

Business opportunities for aquaculture in Kenya

With special reference to food security



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Business opportunities for aquaculture in Kenya

With special reference to food security

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Wageningen Aquaculture

A consortium of IMARES, LEI and the Aquaculture and Fisheries Group of Wageningen University.

Business opportunities for aquaculture in Kenya; With special reference to food security

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Preface

Early 2011, the Dutch Government published its new private sector policy. The primary aim is to strengthen Dutch companies that are active in nine sectors of the economy: water, agro-food, horticulture, high tech, life sciences, chemicals, energy, logistics and the creative industry.

The Netherlands is a major player in the global agro-food industry. This innovative sector is the second largest exporter of food and flowers in the world, and produces 10% of the national product and 25% of the total export of the country. This position can be largely attributed to the successful cooperation between the private sector, research institutions and the government, the so-called 'Golden Triangle' model.

Within the top sector Agro Food, 'internationalisation' has been set as a priority for further economic development. The Netherlands intends to become world leader in innovative, sustainable and efficient food production with high added value. From this position, the Netherlands is an attractive partner for the development of tailor-made systems for local food production. This will not only help countries to provide sufficient food for their growing populations, but also benefits the Dutch economy. What is needed is a combination of entrepreneurship, knowledge, and governmental support, aimed at the entire value chain, organised in the form of specific consortia.

With this in mind, a team of two scientists from the fisheries and marine ecology institute IMARES and from the Agriculture Economics Research Institute LEI (both part of Wageningen University and Research centre) joined forces with the founder and owner of one of the largest fish farms in the Netherlands. They conducted a fact-finding mission to investigate the business opportunities in aquaculture with respect to food security. This report presents their key findings and recommendations.

The intensive collaboration between science and business for this project has led to new insights and business opportunities for aquaculture development in Kenya. As such, this approach could be a model for the new way of development cooperation.

A handwritten signature in blue ink, consisting of a stylized 'J' followed by a series of loops and a horizontal line.

Jan van Rijsingen
(co-author and member top team Agro Food)

A handwritten signature in blue ink, featuring a large, bold 'M' followed by a horizontal line.

Dr. Martin Scholten (Director IMARES)

A handwritten signature in blue ink, consisting of the letters 'R' and 'H' in a stylized, cursive font.

Dr. Ruud Huirne (Director LEI)

Acknowledgements

During the fact-finding mission in Kenya, we met numerous Kenyan entrepreneurs, government officials and scientists. Their cooperation contributed largely to this final report. We would like to thank all of them, but especially Dr. Harrison Charo-Karisa, for his help in the organisation of our interviews, the field visits and the workshop, and for his continuing optimism, which for us greatly reflects and symbolises the spirit of the Kenyan people. We also thank Mr. Hans Wolff, agricultural attaché at the Netherlands Embassy in Nairobi, for the discussions we had and his valuable comments on the text of this document.

Summary

S.1 Key results

In Kenya, the demand for fish is growing while the supply from mainly capture fisheries is lagging behind. This offers great opportunities for aquaculture businesses to play a role in improving food security.

The potential for aquaculture in Kenya is good. The demand for aquaculture products is growing rapidly due to its fast growing population, declining natural fish stocks in Lake Victoria and active promotion of fish consumption by the Kenyan government. (See [sections 4.5, 5.3](#) and [7.1](#))

The small-scale farming of tilapia that is supported by the current aquaculture policy will not sufficiently contribute to food security. More intensive culture systems such as the intensive culture of cat fish will be necessary. (See [sections 4.5, 5.4](#) and [7.1](#))

The current major bottlenecks for more intensive fish farming are: fish feeds, sufficient numbers of fingerlings, water quality as well as quantity, farm management, organisation of the value chain, marketing, capital, supportive legislation and policy. (See [sections 3.5, 5.5](#) and [7.1](#))

Dutch companies can provide feeds, farming and processing equipment and technology, know-how, value chain development expertise and investment capital. (See [sections 6.2, 6.3](#) and [7.1](#))

To facilitate the development of more intensive fish farming we advise the Embassy of the Netherlands in Nairobi to act on two levels:

- influence Kenyan government policy;
- facilitate Dutch and Kenyan private sector involvement. (See [section 7.2](#))

Both levels are interrelated and should be initiated in tandem.

