aquaculture originates from the two Latin words: aqua meaning water and culture a verb, meaning, "To tend to" or "growing out". The word culture, with noun cultivation is used in relation to different sorts of growing activity, from agriculture to more biological terms, as in the cultivation of bacteria, and in agriculture as in culturing of maize, fish and wheat[1].

Based on the FAO` guideline for aquaculture activities,[2] the different culture techniques and practices operating in Kenya are defined in the segment below as following:

[1] http://www.fao.org/fishery/cwp/handbook/j/en.

[2] http://www.fao.org/fishery/cwp/handbook/j/en.

Brackish water aquaculture is the cultivation of species in brackish waters such as lagoons, coves, bays, estuaries and fjords. The salinity in such waters is lower than in pure seawater fluctuating between 0.5‰ and full strength seawater. **Freshwater** aquaculture is the culturing of aquatic animals in freshwater, reservoirs, rivers, lakes, channels and groundwater. Freshwater is determined by the salinity, which does not normally exceed 0.5‰. Earlier stages of the life cycle of these aquatic organisms may be spent in brackish or marine waters.

Land based culture is the culture that occurs "on land", often in human constructed water containers such as ponds, raceways, tanks or earthen ponds, meaning a dug out area in the ground. Main species: Catfishes, Tilapias, Trout and carps. **Cages** are the open or covered enclosed structures constructed with net, mesh or any material allowing natural water interchange.

These structures may be floating, suspended, or fixed to the substrate, with fabricated wall on all sides. Main species reared in cages; Catfishes, Tilapias. **Raceways and silos** Artificial constructed units above or below ground level, which requires the active pumping of water and fish feeds into and out of the unit, due to the separation from the species natural environment. - Main species reared; Trout and catfishes. **Ponds and tanks** are artificial units of varying sizes constructed above or below ground level capable of holding and interchanging water. Similar to the raceways the species need continuous maintenance by the feeding and exchange of water, usually by active pumping and draining of the pond. - Main species reared in ponds and tanks: Carp, Tilapias. **Rice-cum-fish paddies** - used for the culture of rice and aquatic organisms; rearing them in rice paddies to any marketable size. Main type of species raised in rice paddies; carps, tilapias. **Mono culture** the culturing of single species, be it one species of carps, Tilapia or catfish. **Poly culture** the culturing of several species in combination, this system is common among many species, as a mean to enhance growth or to control the reproduction rate by predation. Main species reared in poly-culture systems are; Carps, Tilapias and catfishes. Hatcheries are the construction of housing facilities for the breeding, nursing and rearing of aquatic organism's seed into fry, fingerlings or the juvenile stages. Nurseries refer to the second phase in the rearing process and are usually the setting of ponds and tanks for the continuous growing of fingerling and juvenile organisms.

The most important differences in the different methods of fish farming lie in the intensity of rearing, depending on these criteria's production can be divided in into these main categories:

Extensive culture systems receive no intentional nutritional inputs but depend on natural food in the culture facility, including that brought in by water flow e.g., currents and tidal exchange. **Semi-intensive** culture systems depend largely on natural food, which is increased over baseline levels by fertilization and/or use of supplementary feed to complement natural food. **Intensive** culture systems depend either on nutritionally complete diets added to the system, fresh, wild, marine or freshwater fish, or on formulated diets, usually in dry pelleted form. Commercial fish farms can be small-, medium- or large-scale enterprises, including intensive: ponds, tanks, silos, raceways culture systems, and extensive systems of cage culture again depending on the species and their physical requirements (Ridler, Hishamunda et al. 2001).

2.9 When is aquaculture commercial?

Commercial aquaculture is a business-oriented activity, resembling any other enterprises. The definition emphasizes that the prime objective is to grow fish for maximum profit. Compared to subsistence fish farming, commercial sectors operate on a larger scale thus; the output of fish food is more efficient. The sector also relies on employment, beyond immediate family members, generating jobs and income to the communities. Depending on the size of production, the sector contributes indirectly to local, regional and/or national economic growth (Ridler and Hishamunda 2001)

With the focus on profitability the production more often, calls for a more intensified production and an expansion of cultivated areas, which means higher density of aquaculture installations and the use of manufactured feed resources usually produced outside the immediate area. With more intensified production, follows the needs to carry out chemicals for the control and management of diseases. These practices can have a negative effect on the community and the ecosystem, which will hamper the overall goal of sustainability (SOFIA 2007)

2.10 Sustainability

Sustainability is a term that increased momentum during the late 1980s. The global food production had through decades of modernization policies, increased production to surpass the population growth. The "green revolution" the most famous model for agriculture, Involved merging of small subsistence farms to large commercial driven farms, investment in seed specification, chemical fertilizers, irrigation and cash crop production (Bryant and White 1982).

The modernization policies, strategies and innovations, which encouraged increased production and industrialization, have according to many scientist, undermined the vary basis for that production namely: soil, water resources and the natural genetic diversity. The pursuit of industrial production aiming to increase efficiency and profitability had led to practices that according to many «compromised the future productivity, in favour of high profitability in the present" (Gliessman 1998).

2.11 The relationship between commercial and sustainable aquaculture

The term sustainability usually appears one usually think environmental sustainability. However, in any business enterprise such as commercially driven fish farms the production will not survive without financial sustainability, where profits do not exceeds operational costs. Furthermore, achievement of sustainability cannot be determined by one component alone, as in the case of pure economic growth or maximizing the yield production. It requires an account for multiple impacts over time and spatial scales, to be able to avoid the negative consequences of development options (Costa-Pierce and Page 2010). Feasibility in any commercial enterprise requires market accessibility, engagement by the civil society, legal regulations and guidelines from government in order to be sustainable. Previous attempts to commercialize aquaculture production without considering one of the above has resulted in collapse of the production (Rasowo 1992). In regards to fisheries and agriculture the FAO defines sustainable development as "*Management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and*

continued satisfaction of human needs for present and future generations". Such sustainable development (in agriculture, forestry, fisheries sectors) conserves land, water, plant, and animal resources, is environmentally non-degrading, technically appropriate, "economically viable, and socially acceptable"[3].

Although there is a growing global optimism surrounded the prospect of aquaculture, there is also a growing concern over its potential negative effect on the environment. This concern have caused a challenge regarding its promotion, both politically and economically. According to Bailey (Bailey, Jentoft et al. 1996) "*Aquaculture is not simply a technical process, but one that involves Social relationships*" . The need to incorporate political, economic, social and legal as well as the environmental aspects, in aquaculture governance is becoming more relevant to ensure its sustainability (Frankic and Hershner 2003).

In 1995, the Code of Conduct for Responsible Fisheries (CCRF) was adopted by the FAO, dealing with aquaculture specifically in article 9[4]. The Codes provides principles and international standards for responsible practices in conservation, management and development in the utilization of living aquatic resources, in addition provides codes of conduct for, the role of states and those involved in fisheries and aquaculture (Caddy 1996). The code (CCRF) provides guidelines for good governance practices in aquaculture, accounting for all the principles embedded in definition of good governance, namely: *Accountability, Participation, Predictability and transparency*.

Governance and policies is the focus of this study, due to this assumed impact on development. As Kenya incorporates aquaculture development as part of a national development plan, policies and governance of the sectors needs to guide and assist the development towards desired goals and objectives. It is in these circumstances the role of policies become relevant to analyze.

[3] http://www.fao.org/docrep/005/v9878e/v9878e00.htm.

2.12 The role of governance and policies in aquaculture development

With the overall goal of sustainability "*Policy and good governance are considered key elements required to promote economic efficiency, ecological integrity and social equity*" (Helmore and Singh 2001). The concept of Governance can be seen as "*the exercise of economic, political, and administrative authority to manage a country's affairs at all levels* "(Rhodes 2000). Good governance is thought to be key in reducing corruption, managing public resources better and establishing equality among all stakeholders (Grindle 2004). In 1998, the former Secretary General of the United Nations, Kofi Annan stated, "*Good governance is perhaps the single most important factor in eradicating poverty and promoting development"* (Siddiqi, Masud et al. 2009).

With slight variations in the available literature, the principles for good governance are *Accountability, participation, transparency and predictability*. According to the FAO (2014) *Accountability*: refers to the greater openness in transactions, holding officials answerable for their actions. *Participation*: implies the partaking of stakeholders in decision making at various levels. *Predictability*: refers to the application of laws and regulations, *Transparency:* removes risk of uncertainty regarding transactions cost and agreements. According to the Asian Development Bank and the World Bank, these four governance pillars are fundamental for good governance of an aquaculture sector (Hishamunda, Ridler et al. 2014)Policies relate more to "*statement of goals, and the vision for a sector* ", reflecting the priorities and goals for development. While a strategy is the means / tools and ways to reach policy objectives. Strategies ascribes the responsibility to the different stakeholders, and it is through strategies participants at various levels present their short-term plans, towards the achievements of the policy objectives.

To achieve sustainability for a commercially driven aquaculture sector, it is dependent on a number of factors, including; access to natural resources, available technical "know how", and human resources, surrounded by a suitable legal framework and management system. In addition, the sector requires provision of capital, seed, feed technical support and monitoring. These components are defined as prerequisites for a commercial sector in order to achieve sustainability (Ridler, Hishamunda et al. 2001).

Among the pre requisites for a sustainable commercial aquaculture sector mentioned above, some fall outside the control of governments, therefor named non-policy variables. Natural resources, potential market for the sectors growth, culture and religious conditions that may or may not favor fish production are non-policy variables. Non-sector specific policies, are the policies implemented with the aim of promoting several sectors (Ridler, Hishamunda et al. 2001). Example of non-sector specific policies are policies that fall under a legislative and regulatory framework , such as property rights, anti-corruption policies, trade and foreign investment policies. All policies not confined to aquaculture, but relate or influence a nation's economic sector, as a whole are non-sector specific policies. Policy variables are the variables that can be influenced by governments. Sector specific policies are the policies designed to promote or regulate a specific sector. These policy variables can be implemented on a macro or micro level. Macro level sector specific policies entails rules and regulations, tax exemptions, for fish or fish products, import restrictions or subsidies ascribed the sector as a whole. Micro level sector specific policies are interventions at farm level, such as direct subsidies to specific farmers, donor ships, technical and practical assistance, and kick start packages (Hishamunda and Ridler 2002). While there is little doubt that business friendly environments ensured by sound macroeconomic and non-sector specific policies has a positive effect on economic growth, the question arises whether and to what extents governments should intervene with sector specific policies. The goal of this study is therefor to gain clarity in the role of policies. In many reports on the development of aquaculture in Kenya, poor performance has been ascribed to the lack of a sector specific policy to guide the sector towards desired goal. Recent reports has however questioned the necessity of sector specific policies arguing that macro-economic stability, such as property rights, adequate law enforcements and institutional capacity may be sufficient to support and promote sustainable commercial aquaculture (Jamu, Chapotera et al. 2012).

2.13 Bringing the theory and role of policies together

According to Adam Smith in (page 1 ,Johnson 1997) *a nation's economic growth is largely determined by the overall domestic and international policies that governments follow.* Policies do not develop in a vacuum, they are a result of the political and socioeconomically forces. As the development ideologies changes so does policies and approach to development. From the era of modernization policies where of a technological and production oriented nature, distributing expertise and resources, labeled as "top down "policies. As the policies failed to make any significant growth in production, this approach to development came under scrutiny, and Alternative strategies emerged with a focus on empowerment and participation. Policies where now expected to incorporate human wellbeing, and the focus became more people oriented to meeting *needs* rather than promoting *growth*, labeled as "bottom up " policies. Today, these two approaches to development is more or less interlinked as policy makers acknowledges that that growth must occur in order to improve the lives of many, at the same time policies must incorporate the people's needs in order for development interventions to be successful and sustainable. Table 2.1 below describes how the change in development theories impacted on the policy designs and approach to aquaculture development, adapted from (Ellis and Biggs 2001, Belton 2010)

1960 -1970s	1980 -1990s	2000 -2010
" Top down approach " Centralized state run hatcheries Technology-centered and biological research based assitance		
	" Alternative approach" 1980-95: community based, participative approach started Largely foreign funded projects 1995: FAO adoption of the (CCRF) Beginning of participatory approaches	
		" **Scaling up participation "** Millennium development goals Public private partnership Incorporation of commercial aquaculture in Kenya's PRSP A national Aquaculture strategy Kenya's first aquaculture policy (2011)

3 METHODOLOGY

This chapter conveys a brief explanation on the terms research and methodology. It presents the basis for choice of methodology and the concept of case study research. Primary and secondary literature, analysis of the data, validity and reliability of the literature and the limitation to the study are also discussed in this chapter.

3.1 Introduction

There is a wide range of ways to understand the term research. Martyn Shuttelworth points this out in (Shuttleworth 2008) when stating that " In the broadest sense of the word, the definition of the word research includes any gathering of data, information and facts for the advancement of knowledge ". John Creswell in (Creswell and Garrett 2008) explains research as "a *process of steps used to collect and analyze information to increase our understanding of a topic or issue ".* As a process, it comprises three phases, which starts with the formulation of a question, then the collection of data and finally a presentation of the interpreted data, to answer the question. A Research comprises a methodical examination of a phenomenon in order to acquire a comprehensive valid and reliable data to answer the research question/ hypotheses or to test a theory. Research methodology can therefore be understood as, the link between a perception and thinking and the evidence gathered (Sumser 2001).