S.2 Complementary findings

In general, small-scale subsistence aquaculture contributes only to food availability for local communities, while large-scale commercial aquaculture (i.e. more intensive aquaculture) not only provides food, but may also contribute to employment and economic growth. (See [section 4.3](#))

Compared with the current low productive forms of aquaculture, the development of intensive catfish culture requires an increased and stable supply of high quality inputs (e.g. water, feeds, fingerlings, technology and capital). As a result, it is more sensitive to fluctuations in cost price and the volatility of the Kenyan Shilling. Therefore, the production needs to be organised as part of an integrated value chain with access to different market segments. This makes catfish farming a full-fledged commercial activity - as opposed to a subsistence activity - that needs to be run by the private sector. (See [section 5.4](#) and [7.1](#))

There is considerable interest from the Kenyan private sector (feed companies, fish farmers, horticulture farms) to link up with Dutch companies. (See [section 6.4](#))

S.3 Methodology

Aquaculture is one of four priorities of the Netherlands Embassy in Nairobi to achieve the food security objectives of development cooperation in Kenya. The present research project assessed what the Netherlands can contribute effectively and where there is a recognisable Dutch added value through business development, knowledge and experience. (See [section 1.1](#))

This study assesses the potential role of aquaculture. It addresses current bottlenecks that prevent aquaculture from achieving Kenya's food security objectives and identifies possible interventions. This study furthermore explores business opportunities for Dutch companies in supporting the sustainable development of the Kenyan aquaculture sector. (See [section 1.2](#))

This research project was conducted on two levels; (See [section 1.3](#))

- A desk study order to acquire information on all related aspects important for aquaculture development based on public databases and reports;
- A fact-finding mission in Kenya including interviews with key informants, followed by a validation workshop.

Samenvatting

S.1 Belangrijkste uitkomsten

Terwijl in Kenia de vraag naar vis stijgt, blijft het aanbod dat voornamelijk uit viskwekerijen afkomstig is achter. Dit is een uitgelezen kans voor aquacultuurbedrijven om een rol te spelen bij het verbeteren van de voedselveiligheid.

Het potentieel voor aquacultuur in Kenia is goed. De vraag naar aquacultuurproducten groeit gestaag dankzij de snel groeiende Keniaanse bevolking - waardoor de voorraad natuurlijke vis in Lake Victoria daalt - en de actieve promotie van visconsumptie door de Keniaanse overheid.

De kleinschalige kweek van tilapia die door het huidige aquacultuurbeleid wordt ondersteund, draagt onvoldoende bij aan de voedselveiligheid. Hiervoor zijn intensievere kweeksystemen, zoals de intensieve kweek van meerval, noodzakelijk.

De belangrijkste knelpunten die een intensievere viskweek in de weg staan, zijn: visvoer, voldoende aantallen pootvissen, waterkwaliteit en -kwantiteit, kwekerijbeheer, organisatie van de waardeketen, marketing, kapitaal en ondersteunende wetgeving en beleid.

Nederlandse bedrijven kunnen zorgen voor voer, kweek- en verwerkingsapparatuur en -technologie, knowhow, kennis van de ontwikkeling van de waardeketen en investeringskapitaal.

Om de ontwikkeling van een intensievere viskweek mogelijk te maken, adviseren wij de Nederlandse ambassade in Nairobi actie te ondernemen op de volgende twee niveaus:

- het beleid van de Keniaanse overheid beïnvloeden;
- de betrokkenheid van de Nederlandse en Keniaanse particuliere sector te faciliteren.

Beide niveaus zijn onderling verwant en dienen gelijktijdig te worden geïnitieerd.

S.2 Overige uitkomsten

Over het algemeen draagt kleinschalige aquacultuur voor levensonderhoud alleen bij aan de beschikbaarheid van voedsel in lokale gemeenschappen, terwijl grootschalige commerciële aquacultuur (d.w.z. intensievere aquacultuur) niet alleen voor voedsel zorgt, maar tevens een bijdrage kan leveren aan werkgelegenheid en economische groei.

Vergeleken met de huidige laagproductieve vormen van aquacultuur vereist de ontwikkeling van een intensieve kweek van meerval een hogere en stabiele toevoer van hoogwaardige middelen (bijv. water, voeding, pootvissen, technologie en kapitaal). Als gevolg daarvan is de kweek van meerval gevoeliger voor schommelingen in de kostprijs en de wisselende koers van de Keniaanse shilling. De productie dient daarom te worden georganiseerd als onderdeel van een geïntegreerde waardeketen met toegang tot diverse marktsegmenten. Hierdoor wordt het kweken van meerval een volwaardige commerciële activiteit – in tegenstelling tot kweken als levensonderhoud – die door de particuliere sector dient te worden uitgevoerd.

Vanuit de Keniaanse particuliere sector (voederbedrijven, viskwekerijen, tuinbouwbedrijven) bestaat er veel interesse om de handen ineen te slaan met Nederlandse bedrijven.

S.3 Methodologie

Aquacultuur is een van de vier prioriteiten waarmee de Nederlandse ambassade in Nairobi de doelstellingen van voedselveiligheid wil behalen, die onderdeel uitmaken van de ontwikkelingssamenwerking tussen Kenia en Nederland. Door het huidige onderzoeksproject is beoordeeld welke effectieve bijdrage Nederland kan leveren en op welke gebieden Nederland een duidelijke meerwaarde kan bieden door middel van bedrijfsontwikkeling, kennis en ervaring.

Dit onderzoek beoordeelt de mogelijke rol van aquacultuur. Het richt zich op de huidige knelpunten die verhinderen dat aquacultuur de Keniaanse doelstellingen van voedselveiligheid realiseert en constateert mogelijke interventies. Daarnaast worden in dit onderzoek zakelijke mogelijkheden voor Nederlandse bedrijven verkend om ondersteuning te bieden aan een duurzame ontwikkeling van de Keniaanse aquacultuursector.

Dit onderzoeksproject is op twee niveaus uitgevoerd:

- Een bureaustudie op basis van openbare gegevensbanken en rapporten, waarin informatie werd vergaard over alle verwante aspecten die belangrijk zijn voor de ontwikkeling van aquacultuur;
- Een onderzoeksmissie in Kenia waarin interviews met sleutelinformanten werden gehouden, gevolgd door een validatieworkshop.

research



private sector



government

1 Introduction

1.1 Rationale

In the policy letter for development cooperation dated 26 November 2010, the Netherlands government made a choice for food security and water as priorities. The choice for these two themes is accompanied by a shift from social to economic sectors. The Netherlands, through its companies, knowledge institutes and NGOs, has a clear added value in the area of food and sustainable production. When considering these issues, an increasing amount of attention is paid to the role of the private sector. Promoting entrepreneurship is seen as the major force shaping economic development, to create jobs and generate income.

Aquaculture is one of four priorities of the Netherlands Embassy in Nairobi to achieve the food security objectives of development cooperation in Kenya. The present research project was carried out to assess what the Netherlands can contribute effectively and where there is a recognisable Dutch added value through business development, knowledge and experience to support aquaculture in Kenya to help to achieve the food security objectives.

1.2 Aim

This study assesses the potential role of aquaculture in improving food security in Kenya. It addresses current bottlenecks that prevent aquaculture from achieving Kenya's food security objectives and identifies possible interventions. This study furthermore explores business opportunities for Dutch companies in supporting the sustainable development of the Kenyan aquaculture sector.