When describing the methods applied in a study, the researcher aim is to provide readers a walkthrough, in the steps taken to acquire the data, and explain the reasoning behind the interpretations made. This enables readers to copy the exact steps and reach the same result or more importantly identify why and how this particular study ended up with the results it did. This includes explaining the study's purpose, chosen approach and strategy of the study.

3.2 Research purpose

The purpose of a research is identified, usually in the first phase when the question or the objective of the study is formulated. What we want to achieve by conducting a study reveals its purpose. When the purpose is to discover, uncover or map out how and who, it is called exploratory or descriptive.

While descriptive could be entirely a summarized study of a particular case, exploratory purpose entails observing real life, participating in a project/ event or experimental laboratory work. Researchers can explore "*how things work"* by identifying and presenting empirical evidence on the circumstances and components, which influence a result or conclusion. When the purpose is to, answer why something takes place in the apparent matter or why it occurs at all, the purpose is more explanatory or predictive. Prediction is a statement or assumption that something will occur, based on convictions (theory or evidence from exploratory research). Explanatory aims to connect a case of study/phenomenon to a more general principle or abstract theory of "how things work". One explanation rarely predicts more than one outcome; however, competing explanations can predict the same outcome (Neuman and Neuman 2006).

I am studying the role of policies in aquaculture development when applied as a tool for poverty reduction and food security by investigating the development in Kenya. This study primary objective is to explain, why and how the chosen policy and the strategies tools are applied for the growth of a sustainable commercial aquaculture sector in Kenya. By describing the sectors governance in the past, present and future, I will identify the contributing components to the current policy. Finally, I will elaborate on potential causes and reasons for its success or failure.

3.3 Research approach and strategy

As the purpose of the research has been made clear, second step is to decide the best way to approach the study, the best-suited method to accomplish the set goal. Just as there are various purposes for conducting a research, there are different ways to address a theory, case, phenomenon or project. According to (Blaikie 2009) the research questions

determines the approach and strategy to the study. Research approach can be inductive, deductive, or both. Deductive approach means that the researcher works out from a general premise, a general theory or an idea. When a deductive approach is applied its aim is to conclude whether the statement or theory is correct or not, by sorting out, analyzing empirical evidence. One develop hypotheses to measure against, and look for patterns in the data to confirm or discredit our initial premise.

Inductive approach starts on the opposite end. The researcher observes or has a notion of a cause and effect by observing events or just a hunch, and then studies the phenomenon. This approach does not work out of a set premise, or a preconceived notion, rather aiming to understand if there are any existing premises, to the events observed.

In this thesis, the questions presented in chapter one, require both descriptive and more explanatory answers. An inductive approach is applied to answer these questions. Inductive research implies approach is an appropriate strategy when aiming to describe current events, documenting, and identifying the patterns in the data collected, then to verify whether these strategies are in fact contributing to the overall policy vision of rural employment and poverty reduction.

This study is a literature-based study, a theoretical case study. Case study research enables a researcher to study theories that are more abstract, concepts or global challenges by focusing of a specific example, in this case the development in Kenya. This method is very useful when one aims to identify the relationship between an applied process and its outcome, as it investigates a phenomenon within a real life context (Yin 2013).

3.4 Data collections

The research is an entirely literature based study, a theoretical case study, meaning no real life participation or observing of the case or phenomena is needed. The study is a qualitative research where the data used is both qualitative and quantitative. **Quantitative** data consist of charts, tables, graphs, meaning numerical data and measurable facts. **Qualitative** data encompasses the analysis of documents, government policies, reports, previous research and literature.

According to (Blaikie 2009) data used in social research can be of these three main types; Primary, secondary and tertiary data sources.

Primary data- is the data/ information collected by researcher's direct contact with the source or research subject. Methods used to collect the primary data are Experiments, surveys, interviews, questionnaires and observation. -

Secondary data- Is the data/ information already collected by others, "second hand" information. Secondary data includes; academic journals, already conducted surveys, statistical data, government records.

Tertiary data – Is the data already analyzed by others, this includes reviews, journals and research papers where some information or access to the raw data is not available.

The primary data in this study refers to the quantitative data collected from various reports. Statistical facts, volumes, and numbers derived from governmental documents or published reports, including the Aquaculture policy and governmental programs. Secondary and tertiary literature refers to the qualitative data in this study, the reviews, research papers, books and academic journals analyzing the development and conditions in the sub Saharan Africa and Kenya.

3.5 Validity and reliability

This is a theoretical study, analyzing recent literature and research on the topic of policies and governance of aquaculture development in developing countries. As the literature comprises research from different countries, it is appropriate to look at the validity in relation to how I interpreted the texts. Validity refers to the researchers own ability to collect relevant data to the study. The relevance of the data reflects how well a conclusion of a particular study can be transferred in another context. In this study, it becomes pertinent to emphasize the context which results are valid. Can the findings from literature on development interventions in general, explain the potential outcome in Kenya? Reliability on the other hand relates to how independent the findings are from the researcher approach and accidental circumstances during the study (Miller and Kirk 1986). Reliability can be questioned as; to what extent are the results depending on who interprets the answers? The material presented here is chosen based on the criteria that it must be literature on aquaculture development and be representative in relation to my

questions of policy approaches. Portions of this literature includes empirical studies assigned certain requirements such as; validity, reliability, objectivity (Yin 2013). However, In this regard, it is important to mention that when reviewing the literature on aquaculture development in Kenya, information from both governmental web sites and academic journals presented on many occasions conflicting data regarding; volume, numbers, and years. In these cases, I chose to rely on the data presented by the Food and Agriculture Association, as I consider their data to be the most reliable. Material presented by the FAO, is told in an unbiased and objective manner, making the numbers more reliable.

3.6 Research limitations

Evaluating or assessing a development intervention in a real life context, implies in many books some real life observation or participation; however this is not a requirement. The research approach and strategy can consist of one or a mix of different methods, depending on the researcher aim and objective. The choice of methods is also dependent on external factors such as, amount of time and resources available. Understandably, when choosing a research question and objectives, the researcher are equally influenced by the amount of time and resources available at his or her disposal, as the topic itself. This thesis is a historical literature review, which aims to describe previous research and development, and to show how and it what way, current policies and development strategies are linked to past events.

3.7 Data sources

All literature and data, was collected by searching the library web site BISYS: http://uit.no/ub. By using key words, I found relevant databases. Historical data was primarily from the database; http://www. fao.org/fishery/aquaculture/en and http://www.worldfishcenter.org/. Data on the more recent development was retrieved from The Sustainable Aquaculture Research Network for sub Saharan Africa SARNISSA: http://www.sarnissa.org/HomePage and http://www.nepad.org/foodsecurity/fisheries/aquaculture.

Facts on Kenya, was collected http://www. knbs.or.ke/. The policies and strategy papers where retrieved from the Kenyan governmental websites.

Depicting the history of aquaculture, I found the book *Ecological Aquaculture* edited by Barry A. Costa –Pierce (2008) and the book *The History of Aquaculture* edited by Colin Nash (2010), significant. These resources provide a chronological summary of the development of aquaculture from its birth to the present status. In the assessments of the different practices, techniques and systems of aquaculture, I found the book *Principles and practices* (2005) edited by T.V.R Pillay and M.N.Kutty, a very useful source.

In contrast to literature regarding aquaculture, which I found quite specific, the topic of *food security*, *poverty* and *sustainability* is extensive. These concepts comprises a wider range of variables and theories as to *why* and *how*. This required a thorough examination of the available resources and scanning of literature to attain only the sources of information, most relevant to my study.

Data and research on the subject of poverty and food security was gained through searching the database: http://www.unep.org/. http://www. who.int/publications/en/ and http://www. nepad.org/. The Kenyan Ministry of Agriculture provided reports on the status in Kenya and the FAO database contains numerous reports analyzing the challenges for sustainable food security in the region. The Overseas Development Institute http://www. odi.org/, database provided access to articles by leading researchers on poverty. The FAO document; *why has Africa become a net food importer*? (Rakotoarisoa, Iafrate et al. 2011) and The work of Jenny Clover (Clover 2003) *Food security in the sub Saharan Africa*, published in African Security Review Volume 12 Issue 1, gave a thorough understanding of the historical events, contributing to the increasing challenges to combat food insecurities and poverty in the region.

When searching for Literature on the correlation of aquaculture development and food security I read mostly the study and work conducted by Nathanael Hishamunda et al ; *Promotion of sustainable commercial aquaculture in the sub Saharan Africa* (2001), Policy and Governance in Aquaculture; lessons learned (2014) and *Commercial aquaculture and economic growth (2009)* published by the FAO. The Book *Aquaculture, fisheries, poverty and food security (2011)* by the author Edward H Allison published by the World Fish

Center http://www.worldfishcenter.org/, was used to describe the linkages of commercial aquaculture and increased food security and poverty reduction.

As the discipline of aquaculture is a relatively narrow discipline globally, the authors whose articles/books and research, I found relevant and important, where also co-writers or researchers in other reports/books and documents published on the behalf of global organizations such as the FAO and The World Fish Center.

To identify the incentives behind the policy and the increasing role of governance in aquaculture development in Kenya, I needed to gain understanding of Kenya's international obligations. The concept of *FAO`s code of conduct*, and *the Millennium Developing Goals* (MDG), are important concepts as a background, because aquaculture policies worldwide are largely based on the regulations fostered through these goals and codes.

The Book *Theories and Practices of Development*, by the author Katie Willis *(*2011*)* was great source to gain insight in the historical development of the theories of development, from classical modernization towards contemporary alternative development in the 21th century. When focusing on the theories most relevant to Kenya I found the article *Governance and growth in sub Saharan Africa* (1999) by Benno J. Ndulu and Stephen A. O'Connell , published in the Journal of Economic Perspectives—Volume 13, Number 3—Summer 1999.

In order to understand the current thinking on aquaculture development, and the policy making process, I started this study with a comprehensive historical review on the development of aquaculture.

4 HISTORY OF AQUACULTURE DEVELOPMENT

According to Boris Blumberg in (Boris, Donland et al. (2005), a review is the section, which examines the recent (or historically significant) research studies, acting as basis for the proposed study. This chapter starts by describing the past and present development and governance of the sector, worldwide. Then narrowing in on sub Saharan Africa, the development intervention strategies applied to aquaculture development in the region will be described. Finally, a description on the evolution of aquaculture development in light of the development theories will be presented.

4.1 Global overview

Aquaculture, similar to all food producing sectors evolved through communities need to secure a constant food supply. Archeological findings and research suggest that the sector have existed for over 4000 years (Rabanal 1988) and the development did emerge in communities isolated from each other, similar to the development of agriculture. China is believed to have been the birth place of aquaculture for the purpose of food production(Nash 2010). Publications dating back to the years of 2,300BC depict in detail different designs of pond constructions and different species used in production. It also describes propagation practices from simple storage and observation of fry and fingerling production to sorting and transport of fry. In the period of 2,300 BC to the years about 40 AC, integrated agriculture –aquaculture (IAA) farming systems, of Carps in particular with various types of vegetables was a common culturing practice, in China (Ling and Mumaw 1977).

Aquaculture evolved simultaneously in other parts of the world; however, in most cases this development was temporary. Important to mention is the culture of tilapias illustrated in Egyptian hieroglyphs (2,300BC). Following the Egyptians the Romans (2000 B.C. - 500A.D.) developed coastal marine farming of oysters and red mullets, turtles and fish. Storing aquatic animals in seawater pools on rocky shores, and fresh and/ or brackish water species, in land based ponds. The Romans also managed Oyster beds in

France and England and thus contributing to the culturing practices to be adapted across Europe (Costa-Pierce 2008).

Freshwater farming of carps expanded from Asia to Europe by trade in during the middle Ages (500 – 1600 A.C), followed by the culturing of eels and pike (Markham 1969, Currie 1991). Carp and pike farming in Europe is no longer operating, but the Europeans developed cold water farming of trout and salmon during the nineteenth century (1801-1900) (Yarrell 1841, Goode 1881), the latter becoming one of the highest valued fish food products on the market today.

4.2 Status of production

Prior to the Second World War (1939 – 1945), the production from aquaculture was negligible in volume and value compared to the captured fisheries. It was not until the 1950s that aquaculture production increased to a relevant of fish food supply. This growth of the sector was instigated by stagnation in the global fisheries. Fisheries where experiencing stagnation and in some areas decrease in catches. Decades of technological advancement in fishing methods, with better processing and transportation systems caused a negative effect on the resource base and fish stock began to decline. The lack of potential expansion of the fishery industry and issues of rights to fishing ground is believed to have been the cause of an increased attention to aquaculture, by many nations in the 1950s and 1960s (Pillay and Kutty 2005).

This increased attention naturally led to a series of biotechnological innovations, including better hatcheries, quality fish feeds and the use of medicine. Productions of certain species have been boosted through hybridization, sex reversal, and more selective breeding (Gupta and Acosta 2004). A turning point was the achievement of artificial spawning of fish by the use of hormones, in 1958 (Hickling 1967). This technology severs all ties with the captured fisheries, by avoiding the need to collect fry from the wild, and enabling farmers to be continually provided with fish seed (Shepherd and Bromage 1988)

In the last three decades (1980-2010) the aquaculture sector grew rapidly, with an annual growth rate of 8, 8 %, this compared to the meat producing sector with an average growth rate of 2.2 % and fisheries with 2 %, within the same period (OECD/FAO). World fish

consumption also increased from an average consumption per capita of 12, 6 kg in 1980 to over 18, 4 kg in 2009, and fish food now accounts for 16,6% of the world's populations intake of protein.