1.3 Approach

Commercial companies need up-to-date information to be able to make sound investment decisions. These opportunities range from investment opportunities, export of aquaculture inputs and equipment, import of aquaculture products, and the provision of services, expertise and knowledge. Therefore, this research project was conducted on two levels:

- A desk study to acquire information on all related aspects important for aquaculture development based on public databases and reports;
- A fact-finding mission in Kenya including interviews with key informants, followed by a validation workshop (see appendices 1 and 2).

This document is the result of an intensive collaboration between business and science. This type of collaboration, both at project and sector level, has been the basis for the successful development of the Dutch agro-food sector. It is the interaction between the different partners that leads to new insights, innovations, business opportunities and economic development. As such, this approach can be used as model for the new way of development cooperation.

1.4 Structure

This report is structured as follows: Chapter 2 provides general background information on Kenya. Chapter 3 describes aquaculture in Kenya and deals with the aquaculture chain in Kenya from primary production, fish processing and trade to government institutions and policy. Chapter 4 pays special attention to fish and food security. Constraints and opportunities for the sustainable development of aquaculture in Kenya are analysed in Chapter 5, based on the validation workshop (see Appendix 2). Chapter 6 links the opportunities from the previous chapter to business opportunities for the private sector. The report concludes with recommendations concerning the role of aquaculture for enhanced food security and on business opportunities for Dutch companies in the Kenyan aquaculture sector.



2 Country profile Republic of Kenya

2.1 Key findings

- The country exhibits great extremes of altitude, rising from sea level to 5,200m at Mt. Kenya. Sheltered bays and estuaries are available along Kenya's 640-km coast. Elevation is the major factor in temperature levels, with the higher areas, on average, some 11°C cooler, day or night. For many areas, the daytime temperature rises about 12 °C, almost every day.
- Agricultural productivity is curtailed because only 17% of the country receives an average rainfall of more than 800mm per annum - the minimum requirement for rainfed agriculture.
- Arising from an uneven distribution of water resources in space and time and with an increase in the frequency of extreme weather events, Kenya suffers water scarcity. Kenya water resources are not only scarce but the resource base is vulnerable to depletion while the country's development is highly dependent on water.
- Land is the most important resource in Kenya. In densely populated regions, there is now major concern that land may have become too scarce to make any meaningful contribution to household incomes.
- Kenya's population and agricultural activity are heavily concentrated in the southern half of the country. Kenya's infrastructure backbones have followed this route. The northern half of the country, by contrast, is sparsely populated and characterised by fragmentary infrastructure coverage.
- The country has achieved one of the highest rates of GSM coverage in Africa. Over 90% of Kenya's population lives within range of a GSM signal.
- Only 8% of the Kenyan population is connected to the national grid. Challenges are to improve reliability and bring down costs of power supply.
- Kenya has no proven hydrocarbon reserves and imports all its crude petroleum requirements from the Middle East. Upwards of 25% of the national import bill is attributable to petroleum imports.
- Kenya's population is growing fast, increasingly so in cities. Rapid population growth is set to continue over the next forty years. As a result, each year the country gains some 1m new citizens. At this rate, Kenya's population will reach about 63m by 2030 (up from an estimated 41m in 2011).
- The average Gross National Income (GNI) per capita in Kenya in 2009 was USD760. Social inequality in Kenya is significant. Recent studies rank Kenya

among the top ten most unequal countries in the world and the fifth in Africa. In 2009 the percentage the proportion of the population living below the poverty line was estimated at 47%.