Captured fisheries is still the major source of fish food supply, with about 90 million tons produced in 2012, and aquaculture producing about 63,3 million tons in the same year. In 2012, over 200 species where reported overexploited, and 30 % of the top ten wild fish species caught, where reported fully exploited. With the stagnation or decline in the global marine and fresh water fisheries, and the further increase in demand for fish foods, suggest that aquaculture will become the major source of fish products in the near future (SOFIA 2013).

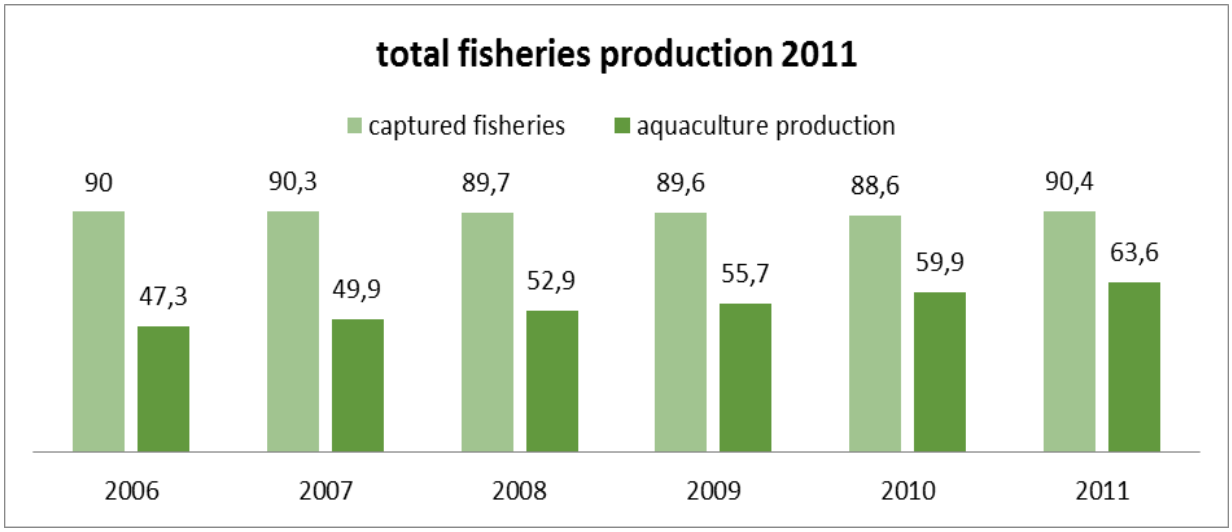
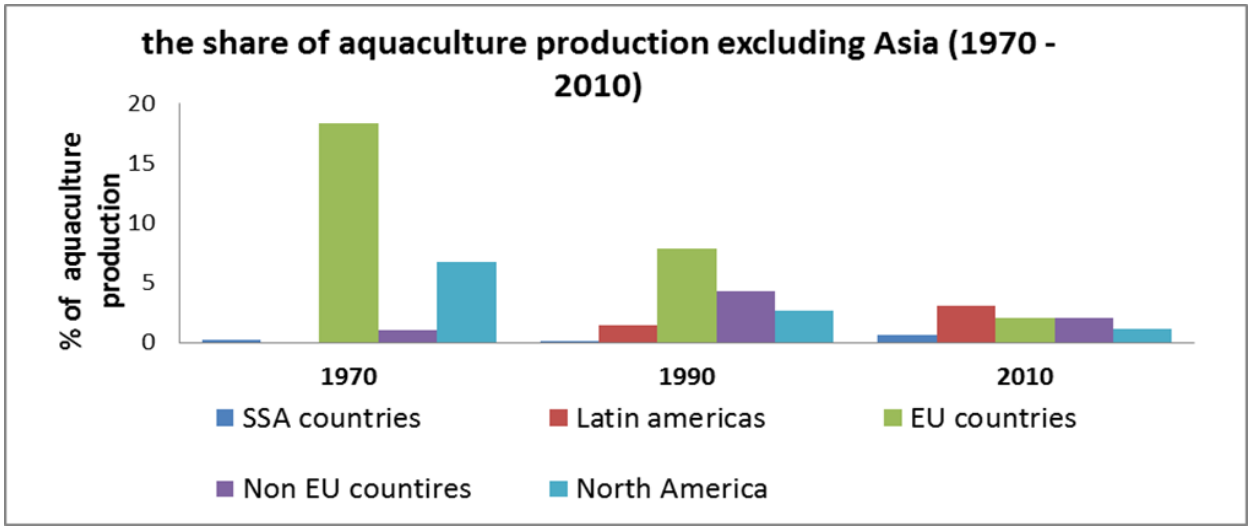


Figure 4.1 Global fisheries and global Aquaculture (2006 -2011) source : (SOFIA 2013)

4.3 Share in production

There is currently over 600 species reared in captivity in over 190 countries. The share in production is dominated by Asia. Asian countries accounts for over 89% of the total fish output from aquaculture and China alone accounts for over 60%. The historic tradition of growing fish in Asia has played a significant role in maintaining Asia's dominant role in aquaculture.

The share in production from the developed world is showing trends of stagnation and decline, while the production is increasing in the developing countries.



4.2 Share in Global Aquaculture Source: (SOFIA 2013)

The figure above displays the change in share of production geographically. It clearly shows an increase (however small) in production from developing countries (Latin America and Sub Saharan Africa) and decline in production from OECD countries (EU, North America and the rest of Europe).

4.4 History of aquaculture in the sub Saharan Africa

Africa does not share the same history in terms of longevity of fish farming, despite the early development in ancient Egypt (2,500BC). Archeological research, suggest that the fish kept in captivity was not destined for human consumption, but merely for the purpose of ornamental and or the practice of religious rituals. Tilapias are found carved on bowls, which is believed to have been used as offering gifts to the goddess *Hathor*, to stimulate fertility, rebirth and regeneration (Desroches-Noblecourt 1954). Although fish was an important source of food for the Egyptians, the fisheries is believed to have been efficient enough to supply for fish foods, which would explain the lack of aquaculture development during and post ancient Egyptian era (Costa-Pierce 2008).

Excluding the archeological traces found in Egypt, the modern aquaculture as we know it to be today, did not emerge in sub Saharan Africa until the first half of the 1900`s. In the

late 1800s Africa was increasingly being occupied by European countries and between the years 1930 to the 1960`s all countries in the sub Saharan Africa was occupied by foreign nations. The British familiar with trout farming from their homeland, introduced trout fishing to the lakes and rivers in both Malawi and Kenya's cooler areas, in the early 1900s (Dadzie 1992)

Soon after fish farms was established in Congo (1937), and Zambia (1942) and Malawi (1950) (Maar, Mortimer et al. 1979). In the 1950s fish farms, and governmental fish breeding centers where established across the region to provide fingerlings and extensions services to local farmers (Pullin 1988, Dadzie 1992).

This development was short lived in many countries due to several reasons, one important being the end of colonial rule in Africa. Late 1950 and early 1960, most of the countries gained back their independence from European colonial states (Ndulu and O'Connell 1999). The transition into independence has been characterized by large -scale political violence, long term Trans-boundary and civil wars and lack of democratic and predictable governance. The trend in the early period of post colonialism is the shift from anti-colonial warfare to political and economic war fare, with fights over resources and access to political power (Straus 2012). The consequences of long term war and political instability have been weak social and economic development, which has had devastating impact on the rural food producing sector (Clover 2003).

4.5 Changing the prospects and approach to aquaculture development in the SSA

From the 1970s aquaculture was incorporated as a tool for increased food security and economic development by many international donor agencies (Brummett, Lazard et al. 2008). In July 1975, the first Regional Workshop in Aquaculture was held in the Sub-Saharan Africa, by the FAO. During the workshop the (FAO 2005/2006) potential for growth the sector and its importance was recognized. Between the years 1978 and 1984 over US$72.5 million where donated to the development of the sector across the sub Saharan region (FAO 2004).

In the late 1970s and early 1980s aquaculture development projects where largely coordinated by foreign donor agencies in collaboration with or by approval of national governments. The major contributors to the sector where the Food and Agriculture Organization of the United Nations (FAO) the United States Peace Corps, the World Bank program of: Training and Visit (T&V) extension approach (Ngugi and Manyala 2004). The approach was technology-centered approach, managed by aquaculture scientist and specialist introducing "technology packages" to be coached to the farmers via extension services and training (FAO 2004). The production from aquaculture increased in many countries during the 1980s but many of these projects failed to sustain sufficient production. In 1987, the FAO/NORAD/UNDP Thematic Evaluation of Aquaculture (Martinez-Espinosa 1996) concluded that one of the main reasons for failure to sustain production in these projects was the weak cooperation between field staff and the sponsoring organizations.

Still highly influenced by the theory of modernization, aquaculture was promoted through foreign led technology and expertise programs in a "top down" fashion. Extension services mainly focused on the biological and technical aspects of aquaculture, failing to consider the socio cultural and economic conditions in the area of interest (Peterson, Kalende et al. 2006). According to Harrison (1991)" *Far too many projects revolved around scientists undertaking work that they enjoy, are interested in, without giving due consideration to other project aspects*"

The projects focus on subsistence fish farming systems have also been criticized as a cause of failure, Research and field study on small scale fish farmers in Malawi in 1993, revealed that ;a larger portion of fish farmers where experiencing growth in profits by market sales, rather than the promoted pond site venues, exchanging fish for other items (Ruddle 1993). The lack of inclusion of farmer's *needs* and a*spiration* resulted poor adoption of technology. The passive participation among recipients caused a short-term boom in production followed by pond abandonment, ones donor support expired and the management was left in the hands of the receivers (Ngugi and Manyala 2009).

In the sub Saharan Africa, Aquaculture was not considered as an integrated activity with the traditional farming systems thus it remained an outsider, in both national economy and national planning (Ernest Yongo 2014). Prior to the 1990s, development plans briefly

mentions aquaculture, then only as "*a low cost community initiative to increase the protein available for domestic use*", Not realizing its potential the sector remained largely ignored by governments as a potential tool in the fight against poverty and food insecurities in the region (Ngugi and Manyala 2004). The lack of governmental priority is believed to have been the main source of the slow growth of the sector, despite the huge potential for aquaculture, Kenya and the sub Saharan Africa has been unable to capitalize on its available resources for increased fish production.

The failures to achieve a sustainable aquaculture sector in the region identified by the FAO/NORAD/UNDP Thematic Evaluation of Aquaculture in 1987 were still existing constraints in the early 1990s, indicating little efforts had been applied to solve the challenges faced by fish farmers and development agencies engaged in aquaculture development (Coche, Haight et al. 1994).

Most of these challenges suggested by many only solvable with greater participation by the host countries (Brummett, Lazard et al. 2008). The thematic evaluation mission was of the opinion that for sub-Sahara to completely utilize on the potential for aquaculture it required a strengthening of the host institutions in terms of structure, organization and managing capacity. There was a realization that the achieve sustainability in any operation the host countries must claim ownership in their development and resource management. In order for governments to provide appropriate infrastructure support, research, extension, markets linkages, aquaculture needs to be included in national development plans and the role of governance needs to be revised (Brummett and Williams 2000).

5 COUNTRY PROFILE

This chapter provides a short introduction of the republic of Kenya's geography, climate, economic and demographic profile. Then with focus on Kenya's incentives for aquaculture development, the sectors development and status will be explained

Figure 5.1 Map of Africa

and

Figure 5.2 Map of Kenya

Source: https://www.cia.gov/library/publications/the-world-factbook/geos/ke.html.

5.1 Geography

The Republic of Kenya is a country in the east sub Saharan Africa. The country straddles the equatorial line, with location: in latitudes of 4˚ N and 4° S, and longitudes of 34° E and 42° E. The capitol of Kenya is Nairobi, Kenya borders Ethiopia in the North, Somalia in the North- East, Sudan in the North - West, Uganda in the West and The Republic of Tanzania in the South. Kenya is about 2.5 times the size of Uganda and can fit 1.5 times into Tanzania. In the west, Kenya borders Lake Victoria, the world's second largest freshwater lake. In the southeast, the country borders the Indian Ocean. The coastal line is approximately 420 km long with an Exclusive Economic Zone EEZ of 230,000km^2 (Ruwa 2011).

5.2 Climate

The geography is diverse. The western and central region is areas of high altitudes containing the Great Rift Valley and Kenya's highest mountain, Mt. Kenya of 5,199 m[5]. The northern region characterized as broad and dry plains, and the coastal region defined as tropical and subtropical. The climate varies greatly due to the wide ranges in altitudes and the proximity to the equatorial line, and the Indian Ocean. It is hot and humid at the coast, temperate inland and very dry in the north and northeast parts of the country. Rainfalls in Kenya is bimodal with long rains occur from April to June and short rains from October to December (Muchena and Gachene 1988).

5.3 Politics

Kenya is a presidential republic, with a multi – party system. In 2010, Kenya adopted a new constitution replacing the old one, which had been in place since independence (1964). One major distinction from the former constitution is that the president no longer has the sole power to suspend or dissolve any assembly, elected independently, hence limiting prior issues of autocratic rule (Kramon and Posner 2011). The new constitutions along with different funds such as the Economic recovery strategy, Vision 2030 and Economic stimulus program pursue the common goal to "alleviate poverty by enhancing community participation in project identification, management, monitoring and evaluation". The new constitution embraces decentralization / devolution as the primary structure of government. Former governing structure, had resulted in alienation among citizens, discrimination based on ethnicity and religion. The objective for decentralization / devolution of government is to encourage greater room for inclusion and participation of community members in governance at their local level culture where good governance becomes the norm (Kibua 2008).

[5] https://www.cia.gov/library/publications/the-world-factbook/geos/ke.html.

5.4 Economy

Kenya is the largest economy in the East African Community EAC (Burundi, Kenya, Uganda, Tanzania, Rwanda) accounting for 40 % of the region Gross Domestic product (GDP). The economy is based on the natural resources: Tourism, agriculture, forestry, mining and fisheries. Agriculture is the second largest economy after tourism, accounting for 51% of the Gross Domestic Product GDP. This includes all parts of the sector production as well as manufacturing, processing and trade and transport sectors linked to the agriculture production. Kenya is considered one of the most progressive countries in terms of policy making due to stable political environment. In 2007, the country was ranked to be among the top ten global reformers, in the ease of doing business by the World Bank's Doing Business Report 2008 (Odhiambo 2008).

The image of the seemingly stable and peaceful democracy was shaken under the 2007/08 election with serious post-election violence. Post-election violence (2007/2008) and aftermaths of the global financial crisis in 2008 had severe impact on Kenya's economic growth and political stability (Kagwanja and Southall 2009). In addition to the unstable macroeconomic environment, the country experienced less rainfall followed by drought, which had a negative impact on food and non-food production. High inflation, volatile pricing on import goods combined with a slowdown in agriculture production, caused the GDP growth to have a serious drop from 6.9 % in 2007, to only 0.2 % in 2008. These incidents had a direct effect on the nations poverty rates, with an increase in the portion of people living below the poverty line to grow from 48, 8% in 2007, to over 50 % in 2008, then only had a marginally decline to 49,8% in 2012 [6].

Agriculture is the backbone of Kenya's economy. The sector comprises. Cash/ non- food and food crops, forestry, livestock and fisheries. Food crops accounts for 32 % of the nation's GDP but only 0.5% of the exports, industrial crops such as horticulture, tea and coffee accounts for 55 % of the exports, with horticulture alone contributing to 38% of the country's export earnings. Given its important role in Kenya's national economy, these

[6] http://www.kippra.org/downloads/Kenya%20Economic%20Report%202013.pdf.

high valued export crops, has received most policy support (GoK 2010). The food-producing sector, however is dominated by small-scale family subsistence farms, with little application of modern science and technology (Chauvin, Mulangu et al. 2012).

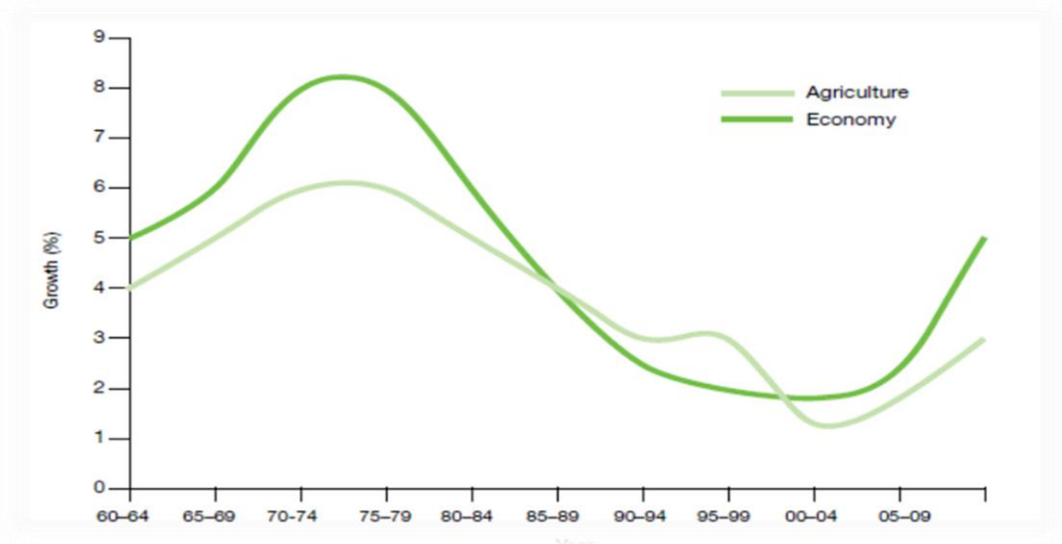


Figure 5.3 Agriculture and economic growth. Source : (GoK 2010)

In the first decade of independence, the government invested 13 % of its annual national budget. During the period between 1980s and 1990 the national expenditure towards agriculture development was declining annually, to as low as 2 % of the national budget. The low investment in extension and research and maintenance of the existing agriculture institutions had a devastating impact on agriculture production and ultimately on Kenya's total economic growth. This negative trend started to reverse in in the early 2000, and especially after 2003, when new Government gradually started to put more investment in the sector with an annually budgetary allocation of 4, 5 % , which picked up the agriculture growth rate to 2, 4 % (GoK 2010).

5.5 Fisheries Sector

The fisheries sector contributes .8% of the country`s GDP and employs around 1 million Kenyans. Fisheries plays a significant role in the livelihoods for many communities in Kenya, in addition fish export contributes about 70 million USD in foreign exchange

earnings annually. The sector consist of industrial and artisanal fisheries, interlinked in value- chain including; fresh and processed fish production targeting local, domestic and export markets, and a growing fish meal sector. Fisheries take place in Lake Victoria, Lake Turkana, and then smaller catches in the lakes: Naivasha, Baringo, Jipe, Chala and the river Tana (Otieno 2011). Coastal fisheries is conducted along the long shore, however the fisheries is still underdeveloped, and contributes only about 4 % of the total fisheries with most of its off shore fisheries exploited by Distant Water Fishing Nations (DWFN). Lake Victoria accounts for over 95 % of the annual catches and provides the majority of fisheries formal employment (Ngugi and Manyala 2009).

Since the 1999 there has been a decline of the captured fisheries leaving the coastal regions unable to provide a stable livelihood, and on a national level an increasing dependency on fisheries imports to supply the growing population (Rothuis, Duijn et al. 2011). In Lake Victoria alone the fish production has declined from 200, 000 metric tons in 1999, to about 130,000 metric tons in 2007 (ACP 2011). Due to the dwindling of traditional fisheries combined with a rapid population growth, the Kenyan government have increasingly paid more attention to the aquaculture sector, to fill the gap in demand and supply of fish food.

5.6 Demographics

Kenya is multi-ethnic, with high diversities of socioeconomic and cultural profiles. Urbanization is increasing, however over 75 % of the population still reside in rural areas, which are characterized as heterogenic due to the various cultural and tribal traditions[7]. Over 40 % of Kenya's 44 million citizens are unemployed and live below the poverty line. The youth (< 15 years) construe nearly half of the population, and accounts for 70 % of this unemployment. Inequalities are wide, with the top 10 % of the population earning 44 % of the national income and the bottom 10 % earning less than 1 % (Bigsten, Manda et al. 2014).

[7] http://devolutionhub.or.ke/resources/key-actors-in-devolution/key-government-institutions/commission-on-revenue-allocation.

Table 5.1Kenya demographics (2000 and 2014). Source : (Allison 2011) and http://data.worldbank.org/country/kenya

CATEGORY	UNITS	2000	2014
ECONOMIC DATA:			
GNI per capita	US $	420	1,160
Growth rate GDP	%	0,6	5,4
Agriculture GDP share	%	32	25
Fisheries share GDP	%	0,5	0,8
Aquaculture portion in fisheries share	%	0,0105	3 (Est 2007)
POPULATION:			
Total population	Million	30,1	44
Population Growth rate	%	2.4	2,11 (Est 2014)
Urbanization	%	33,4	25,2
SOCIAL INDICATORS:			
Life expectancy	years	47	63,5
Infant mortality	Per`000	77.7	40,71
Poverty rate	%	45 (Est 2005)	49,8

5.7 Economic stimulus Program

Owing to the Global financial crisis and the post-election violence the economic growth, which had been rapidly growing between 2003 and 2007, had an abrupt downturn in 2007/2008. Restoring Kenya's economy to its former status through rapid creation of business opportunities and job creation was made a priority. Coordinated under The then Finance minister now President Hon. Uhuru Kenyatta, the Economic Stimulus program ESP was presented (Kogi 2013). ESP is a budget proposal to stimulate the economic growth, under the theme" overcoming todays challenges for a better Kenya tomorrow" (Kenya). Key sectors of the economy were stimulated through the program, and Aquaculture was one of the sectors identified as key pillars in Kenya's economic development.

5.8 Rationale for Aquaculture in Kenya

For the rural population in Kenya only 30 % of the food consumed is purchased, and the remaining 70 % derive from own production (Kiome 2009). In more impoverished and remote areas, these values should naturally have a larger disparity. The main agriculture production are cereals such as maize, rice, roots and tubers (Kiers, Leakey et al. 2008), consequently the main component in the daily diet are carbohydrates. Although these food components provide energy and nutrients, they lack essential amino acids (proteins) and contain only small quantities of micronutrients essential for human health. Diets poor in micronutrients causes: illness, blindness, premature death, impaired mental development, and susceptibility to infectious diseases (Jamison 2006). The low diet diversity is major cause in the large occurrences of nutrient related diseases in Kenya. According to 1999 national micronutrient survey in Kenya, the most common deficiencies include : Vitamin A deficiency (VAD), iron deficiency anemia (IDA), iodine deficiency disorders (IDD) and zinc deficiency (GoK 2012). Fish meat has a high protein low fat ratio. In general, with few exceptions fish meat is a rich source of micronutrients, various vitamins such as Vitamin A, B and D, and minerals such as Zink, Selenium, Calcium and Iron among others, and essential fatty acids, all beneficial to human health (Huntingford, Jobling et al. 2011). Medical science states, that the nutrient content in fish meat contributes to the reduction of child mortality, improvement of maternal health, and serves as a more efficient source of protein to the people suffering from HIV/AIDS and other diseases (Edwards 2000, Mumba and Jose 2005, Finegold 2009).

Over 90 % of the world's aquaculture output comes from Developing countries. This growth and expansion of the sector in the developing world is largely due to the increased production of fresh water herbivorous/ omnivorous species of Tilapias and common carps. These species have proven to be a relatively cheap and easy entry point for practicing aquaculture in developing countries, particularly for small-scale fish farmers. Given the continuous growth and expansion of the sector in the developing world, aquaculture has become a highly recognized component in the improvement of the livelihoods of the poor (Edwards 2000).

The assumption is that: if the poor adopt aquaculture, own consumption of fish will increase leading to household nutrition and food security. Diversification of food production by fish farming has proven to contribute positively to the improvement of wellbeing amongst the poorest in several countries in Asia; Bangladesh; China, India and Thailand (Prein and Ahmed 2000). In addition to the added produce for sale, fish farming increases the farmer's resilience to seasonal shock of crop failures (Stevenson and Irz 2009).

The FAO Fisheries and Aquaculture Department encourages commercial or business – oriented aquaculture as a means of increasing food availability and accessibility, employment and income, particularly in the developing countries(Hishamunda, Cai et al. 2009).

The figure below describes displays the potential impact pathways fish farming can have an on poverty reduction.