- The national long rains assessment estimates that 3.75m people in pastoral and marginal cropping lowlands are food insecure in Kenya.
- One third of Kenya's population live in urban areas, out of which 40% reside in slums. In spite of deteriorating food security and income indicators in high population density urban centres, urban migration is rising steadily. A large proportion of urban dwellers were unable to meet food needs on a sustained basis over an extended period.
- Kenya's adult literacy rate (for ages 15+ and over) of 84.5% is slightly higher than the world average of 77.5%. However, there is considerable regional disparity.
- In 2010, Kenya benefited from the global economic recovery as well as higher prices for its exports. While the economy grew by 2.6% in 2009, it is estimated that the growth rate of the gross domestic product (GDP) nearly doubled to reach 5.0% in 2010. The agriculture and manufacturing sectors became Kenya's new growth drivers after two years of weak performances. The outlook for 2011 is promising and a combination of trends could contribute to ensure positive prospects in the short to medium term.
- In September, Kenya's year-on-year inflation rate rose for the 11th month in a row in September to 17.32%, driven by higher energy and food prices. The overall year-on-year rate of food inflation stood at 24.37%. Transport costs have also surged, to record a year-on-year rise of 24.77% in September.
- A weak shilling has been hurting the balance of payments, which means import costs, particularly those that are energy related, are likely to continue increasing.
- Almost half (46%) of Kenya's exports for the year up to August 2010 went to African countries.
- The main sources of foreign direct investment were Australia (KES16bn), Israel (KES4bn), the UK (KES738m) and India (KES434.3m).
- From the perspective of the ease to do business, out of other countries that are part of the East African Community Kenya ranks 2nd after Rwanda.
- Although Kenya has recorded some improvements in the past four years, including an increase in productivity, Kenyan firms still face an adverse business environment. In fact, the total losses incurred by businesses because of power outages, theft and breakage during transport, payments of bribes, and protection payments are much higher than total losses experienced by

the middle-income countries in Africa and by China and India. The top constraints identified by the Kenyan managers were tax rates, access to finance, corruption, security, infrastructure services (electricity and transportation), and business licensing.

- With no additional procedures specifically required of foreigners, it takes as long to establish a domestic enterprise as a foreign-owned limited liability company (LLC) in Kenya (Nairobi).
- Despite Kenya's strong legal framework, there are problems with the length of arbitration proceedings and the enforcement of arbitration awards.
- In Nairobi, the process of leasing land is governed by several laws that deal with the registration and disposition of interests in land. Only companies that are 100% domestically owned can acquire land that is subject to provisions under the Land Control Act, such as agricultural land. Nonetheless, foreign companies seeking to access land in Kenya have the option to lease or buy land from private and public landholders.
- Kenya's economy, one of Africa's most developed, has gradually emerged from political instability and the economic slowdown. Reforms in public finance management have continued, though progress has been sluggish. Weak protection of property rights and extensive corruption continue to hold back overall economic freedom.

2.2 General

Table 2.1	Country facts
Population in 2011	41,070,934 (est.)
Population growth rate in 2011	2.462% (est.) (0,371% in the Netherlands)
Median age in 2011	total: 18.9 years (est.) (41.1 years in the Netherlands)
Capital	Nairobi, 3.375m inhabitants (2009)
Major languages	English (official), Kiswahili (official), numerous indigenous languages
Land area	580,367km ² (14 times the Netherlands)
Arable land	8.01%
GDP in 2010	USD66.03bn (est.) (purchasing power parity)
GDP - per capita (PPP)	USD1,600 (2010 est.) (Ethiopia: 1,000, Uganda: 1,300, Tanzania: 1,400, the Netherlands: 40,300)
GDP - real growth rate (est.)	5% in 2010, 2.6% in 2009, 1.6% in 2008
GDP - composition by sector in 2010	Agriculture 22%, Industry 16%, Services 62% (est.)
Currency	Kenyan shilling (KES); €1 = KES137; USD1 = KES101 (1 October 2011)
Literacy (age of 15 can read and write)	Total population: 85.1% (2003 est.)
Population below poverty line	50% (2000 est.)
Inflation (est.)	4% in 2010, 9.2% in 2009
Exports - commodities	Tea, horticultural products, coffee, petroleum products, fish, cement
Export - partners in 2009	UK 11.4%, Netherlands 9.9%, Uganda 9.2%, Tanzania 8.9%, US 6%, Egypt 4.3%
Main imports	Machinery and transportation equipment, petroleum products, motor vehicles, iron and steel, resins and plastics
Import - partners in 2009	India 12.5%, China 11.9%, UAE 9.1%, South Africa 8.1%, Saudi Arabia 6.4%, US 6.1%, Japan 5%
Source: CIA 2011.	