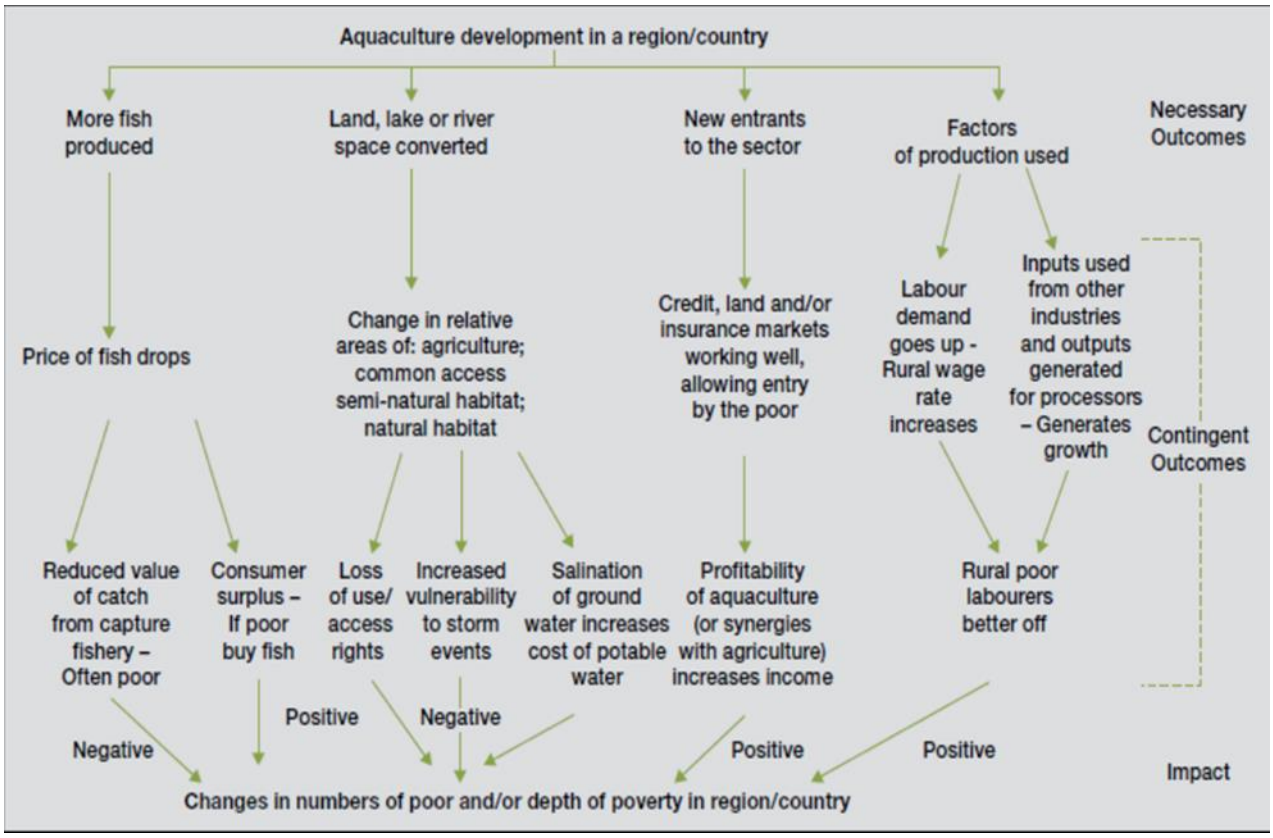


Figure 5.4 presenting the potential pathways aquaculture may have a positive and negatives impact on poverty reduction (Stevenson and Irz 2009, Allison 2011).

5.9 Economic stimulus Program and aquaculture

In 2009, the culture of Nile Tilapias and African Catfish was incorporated in the GoKs Economic stimulus program ESP. The ESP was intended as a short-term highly intensive program for duration of six months; however, the funding was extended to include the development of a Fish Farming Enterprise Support Program (FFESP).

The Fish Farming Enterprise Productivity Program (FFEPP) was designed as a three-year program with the intent to create over 120,000 jobs and income opportunities, through increased fish farming. The FFESP funded the construction of 28,000 fishponds at 300 m^2 each, in over 140 constituencies. All fish farmers, partaking in the FFESP where provided free fish feed and 1000 fingerlings. In addition, the program also facilitates training programs through governmental research farms and local extension service. Participants were entitled to receive capacity building through trainings on pond management, record keeping and fish harvesting and post-harvest handling, marketing (Njagi, Njati et al.). In 2007, the Aquaculture Association of Kenya (AAK) was created, The AKK function as an umbrella body for all fish farmers and fish farmer groups, registered in the association. The association serve as a platform for networking among farmers and other stakeholders, advocating for improved production, marketing and capacity building[8]. Program participants are supposed to form clusters within their constituencies.

[8] http://aakfish.org/index.php/who-we-are.

6 AQUACULTURE DEVELOPMENT IN KENYA

The Kenyan aquaculture sector consists of freshwater and Mari culture or brackish, however at present time freshwater fish farming is the only sector making any contribution to the national fish food supply. Aquaculture in Kenya also encompasses culturing of organisms not destined for human consumption such as farming or culturing of ornamental fish species, aquatic plants such as seaweed, and crocodiles. Although those production may be highly profitable, this study will only consider the fish production destined for human consumption. First a summary of the history of aquaculture in Kenya.

6.1 Aquaculture in Kenya past and present

Fish farming in Kenya is a non-traditional activity introduced by the British, during the colonial period (1885-1963). The British began farming cold-water fish such as Brown Trout (*Salmo trutta*) and Rainbow Trout (*Salmo gairdneri*) for stocking them in cooler lakes and rivers to support sport-fishing activities. Later in 1924, the Colonial fisheries department established Africa's first national fish culture station in Sagana, and began the research on the culture of the indigenous specie *Oreochromis spp* Tilapias. This evolved to static pond culture of tropical species such as common carps (*Cyprinus carpio*) and black bass (*Micropterus salmoides*) around lakes and rivers destined for human consumption (Bardach 1997).

In 1948, the colonial government had built two state fish farms, Sagana fish farm and Kiganjo fish farm, supplying fish seeds for warm and cold-water species, respectively (Okeyo and Omollo 2008). The more consistent supply of fish seeds led to an expansion of farms across the country (see figure 6.1). After independence in 1963, fish production experienced a rapid boom due to a national marketing initiative, called the "eat more fish" campaign, launched by the Kenyan fisheries department (FD). This national investment is believed to have sparked an interest by farmers to engage in fish farming and by the early 1970s there was about 30,000 fish ponds in the Nyanza and western provinces, alone (Zonneveld 1983).

Apart from the "Eat more Fish" campaign, aquaculture received little government attention; and by the 1980s, the positive outcome through the "eat more fish" campaign was dwindling. Most ponds where abandoned or poorly managed, resulting in poor harvest (Manyala 2009).The low productivity has been identified as a cause of several factors, including: a lack of sufficient and quality fish feeds and seeds. The lack of financial support in terms of capital and financial assistance, inadequate extension services, and insufficient training for extension workers, leading to poor farm management (FAO 2005/2006, Neira, Engle et al. 2009). Aquaculture, was not considered by the Kenyan government as a necessity, hence the challenges faced by fish farmers to grow their production, was largely ignored.

Figure 6.1 Aquaculture production in Kenya (1950s -2000).

The data provided by the FAO National Aquaculture Sector Overview[9]. It displays average annual fish production in Kenya. During the first period of independence aquaculture production grew from 200 metric tons per year in the 1950`s to 400 metric tons during the 1960`s. From the late 1960s to 1975 there was a decline in production from 400

[9] http://www.fao.org/figis/servlet/SQServlet?ds=Aquaculture&k1=COUNTRY&k1v=1&k1s=114&outtype=html.

metric tons to less than 200 metric tons. In the 1990, there was a great boost in the fish production, however this boost was short lived (FAO 2011-2014).

The incoherent production has been pinned on several factors one of them being the inconsistent leadership and lack of governance support. During the 1970s, 80s and the early 1990s aquaculture remained under the radar by the Kenyan government both in terms of devoting public funds and in terms of fostering aquaculture policies towards its development. The growth of the sector was by farmers own resilience and foreign donor ships which operated largely without any government participation in its activity, or noticeable surveillance.

6.2 Re-defining development goals and governance of aquaculture in Kenya

In 1996 -1999, an economic assessment of the aquaculture in Kenya was conducted in the central province stationed at the Sagana research center, funded and managed by the Pond Dynamic Aquaculture Collaborative Research Support Program (PD/A CRSP)[10]. This American led research program based in the Oregon State University focuses on improving the efficiency of aquaculture systems worldwide. Partially funded by the United States Agency for International Development (USAID), their vision is to identify constraints and opportunities for aquaculture, increase the efficiency of pond culture systems and to disseminate successful aquaculture strategies. In the name of participation, the PD/A CRSP in contrast to earlier fish farm projects encouraged collaboration with host countries. Kenyan researchers where incorporated in the research, and farmers where encouraged to participate in the trials, aiming to identify constraints to aquaculture production, and to design best management options that are environmentally and culturally appropriate (Ngugi, Omolo et al. 2005).

In collaborations with the Department of Fisheries at Moi University, the on farm trials resulted in a higher yield from pond culture of Tilapias and catfish. These results where central to the shift in the government's attitude and approach towards aquaculture

[10] http://aquafishcrsp.oregonstate.edu/.

development. The program demonstrated that with better management practices and more attention to the economics of aquaculture have the potential to become a lucrative business activity in Kenya (Bart, Bolivar et al.).

Since the beginning of Kenyan aquaculture in the 1960s up to 2006, total annual aquaculture production has never exceeded 2,000 MT (see **figure 5.2**)(FAO 2013). It is attributed the successful trials of the PD/ACRSP that the government became fully aware of the potential role this sector could play in the national economy. According to the report: Strategic Reassessment of Fish farming Potential in Africa, published in 1998; Kenya have about 30 % of land surface highly suitable for commercial fish farming (Aguilar-Manjarrez and Nath 1998).

With these estimates, and a declining fisheries it became clear that the potential for fish food production in Kenya was not only underutilized, but also essential to supply the national fish demand (Jamu and Ayinla 2003). During the preparation of the Poverty Reduction Strategy Papers (PRSP) in 2001, Kenya recognized aquaculture as one of the core activities that can contribute to rural food security and poverty alleviation.

By 2006, the annual yield from fish farming surpassed 4,218 MT and was valued at $10.78 million, accounting for 3% of the total fish production. A national aquaculture inventory was conducted in 2005/2006, showed an increase of fish farmers and expansion of areas utilized for fish farming, even to areas not costumed to fish meat consumption. Notwithstanding the greater awareness and good will from government, the sector failed to grow at expected rate, and production was still too low to fill the growing demand for fish products across the nation (Ngugi and Manyala 2009)

6.3 Freshwater aquaculture

Endemic to the African continent, Tilapias inhabit most freshwater lakes and rivers in the sub Saharan Africa (SSA), and is the most cultured fish in the whole of sub Saharan Africa (Gupta and Acosta 2004). In Kenya, the Tilapia specie *Oreochromis nilocticus* accounts for over 74 % of the total fish farmed The African catfish (*Clarias gariepinus*) are carnivorous meaning they require fish meat in their feed, and are therefore commonly used in poly culture production with tilapias as they reduce the reproduction rate by eating the tilapia

larvae, thus prevent overcrowding of fish in ponds. Catfishes are highly desirable on the market due to its high meat and low bone content ratio compared to tilapias. Catfish production accounts for about 16 % of the total fish production output. In Kenya production of Rainbow Trout (*Oncorhynchus mykiss*), was the first established aquaculture production. Today, this production accounts for 5 % of the total aquaculture output. This production is highly commercial, conducted with highly intensified systems in raceways and silos in cooler highland areas. Common carps and ornamental species such as gold fish and other endemic species accounts for the remaining 5 % (Otieno 2011).

Figure 1Picture of major aquaculture species in Kenya. Source : (Munguti and Ogello 2014)

6.4 Mari culture

The Coastline is about 600km long and stretches between Somalia in the North at Longitude 1° 41' S and The Republic of Tanzania in the South Longitude 4° 40' S. The marine ecosystem consists of several mangrove forests, coastal wetlands, lagoons, coral reefs and the open ocean (NEMA 2009). Home to a wide variety of aquatic species, many are adaptable to aquaculture systems. The aquaculture that is undertaken in the coastal regions are small scale, and mostly on an experimental level. There have been attempts to establish large-scale productions of prawns and oysters, but the production has more

or less collapsed. Main culturing species are tiger Tiger prawn (*Penaeus monodon*), Indian white prawn (*Penaeus Indicus*), mud crabs mainly (*Scylla serrate*) and milkfish (*Chanos chanos)*. Culturing practices are mainly human constructed earthen ponds for milkfish and prawn culturing, and enclosed pens and floating or submerged cages stocked with mud crabs in the natural water, within the mangrove forest. The culture of mud crabs is estimated to grow because of its low cost and high return. In addition to the profitability, Mud crab culture is proven ecologically sustainable (Mirera 2011).

Mari aquacultures practices take place within or close to mangrove forests. The largest mangrove forest is found around the Lamu archipelago (67 per cent) situated the north coast, and the second largest mangrove area is in the Kwale and Kifili district both 10 per cent each. The rest of the mangrove area spreads out to smaller estuaries such as Shimoni –Vanga, Funzi and Gazi bays in the south and Port-Reitz, Tudor, Mtwapa and Mida Creek (NEMA 2009). The marine aquaculture is under - developed in Kenya, although the potential for growth is substantial (Hecht 2006). These areas are characterized as fragile ecosystems with the human impact almost inextricably lead to environmental degradation. Therefor to undertake production within the fragile ecosystems precautionary approach is strongly suggested. Mari culture contributes insignificant as of yet, but this is estimated to change, as the interest for the industry grows.

6.5 Current status of aquaculture in Kenya

Aquaculture in Kenya is largely pond culture with about 9116 ponds across the country. 5934 of these ponds are clustered in the western region, near Lake Victoria (see figure 6. 2). The production is mainly small-scale semi intensive culture systems accounting for over 70% of the total output (Ngugi and Manyala 2009).

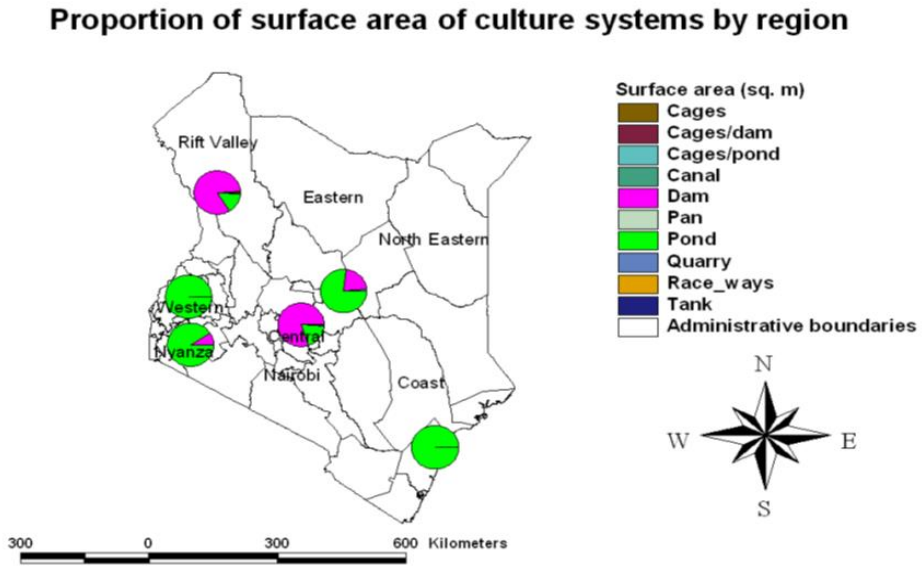


Figure 6.2 Map of areas of high aquaculture production in Kenya, Source: (Ngugi and Manyala 2009). Since the launching of the FFESP fish, production has more than quadrupled from 4,452 MT in 2007, to over 22345 metric tons in the year 2011. Aquaculture is now the fastest growing food-producing sector in the country, and Kenya is today the fourth largest producer of fish food in Africa (SOFIA 2013).

Table 6.1 Number of farmers, ponds Cages and total production in Kenya

	2006	2007	2008	2009	2010	2011	2012
Total Production MT	4,218	4,245	4,452	4,895	12,153	19,584	22
No. Of farmers	4,742	4,742	4,742	6,328	14,12	48,721	49,05
No of ponds	7,477	7,471	7,53	9,116	15,529	45,745	69,998
Area of ponds (ha)	217	216	227	275	467	1361	Na
No of Dams/ reservoirs	301	301	310	331	331	124	Na
Area of dams/reservoirs (ha)	497	498	498	547	547	740	
No of tanks/ raceways	284	149	156	161	161	161	
Area of tanks/ raceways(ha)	78,289	21,347	22,413	23,085	23,085		

Source : (FAO 2013) shows the increase of number of farmers, areas of ponds, tanks and dam's pre and post the FFESP.

6.6 Kenya aquaculture Governance and Policy

For an aquaculture sector, to contribute towards national food security and poverty alleviation its policy formulations must be in cognizance with the nation's broader policy agendas. This includes Macro policies such as Kenya national food policy (1981 and 1994), Millennium Development Goals (2000), Kenya Vision 2030,(Kenya) the agricultural sector extension policy (NASEP 2012)and the national agricultural research system policy (NARS, 2008). To make additional contribution to national foreign exchange earnings in terms of trade and export, the policy must reflect the thrust of relevant regional and international agreements and goals. For This reason, the industry is subjected to the external regulations and governing codes such as the FAO code of conduct for responsible fisheries (CCRF).

The Kenyan policy strategies relates to the overall national development objective to modernize the nation into a "newly industrializing, middle-income country providing a high quality of life to all citizens in a clean and secure environment", imbedded in the

Kenya Vision 2030. The Vision 2030, similar to the ERS paper recognizes agriculture as the "leading productive sectors for Kenya's economic recovery".

The Vision 2030 is a new long-term development blueprint for the country, as a follow – up, from the Economic Recovery Strategy for Wealth and Employment Creation[11] (ERS) paper 2003-2007, and the strategies to revitalize the agricultural sector (SRA) from 2004. Based on the ideology of modernization the strategies represent paradigm shift: *from subsistence production into commercially driven agriculture sectors, giving priority to principles of good governance and long-term environmental sustainability goal*s (GoK 2010).

6.7 Policy overview

The formulation of the Kenyan aquaculture policy was of the new constitution (2010) with its devolution of governance from central to decentralize governing structures. Briefing and consultations were on the outset held with the Ministry of Fisheries Development. During the process fish farmers, feed and seed producers, research institutions, processors and others were consulted, assuring their buy in of the policy (ACP 2011). In accordance with the Kenya's Vision 2030, the policy aspires to "*support a vibrant industry, with strong and efficient marketing systems, that enables investments and economic gains, and greater contribution to the national food security*". Managed under the Ministry of Fisheries (MOFD), the policy consolidates all components: legal, technical and administrative sectors into a comprehensive framework. The overall objective for the policy is to "*enhance aquaculture sub sectors contribution to wealth creation, increased employment for all especially the youth and women, food security and income generation through effective private, public and community partners*".

6.8 Policy objectives

1. Develop and enact the necessary legislation, legal and regulatory framework to guide the development, management and regulation of the sub – sector.

[11] http://siteresources.worldbank.org/KENYAEXTN/Resources/ERS.pdf.

2. Create a private sector driven aquaculture advisory and research board (AARB) to advice the sub sector on aquaculture development
3. Promote development of small scale, medium scale and large scale aquaculture enterprises.
4. Encourage investment in small, medium and industrial commercial aquaculture for domestic and export markets. In doing so, the government will encourage the provision and availability of affordable micro finance.
5. Develop seed production technology: feed technology, production technology and certification procedures for the aquaculture sub sector accompanied by appropriate infrastructure development.
6. Provide and promote aqua business development, ancillary industries, business services development for inputs, marketing and value addition through appropriate regulations, promotion and facilitation of public – private sector partnerships (baseline surveys and databases)
7. Continue to develop with a view to generating employment opportunities for the maximum number of Kenyans either directly or indirectly. The government will also ensure aquaculture farmers and those involved in supporting aquaculture activities enjoy improved livelihoods. Achieve self-sufficiency in fish and ensure that the domestic market is at all times adequately supplied. The government will further emphasize the nutritional importance of fish consumption while adhering to food safety standards.
8. Facilitate a framework for extension and training to ensure a competitive aquaculture industry.
9. Facilitate mobilization of funds for the development of aquaculture
10. To ensure that gender issues, HIV/AIDS and other lifestyle diseases and cross cutting issues in aquaculture are addressed through establishment of social development programs in aquaculture in collaboration with relevant stakeholders and partners.
11. Develop a system- wide framework for sharing information on aquaculture.
12. Establish a monitoring and evaluation system for the sub sector

6.9 Policy Guiding Principles

I. Good Governance
II. Food Security
III. Entrepreneurship
IV. Resource mobilization
V. Public Private Partnerships
VI. Innovation
VII. Capacity Building
VIII. Quality Assurance
IX. Environmental Sustainability
X. Gender Mainstreaming and Cross Cutting issues

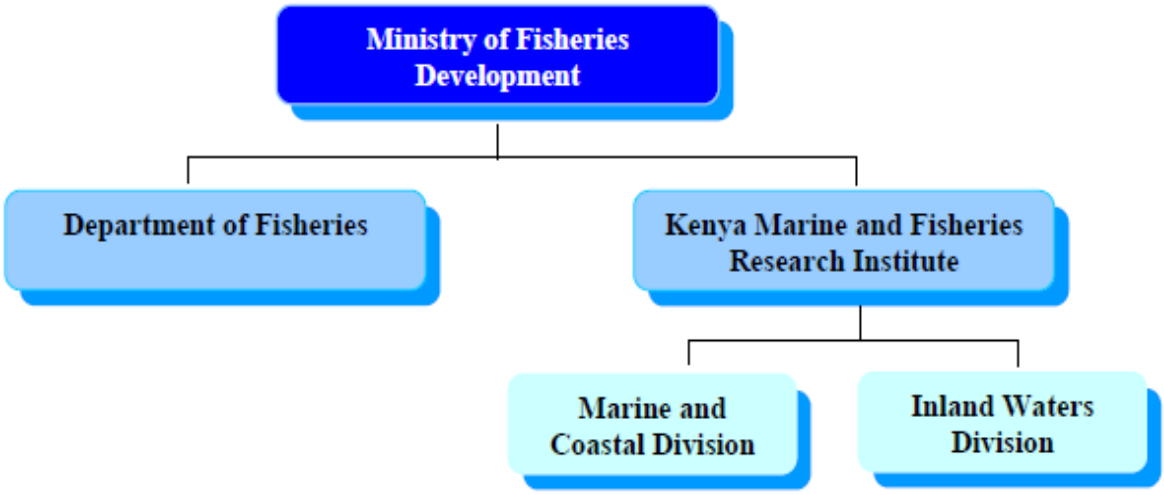


Figure 6.3 Ministry Of Fisheries Development Organization Chart

Source: http://bomosa.oeaw.ac.at/mains/deliverables/032103_D4-6.pdf.

In 2008, the Ministry of Fisheries Development (MoFD) was created, from the Ministry of Livestock and Fisheries Development. During the success of the FFESP, aquaculture recognized as a major contributor to development, and elevated from program level to national development with a directorate under the Ministry of fisheries (Ngugi and Manyala 2009).

The structuring of the aquaculture sector includes a directorate for aquaculture development and two research departments (freshwater aquaculture and Mari culture). The Kenya Marine and Fisheries Research Institute [12](KMFRI) plays a leading role in the Kenya's national aquatic research, and the KMFRI staff is distributed at various governmental centers. To date, the Kenyan government has designated several aquaculture facilities in various parts of the country to serve as research centers, training facilities, and sources input supply, for fish farmers (Dr Kazungu Johnson 2009). The major governmental training and research and education facilities are according to (Ngugi and Manyala 2009):

- Kenya Marine and Fisheries Research Institute (KMFRI)
- Lake Victoria Basin Development Authority (LBDA)
- Sagana Centre: Pond fish culture, mass fingerlings production and Aquaculture Health: (Fish diseases, sanitary standards, and water quality)
- Sangoro Station: Breeding and seed quality certification
- Kegati Station: Fish feed formulation, testing and certification.
- Mombasa Centre: Mariculture, (Inshore mariculture, seaweeds, mangrove oyster culture, prawn and artemia culture and aquariam fish breeding)
- Kiganjo Trout Hatchery
- Moi University, Department of Fisheries and Aquatic Sciences

Through the Kenyan Marine and Fisheries Research Institute (KMFRI), the government carries out, research and trials on fish farming procedures, value addition to aquatic resources, and inputs to aquaculture operations, for the purpose to improve and ensure sustainable management of the sector[13]. In the western part of Kenya, the Lake Victoria Basin Development Authority (LBDA) promotes aquaculture and train extension agents and provides input supply.

[12] http://www.kmfri.co.ke/.

6.10 Stakeholders

The stakeholders involved in Kenyan aquaculture range from the Governments, with its institutions, legislation and officers to foreign led agencies to single independent fish farmers. Also included are exporters, processors, service providers, traders and input suppliers. As promoted through the FFESP most stakeholders are encouraged to join associations and groups. These associations are Aquaculture Association of Kenya (AAK), Beach Management Units (BMU), Commodity Based Associations, and Kenya Fish Processors & Exporters Association (AFIPEK), Competent Authority (MOFD) and relevant Government Departments and collaborators such as ; Kenya bureau of standards (KBS) National Environment Management Authority (Wakwabi, Abila et al. 2003). A number of international agencies and bilateral organizations have been since early years of independence, actively engaged in aquaculture development in Kenya (Rothuis, van Duijn et al. 2011). The industry operates under the guiding principle of public private partnerships, and is currently supported or in collaborations with numerous international agencies. Most of the international agencies provide funding both on macro (funding of institutional and infrastructure development) and on farm level (micro finance, isolated donor projects and community based programs).

Below is a summary of the international agencies, adapted from (Ngugi and Manyala 2009, Rothuis, van Duijn et al. 2011) that play a significant role in the aquaculture development in Kenya:

- United States Agency for International Development (USAID)
- World Bank (WB), European Union, United Nations development Program (UNDP)International Development and Research Center (IDRC)
- Norwegian Development Agency (NORAD)
- International Foundation for Science
- Food and Agriculture Organization of the United Nations (FAO)
- Department of International Development –Government of UK (DFID)
- The Sustainable Aquaculture Research Networks in the Sub Saharan Africa (SARNISSA)
- Belgian Development AID
- Japan International Cooperation Agency (JICA

7 THE MAIN CHALLENGES FOR AQUACULTURE DEVELOPMENT

In this chapter, challenges, weaknesses and constraints identified by the Kenyan Fisheries Department will be explained. The Ministry of Fisheries recognizes that despite the rapid and impressive growth of aquaculture, there still exists major constraints, hindering the sector to maximize its potential. In order to adress these issues, a SWOT analytical tool was utilized. It is based on the research and development constraints identified in the SWOT analysis, the roadmap and policy framework was created.