The politics of Kenya take place in a framework of a presidential representative democratic republic, whereby the President of Kenya is both head of state and head of government, and of a multi-party system. Executive power is exercised by the government, with powers shared between the President and a

Prime Minister, who coordinates and supervises the cabinet. Legislative power is vested in both the government and the National Assembly. The judiciary is independent of the executive and the legislature.¹

2.3 Natural environment

2.3.1 Geography

The geography of Kenya is diverse. Kenya has a coastline on the Indian Ocean, which contains swamps of East African mangroves. Inland are broad plains and numerous hills. Central and Western Kenya is characterised by the Great Rift Valley, home to three of Africa's highest mountains, Mount Kenya, Mount Elgon and Kilimanjaro. The Kakamega Forest in Western Kenya is a relic of an East African rainforest. Much larger is Mau Forest, the largest forest complex in East Africa.² Kenya is bounded by Tanzania in the south, Uganda in the west, Sudan and Ethiopia in the north and the Indian Ocean in the east. Kenya has a shoreline of approximately 640km. In the west it borders Lake Victoria. The lake has a shoreline of 4,828km and is divided among three countries: Kenya (6% or 4,100km²), Uganda (45% or 31,000km²) and Tanzania (49% or 33,700km²).³

Kenya exhibits greater extremes of altitude than any other African country except Tanzania, rising from sea level to 5,200m at Mt. Kenya (0°09'S/37°19'E), the highest point in the country. It stretches 1,062km from north to south, between latitudes 5°00'N and 4°40'S, and 891km from west to east between longitudes 33°58' and 40°55'E. Along the shores of the Indian Ocean the coastal plain, below 200m, widens from south to north. It reaches a minimum width of 21km just north of Mombasa (4°03'S/39°41'E) and a maximum width of 240km at Kiamboni on the Somalian border. To the west, the land surface rises to a plateau 500-1,000m above sea level (a.s.l.) in the north, and 1,000-1,500m a.s.l. in the central and southern districts. Numerous hilly ranges rise above the plateau in the north, the most important being the Huri (1,252m a.s.l.), Katigithigira (986m a.s.l.), Lapurr (1,481m a.s.l.), Loichangamatak (1,175m a.s.l.), Marsabit (1,702m a.s.l.), Mogila (1,694m a.s.l.), Murua Lokwana (1,701m a.s.l.), Pelekech (1,585m a.s.l.) and Songot (1,752m a.s.l.) Ranges. In the south, the Wundanyi Hills rise to 2,209m a.s.l. (3°23'S/38°18'E). In the

¹ http://en.wikipedia.org/wiki/Politics_of_Kenya

² http://en.wikipedia.org/wiki/Geography_of_Kenya

³ http://en.wikipedia.org/wiki/Lake_Victoria

central districts mountains rise much higher above the plateau, among them the isolated volcanic massif of Mt. Kenya (Hughes et al., 1992).

The Eastern or Gregory Rift Valley crosses the country sinuously, from Lake Natron in the south to Lake Turkana in the north, bisecting the interior plateau. There are mountains along the valley margins, and several important lakes lie on the valley floor in Central Kenya. On the eastern side of the valley the Aberdare Mountains rise to 3,999m a.s.l. at Mt. Lesatima (0°18'S/36°37'E), while on the western side, peaks reach 3,098m a.s.l. (0°45'S/36°06'E) on the Mau Escarpment and 3,370m a.s.l. (1°15'N/35°26'E) in the Cherangany Hills. West of the Rift Valley land slopes down to Lake Victoria with a water surface at 1,133m a.s.l. Mt. Elgon, 4,321m a.s.l., is another isolated volcanic massif, situated in central western Kenya on the Kenya/Uganda border (1°07'N/34°32'E) (Hughes et al., 1992).