Strengths	**Weakness**
• Well trained technical staff • Institutional capacity • Collaboration among stakeholders • Availability of numerous species with aquaculture potential • Selective breeding programs in place , improved growth and survival for catfish and tilapias	• Lack of aquaculture policy • Inadequate training facilities and public facilities (hatcheries and feed mills) • Inadequate capacity to conduct extension in aquaculture • Weak and inadequate legislation • Underdeveloped infrastructure • Poor adoption rate of aquaculture technology • Low funding levels by governments and other financial institutions • Lack of demand driven research • Lack of certified fish seed and feed • Lack of quality and affordable fish feed and seed • Weak monitoring • Low remuneration of staff
Opportunities	**Threats**
• Large areas underutilized available for aquaculture expansion • Establishment of directorate of aquaculture • Existence of private sector engagement in aquaculture sector in value addition • Unexploited local, regional and international markets	• Environmental degradation (floods, drought, pollution) • Introduction of alien species (cage culture failures) • Conflict in land/ water utilization • Corruption (Theft, political instability and uncertainty)

Figure 7.1SWOT analysis

From the list of weakness, opportunities and threats, the role of policies is determined by the impact and success of strategies intervention. Weakness in a policy can be identified

by its failure to address a particular objective or goal. For the sake of simplicity the weaknesses, threats and opportunities was categorized into; (1) technical and human resources (institutional constraints), (2) Input supply (feed, seeds and fertilizer supply), To be able to predict and assess the full impact of government intervention, the policy composition, interventions and strategies implemented will be explained both theoretically and empirically. I will in the following discuss bot these elements and how the policy addresses the major challenges for development of aquaculture. Finally, in the light of development theory I will address what can be learned from this approach to development. The category pertaining to Market constraints (corruption/ conflicts with land access/ water utilization environmental challenges and weak and inadequate legislation is not discussed in this paper) as these issues are falls under the non-sector specific policies. However the aquaculture laws and regulation is included to give a complete picture of the sector.

7.1 (1) Technical and human resources (institutional constraints)

In the SWOT analysis framework the Weakness regarding Human and technical resources, includes: A limited capacity to conduct extension in aquaculture; low level of adoption in new aquaculture technology; inadequate training and lack of demand led research. Regarding the limited capacity to conduct extension services, this issue relates to the lack of extension agents, and the methods and quality of services provided. Extension services in Kenya, have been predominantly provided by the public sector. The consensus is that by the late 1960s, the colonial infrastructure developments were beginning to collapse. Post-independence Kenya where faced with numerous challenges, not in a position to maintain the institutions already established regarding research stations, educated staff and technological resources (Grover, Street et al. 1980, Satia 1989). With the *hurried on* public sector downsizing regime in the 1980s, there where little or no funds allocated the hiring and training of public aquaculture extension officials and researchers. Thus research stations and universities that facilitate and produce extension agents, where not maintained. This resulted in not enough extension officers to go around, the assistance provided then became geographically skewed to exclude more remote farms (Nambiro, Omiti et al. 2006). In addition to the lack of enough extension

agents in the field, the farmers have criticized the design of extension program as not to be adequate or even adoptable (Harrison 1991). The history of extension systems in Kenya has since the colonial and post-independence era, evolved through various stages, mirroring the different development theories. Although the systems where varied in levels of success and longevity, they were considered as inflexible and uniform distributed in a "*top down"* approach (Muyanga and Jayne 2006). One of the issues with top down approach to extension services was agents and projects little regard or capacity to adress other factors such as marketing, value addition alternatives for stakeholders.

This weakness is partly due to the low public investment in extension training, and education, resulting in poor advice from unskilled extension workers not able or lacking the capacity, to adjust their services to accommodate farmer's needs.

The combination of few extension officers and lack of maintenance and training of the existing agents weakened the government's ability to supply effective and proper extension services to fish farmers (NASEP 2012).

On the demand side, farmer's proximity to extension facility plays a significant role in the likelihood for farmers to seek assistance. Extension is perhaps the most important component in aquaculture development, especially in rural areas where access or more importantly the lack of access to information can be costly (Wanga 1999). Studies on the extension efficiency in Kenya, argues that ; Farmers own resources in terms of education and economic also play a role in the awareness of the extension opportunities available to them (Nambiro, Omiti et al. 2006).

Another constraint has been the inconsistency and uncoordinated training of and services provided by extension agents. A weak public sector, and lack of ownership by Kenyan government, led to an arena with various private extension agencies , providing contradictory advice, with variable pricing and quality of inputs (Harrison 1993). This may have contributed to the negative image of aquaculture in Kenya, during the 1980s and the early 1990s. Several studies conducted in this period (Harrison 1993, Kaliba, Ngugi et al. 2007) points a negative perception of fish farming by farmers, resulting in low participation by farmers to its potential growth, paying more attention to the more income secure crop farming (Nyandat 2007). Kenyan entrepreneurs and bankers whom shared this skepticism, viewed aquaculture to be a "risky business ", thus there was a

reluctance to invest or provide loans to the farmers towards this development (Neira, Engle et al. 2009). Similar to the neglected investment on extension services, the education and research have equally been ignored. Although Kenya is one of the first sub Saharan countries to provide education in the field of aquaculture, in the years of 1994 to 96 there were no more than 60 graduates (Manyala 2009). As aquaculture constantly evolves to include newer technology and better management practices extension programs are often designed to teach farmers the latest technology. Extension is the key component linking latest research to government agencies, and farmers. They don't just convey information from research onto the field, but function as a channel of reverse communication where extension officers observes the cause and effect of recent development and reports back to researcher (p 608, Birkhaeuser, Evenson et al. 1991). For an extension, services to contribute to a sectors development it is required, human and technical capacity supported by political will in terms of funds or enabling policies and institutional structure.

7.2 Policies towards (1) Technical and Human resources (Extension and research capacity)

It is within extension and research where the majority of changes has been made, with regards to governance. Originating from the modernization policies, previous extension and research modes of delivery was constructed in a top down, purely technical fashion. During the 1980s and 90s, there was a re- orientation of extensions to more participatory processes. This shift was not isolated to aquaculture alone, but a part of a larger decentralization process with institutional and functional changes within agriculture sector, elaborated on in the Vision 2030 (Kenya) and the New National Agricultural sector extension policy (NASEP 2012). The decentralization process represents a paradigm shift away from modernization, with "top down" dissemination of knowledge and resources, towards a "bottom up "more participatory way of conducting extension services. First changes made, was the shift from a supply driven research and extension to more demand driven approach to research and extension. Demand led approach to extension and research, elevates the concept of participation to not only consider from an academic perspective what the recipients "*needs*", but actually listening and taking serious what

they" say" and accommodating their request (Garforth and Levy 2005). This approach demands a more complete participation from farmers to take ownership of their own desires and therefore be more accountable for the outcome. From a governance perceptive demand led approach, involves a reorganization of the extension system from the traditional public delivery and public finance system, to include various forms of *private or public delivery* with *private or public* finance systems of extension (Nambiro, Omiti et al. 2006). One of the strategies aiming to strengthen the capacity of extension delivery was to encourage private sector participation in the delivery and financing of extension services. The National extension policy (NASEP 2012) encourages privatization of extension services, decentralization and diversification of extension services. According to Roth et al in (Schwartz 1994) public sector, are in general over-burdened with numerous activities. Therefore moving some of the tasks and responsibilities onto the private sector might allow more effective implementation of technology and training. In addition, Private sector are dependent on clients purchasing their services, therefor are more inclined to shift according to the dynamics of the sector and client's preference. Public extension services however are more independent to the influences of market forces, and therefor due to lack of direct incentives can become static and inflexible (Schwartz 1994).

One of the issues with increased private sector involvement in Kenya is the low performance of private sector. Similar to the downsizing of public sector services and development, the private sector consists of weak technical and human (*know how*) capacity. Another challenge with greater participation of private sector are Issues with conflicting advice and duplication of extension services. This especially occurs as private funded extension projects operate isolated from the surrounding ecosystem and public institutions (Harrison 1991).

Another strategy to adress the lack of qualified personnel is to facilitate public private partnerships. According to the Policy objective (5) *the Government will promote and facilitate public – private sector partnerships (baseline surveys and databases).* Private and public collaborations in PPPs have the benefits of operating within governments settings, and monitoring standards. Within the PPP arrangements, there is multiple of innovative methods available to improve the capacity among farmers, officials, researchers and entrepreneurs (Hall 2008). Addressing the issues with low adoption of technology a government intervention is aimed at strengthening the farmer's capacity, through

empowerment. In the National extension policy (NASEP), empowering farmers is considered as crucial to improve the adoption rate to newer technology and alternative practices. Through the FFESP, stakeholders are encouraged to join associations and groups. A study on the effectiveness of extension service deliveries in several sub Saharan countries (Davis 2008), pointed out challenges with farmers limited capacity to self-identify needs and condition for improvements on their farms. Groups and associations serves as an arena where farmers can share skills, knowledge amongst each other, it also increases farmer's awareness of condition of improvement. Empowerment is According to Marilee Karl (1995) " *a process of awareness and capacity building leading to greater Participation, to greater decision-making power and control, and to transformative Action"*. Therefore, the socio- economic benefits of group formation will more efficiently empower farmers to become more participant in their own development. From a governance perspective groups and associations is a more cost efficient way to disseminate extension service to the fields. The most commonly used methods used by extension agents is; group training, study tours, and farm demonstration on selected private or public farms sites (NASEP 2012). From a governance perspective groups and associations is a more cost efficient way to disseminate extension service to the fields. The most commonly used methods used by extension agents is; group training, study tours, and farm demonstration on selected private or public farms sites (NASEP 2012).

One important component in aquaculture is access to relevant and appropriate research. The government implements strategies to strengthen the human resource base for research through education and training. Research is demand driven, where the role of government is to support farmer participatory research, facilitate farmer's access to governmental facilities. Policy objective (8) *Facilitate a framework for extension and training to ensure a competitive aquaculture industry*. One Governmental intervention was to provide free training and education.

Through the FFESP over 500 hatchery managers and over 10,000 farmers received training, through a national training program. The government also provides partially funded education in the field of aquaculture at B.Cs, MSc and Ph.D. levels , at the Department of Fisheries and aquatic science at Moi University http://www.mu.ac.ke/. Much of the training of aquaculture personnel is through public –private partnerships.

The role of non-governmental institutions, such as international universities and agencies, is to provide funding, and disseminate research results. Most human resource support through public private partnerships has been through the funding of rehabilitation the existing research, educational and training facilities across Kenya (Ngugi and Manyala 2009).

7.3 Limited availability of (1) inputs supply (Feeds, seeds and fertilizers)

In the SWOT analysis framework above, several issues, regarding supply of inputs was identified. Lack of affordable and sufficient quantity and quality input supply; lack of quality standards and certifications and inadequate training facilities and multiplication centers (hatcheries and feed mills). For clarification, I categorize these issues as availability and accessibility constraints. Accessibility – In this case can be interpreted to "the *physical and economic access to sufficient inputs".* Limited access to affordable and quality input supply is one of the greatest constraints for commercially oriented farming. At a technical level the farmer's access to affordable high quality, inputs are critical factors affecting the overall profitability of their enterprise. At subsistence level, farmers can rely on their own agricultural by -produce and natural pond productivity to feed and stock their ponds (Hecht 2007). However, when aiming for market value, the nutritional content in fish meat, growth rates and final size of the fish, becomes critical factors farmer's needs to consider attaining profitability. Availability – can be *referred "the amount of inputs that's available in a country or area through all forms of domestic production, imports, stocks or aid*". In Kenya, governmental led aquaculture centers is the main supplier of fish seeds and feeds, with minimal private sector participation(NASEP 2012). Due to decades of neglect and limited public funding these facilities have been characterized as poorly managed with lack of appropriate equipment and technical expertise. Although the lack of sufficient supply of inputs has been a constant weakness, for the sector, the rapid expansion of fish farms due to the success of FFESP triggered an immediate shortage (Munguti and Ogello 2014) of fish seeds and feeds that unless addressed, will serve as a threat to not only farmer's short-term feasibility, but also the sectors sustainability as a whole.

7.4 Policies towards feeds and seed accessibility and availability

Aiming to jump-start a commercial sector, the government implemented a series of strategies mainly in the form of donation and subsidizing programs. The first strategic intervention was making sure that there is an overall increase in domestic production of input supply (feeds, seeds). Policy objective (5) *Develop seed production technology: feed technology, production technology and certification procedures for the aquaculture sub sector accompanied by appropriate infrastructure development.* A Substantial funding through the ESP was allocated to the rejuvenation of the regional aquaculture centers to operational standards. Kenya government implemented national seed and feed production programs through regional state led aquaculture centers: Sagana aquaculture center (Kiriyaga county) Kiganjo trout farm (Nyeri County), Chwele fish farm (Bungoma County) Wakhungu (Busia county), Kisi fish farm (KisiiTown). Despite this increased effort, Public facilities alone are not able to supply the growing demand, and with the widening gap in supply and demand, there is a dependency on private sector to fill the market demand.

The Kenyan Government acknowledges that In order to accelerate the sector there is a need to strengthen the existing public aquaculture centers at the same time establish or stimulate development of new fish feed mills and hatcheries, from the private sector. Policy objective (6) *The Aquaculture Policy encourages private sector engagement and joint Public –Private partnerships and promotes value chain development*. One activity aiming to promote private sector engagement, in 2010, was to provide fish pellet machines to over 30 privately owned fish feed manufacturers across the country (Munguti and Ogello 2014). With a larger engagement of private sector, follows a need for mechanisms to regulate, monitor or certify the hatcheries and feed mills, in order to enforce optimal fish standards (Ernest Yongo 2014). In Kenya, the Issues with low quality of the inputs emerged as a serious constraint, due to the rapid boom in private sector production. The high demand opened up a market for unethical suppliers, compromising the quality of the fish, causing financial losses for farmers.

In accordance with the Policy objective (5) the KMFRI, Department of Fisheries together with the existing Commercial fish feed producers, fish farmers and the Kenyan Bureau of Standards KBS developed Kenya's first Fish Feed Standard. The commercial feeding standards where established in order to ensure an optimal quality of fish feeds for catfish and tilapia fry, fingerlings, growers and brooders. Based on these standards certifications are granted to fish feed producers whom qualify to meet the optimal nutritional content. Prior to the standards, only two of the then eight existing feed manufacturers where meeting the standards. The issue of low quality fish feeds can be addressed by enforcing these standards, they provide a benchmark, for existing feed manufactures and fish farmer's to improve the quality of their feeding compositions (Munguti, Safina Musa et al. 2013).

In regards to fish seeds, Access to quality seeds has been a major bottleneck to the progression of the sector. Today, most fingerlings are produced through selective breeding or by other improvement techniques such as sex reversals and hybridization. A deliberate strain improvement requires technological "*know-how*" and technical facilities. Due to little investments in research and technology , existing fish breeding facilities have been prone to poor management, resulting in a lower seed quality (Brummett, Lazard et al. 2008). The government have identified the need for quality improvement of fish fingerlings and the need to rapidly increase its production.

In 2006, the government approved funding for a selective fish breeding for quality seeds to enhance aquaculture production in Sandor research center, near Lake Victoria http://www.kmfri.co.ke/sangoro.html. Since then the research department has invested in the strengthening of hatchery techniques in the public aquaculture centers across the country. As in the case of fish feed industry, the growing demand depends on private sector engagement. The Kenyan Bureau of Standards KBS, in collaborations with researchers at KMFRI, has authenticated several privately owned hatcheries nationwide, however a quality standard certificate, as with the fish feeds is not completed.

7.5 Aquaculture legal framework

The fisheries resources are managed by the Department of Fisheries. Aquaculture occurs in nature, so its operations have an impact on the environment as well as other economic sectors, sharing the resource base with aquaculture. Each of these sectors operates with their own legal provision and policy framework. Therefor the aquaculture legal and regulative framework should be addressed, from a multi- sectorial perspective. In the table below (Figure 7.2) the most significant rules that regulate the sector are:

Fisheries and aquaculture rules	Food Safety and Public Health
• Fisheries Act Ch. 378 (1991) • Forest Act • Fisheries (quality Assurances) regulations 2000 • Water Act • Water(plan of transfer of water services) rules (2005)	• The fisheries (safety of fish , fisheries products and fish feed)regulations 2006 • Animal disease act (Ch. 364) (1965) • Code of hygiene act practise (1986)
Environment and water Resources	Including the brackish water aquaculture
• Environmental Management & Coordination Act • Water quality regulations (2006) • Lakes & Rivers Act • Wildlife (Conservation & Management) Act • Convention On Biological Biodiversity (1992)	• United Nation Convention on the Law of the Sea (1982) • Convention for the Protection, Management and Development of the • Marine and Coastal Environment of the Eastern African Region (Nairobi 1985).

Figure 7.2 Source :(BOMOSA 2009)

The major legal documented that directly relates to the aquaculture and fisheries is the Fisheries ACT (Cap 378). This Act mainly concern the handling of the live fish in Kenyan waters, regulating the transfer of species from one catchment area to another (Manyala 2009). The mandate to enforce the Fisheries ACT is ascribed the newly established Directorate of Aquaculture.

The Directorate of Aquaculture provides a range of services and has the duty and responsibility to conduct fisheries statistics, Fish quality controls and monitor the management's procedures. The directorate of Aquaculture is also responsible to facilitate and manage the national extension service, whose main objective is to promote and support the development of sustainable commercial aquaculture production, across Kenya.

7.6 Aquaculture licenses certificate

According to the Fisheries (safety of fish, fisheries products and fish feed) regulations 2007*"No person shall establish or use a fishery enterprise for the purpose of production, culture, processing, storage, packaging, transporting or placing on the market of fish or fishery products intended for human or animal consumption. Unless he has applied for and obtained prior approval to do so from the competent authority*[14]. Fisheries Officials may withdraw suspend or approve any operational license based on whether the conditions and requirements are fulfilled[15]. It is important to note that, for any group whom wants to acquire a license to practice aquaculture have to pay a fee for approval and for health certificate. Operating licenses for Fish feed mills, hatcheries, processing factories and permits for export , is also required and only attainable against a fee. Farmers also have to pay additional fees for inspection, trade license and certification. Fees to join associations, farmer's cooperatives and groups varies in price. From no fee, usually self-help groups to a registration fee and licensing up to 10,000 KSH (1000NOK) this is divided on group members to pay a 10 % of the total (FAO 2013).

[14] http://www.kenyalaw.org:8181/exist/kenyalex/actview.xql?actid=CAP.%20378.

7.7 Summary of Achievements

Since the launching of FFESP production has more than quadrupled from 4,452 MT in 2007, to over 22345 metric tons in the year 2011. Aquaculture is now the fastest growing food-producing sector in the country, and today Kenya ranks as the fourth largest fish food producer in Africa (SOFIA 2013). The sector according to (Jamu, Chapotera et al. 2012), has created over 28,000 farmers with full time employment, 280,000 through seasonal employment and another 140,000 Kenyans with indirect employment. In addition to the employment in production the Ministry of Fisheries employs 480 extension officers.

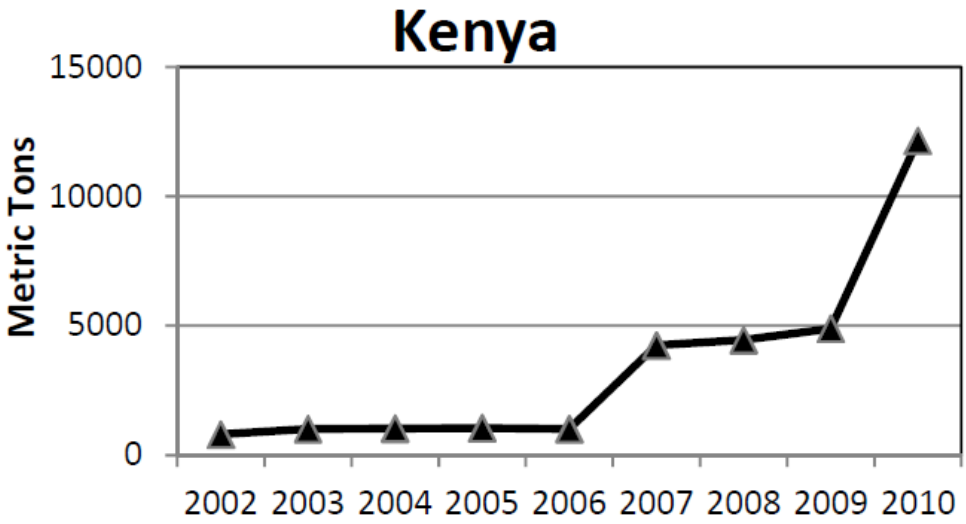


Figure 7.3 presents the growth of fish production in Kenya. Source: (Jamu, Chapotera et al. 2012) There is no doubt that due to government interventions to boost the nation's fish farming industry has been successful. In a short period of time, aquaculture has risen from a merely garden activity (compared to its estimated potential) to become a sector with significant prospects of contributing to livelihoods as well as Kenya's national socioeconomic growth. But not to be blinded by the shooting arrow of growth in volume, (fig 7.3) there are some concerns that needs to be elaborated on.

7.8 What can been learned by this approach

This section is a discussion on the findings from the policy assessment, with some final comments on the way forward. Kenya's aquaculture policy is a comprehensive framework encompassing cut crossing issues concerning markets, civil society, and government. It is a policy which proposes the private sector to be the engine for growth. By promoting public and private partnerships, and downsizing the role of governments to function purely a facilitator (SOFIA 2007), it is clear that the Kenyan government has a vision for the sector to prosper into a sustainable commercial sector, which by its definition, is self-sufficient. Now, when assessing the strategies implemented towards reaching this goal, the focus will be on the most implemented interventions, namely; privatization and subsidies.

Donor ship and subsidies

For Kenyan farmers, entrepreneurs and financial institutions aquaculture projects is nothing new. They "come and go ", the failure for aquaculture to become a *full-fledged* member of the Kenyan farm life, have created a skepticism by farmers to engage in the sector, despite its obvious potential. In Kenya, commercial fish farming is a development intervention, meaning implemented with intent, therefor the scene, vision and prospects needs to be explained and demonstrated in a convincing and understandable way, for farmers, entrepreneurs and bankers to buy in on the endeavor. The projects must be marketable for farmers to become willing to invest time and resources in fish farming. One way to encourage participation is by donor ships and subsidies. Kenya has since the FFESP actively committed itself to the introduction and implementation of fish farming across the country, at a price of Ksh 1.12 billion (Jamu, Chapotera et al. 2012). Most of which is allocated pond construction, feed and seed production and even direct imports to supply farming activities, all in the form donor ships and subsidies. In Kenya, earlier attempt to improve production by Top- down strategies have resulted in a larger dependency rather than resilience. Understandably, there are some concerns about the sustainability when implementing subsidies in commercial aquaculture. However, some argue that subsidies in the form of startup packages is necessity in the first phase of production. So called start-up funding, packages here in the form of FFESP, needs to be

implemented for the sector to reach a stage of marketability. The assumption or objective is for the recipients of such start- up packages is to "learn by doing" (Ridler, Hishamunda et al. 2001). Subsidies are not uncommon in any food producing sector, however the level of where governments gets involved varies, in the case of FFESP ,Kenyan government have taken on an active role both in the distribution, imports, and production of input supply. As the success of FFESP attracted more farmers digging more ponds, the demand has grown beyond the government and private sector capacity to supply. (Munguti and Ogello 2014) , This gives an indication that even though growth is still positive, there is a relatively great chance that much of this growth is not sustainable ones governmental donor support seizes.

Privatization

Another strategy which is emphasized in all aspects in the policy is, privatization. Kenyan policy is gearing the sector towards increased private management, encouraging private entities to take a lead role, in the growth of the sector. Experience from other fish farming producing countries, shows that public institutions such as Research stations, universities and extension offices provide important support and guidance, however when the sector progresses into a more commercial driven production, private sector involvement is critical for the sectors growth and sustainability (Hishamunda and Subasinghe 2003, Hishamunda, Ridler et al. 2009). One of the challenges identified in this study was the low level of capacity and resource in the exiting private sector. Given the focus on private sector and the important role it serves in a market oriented production, it is suggested that more resources are invested in education and training, rather than actual development of fish farms and its supply. This strategy will naturally discourage more farmers to engage in aquaculture, however keeping a long-term perspective, greater investment in research and education will grow new fish farmers for tomorrow, and reduce the fish feeding obligation from governments.

7.9 Conclusion

The purpose of this study was to assess the role and impact of polices in development of aquaculture, by assessing the new Kenyan aquaculture policy (2011). The specific objectives where; to identify the main challenges faced by the Kenyan aquaculture sector, then by describing the policy goals and objectives, I was to assess how the policy addresses the challenges faced by the sector, and finally, elaborate on potential causes and reasons for its success or failure.

Answering the first research question, which aimed at identifying the main challenges faced by the sector, historical review of the history of aquaculture development in Kenya was conducted. I found that despite of a high potential for aquaculture and relatively long history with several attempts to establish the sector in a sustainable fashion, the sector has continued to stay underdeveloped. During the review of the history of aquaculture development in Kenya, it was disclosed that the challenges, constraints and weaknesses identified as early as 1987 by the thematic evaluation actually persisted in 1993 and was present in 2011. This supports the assumption that the failure to utilize the potential for aquaculture in the country was attributed weak governance and political will. The lack of ownership was also identified as an issue. Aquaculture has been operating in Kenya for over a century, with minimal or sporadic attention from Kenyan government. This led to an unregulated sector with various "grow and go" projects, mainly conducted by foreign led agencies.

The second research objective was to assess how the new Kenyan policy addresses the challenges faced by the sector. The purpose of policies is to identify challenges and constraints for then to provide solutions for how to adress them, another purpose is to provide strategies to guide the sector in the right directions, according to government objectives and overall vision for the sector. In order to conduct a proper assessment I adopted the Kenyan government SWOT analytical framework, as the challenges identified by the governments serve as the basis for this policy.

When comparing my findings from the first research question to the governments SWOT analysis, I found them to be compatible.

I found that at on a government level, a shift from the more centralized state run governing system towards a decentralization of power, was instrumental for the government to give attention too, and for the realization the potential for aquaculture development in Kenya.

In the policy assessment, several issues regarding technical and human resources was addressed, and the limited access and availability to fish farming inputs. Much of these issues although longstanding, have become serious threats at farm level, due to the success of FFESP. A large quantity of fish farmers have been born as a result of this government intervention, and the Kenyan government where caught in bit of a jam, with too much too fast, with a supply and extension service not equipped to meet the growing market. I believe that many of these strategies in place serve more as a response to FFESP, and not initially part of any long term strategy. Previous governmental led support programs to expand and intensify aquaculture sector in Kenya, has proven not to be sustainable. The emphasis on private sector involvement is one channel to relieve the government's responsibility and thus guiding the sector towards self-sufficiency.

Given the short life span of the policy and the sectors growth, post FFESP, it is impossible to make any conclusion to whether this is a sound policy or not. However Kenya's increasing demand for fish food connected to the rapidly increasing population may improve the likelihood for the sector to sustain production beyond governmental funding.

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