2.3.2 Wetlands

Offshore the coast is fringed by coral reefs, and there are mangrove forests at several sites, notably in sheltered bays and estuaries. Many contain barren mud-flat areas, often with peripheral saltmarsh vegetation. Floodplains occur on many rivers, and there are permanent swamps on the shores of lakes, and in numerous depressions along rivers. There are several lakes, including the endorheic soda lakes of the Rift Valley and the part of Lake Victoria situated in Kenya. High-altitude bogs occur in the mountains (Hughes et al., 1992).

List of Wetlands as described by IUCN (Hughes et al., 1992):

1. Tidal Wetlands
2. The Lotikipi Plain
3. Riverine Swamps & Floodplains
 - a. The Tana River
 - b. The Athi/Tsavo/Galana System
 - c. The Ewaso Ngiro North
 - d. The Ewaso Ngiro South
 - e. South-western Rivers
4. Natural Lakes
 - a. Lake Victoria
 - b. Lake Amboseli
 - c. Lake Magadi
 - d. Lake Naivasha
 - e. Lake Elmenteita
 - f. Lake Nakuru

- g. Lake Bogoria
- h. Lake Baringo
- i. Lake Turkana
- 5. Isolated Swamps & Pans
- 6. Minor Lakes
- 7. Artificial Impoundments

2.3.3 Climate

Kenya's climate is influenced by its proximity to the equator, topography, the Indian Ocean, and the Inter-Tropical Convergence Zone (ITCZ) (National Environment Management Authority, 2005). Elevation is the major factor in temperature levels, while seasonal rainfall in Kenya is driven mainly by the migration of the ITCZ.

Temperature

The climate of Kenya varies by location, from mostly cool every day, to always warm or hot. The climate along the coast is tropical. This means rainfall and higher temperatures throughout the year. At the coastal city of Mombasa, the air changes from cool to hot almost daily. The further inside Kenya, the more arid the climate becomes. An arid climate is nearly devoid of rainfall, and the temperature swings widely according to the general time of the day or night. For many areas of Kenya, the daytime temperature rises about 12 °C almost every day.¹

Elevation is the main factor in temperature differences, with the higher areas, on average, some 11°C cooler, whether day or night. The many mile-high cities have temperature swings between roughly 10 and 26.1°C. Nairobi, at 1,798m, has a temperature ranging between 9.4 and 26.7 °C. At lower altitudes, the morning temperature is similar to the highland daytime high temperature. During the day, the temperature increases. Hence, the overnight low temperatures near sea level are nearly the same as the high temperatures of the elevated Kenyan highlands. However, locations along the Indian Ocean have more moderate temperatures, with temperatures a few degrees cooler in the daytime, such as at Mombasa.²

There are slight seasonal variations, with temperatures being some 4 °C cooler in the winter months. Although Kenya is centred at the equator, it shares the

¹ http://en.wikipedia.org/wiki/Geography_of_Kenya

² http://en.wikipedia.org/wiki/Geography_of_Kenya

seasons of the southern hemisphere: the warmest summer months are in February-March and the coolest winter months are in July-August, although the difference is only a few degrees.¹

Rainfall

Seasonal rainfall in Kenya is driven mainly by the migration of the ITCZ, a relatively narrow belt of very low pressure and heavy precipitation that forms near the earth's equator. The exact position of the ITCZ changes over the course of the year, migrating southwards through Kenya from October to December, and returning northwards in March, April and May. This results in two distinct wet periods - the 'short' rains from October to December and the 'long' rains from March to May. The amount of rainfall received in these seasons is generally 50 to 200mm per month but varies greatly, exceeding 300mm per month in some localities.² Rainfall between June and September never exceeds 25mm (Hughes et al., 1992). The onset, duration and intensity of the rainfall in the two wet periods vary considerably from year to year. The movements of the ITCZ are sensitive to variations in Indian Ocean sea-surface temperatures and vary from year to year. One of the most well-documented ocean influences on rainfall in this region is the El Niño Southern Oscillation. El Niño episodes usually cause greater than average rainfalls in the short rainfall season, whilst cold phases (La Niña) bring a drier than average season.³ The influence of the ITCZ is modified by the altitudinal differences, giving rise to varied climatic regimes. Annual rainfall in Kenya follows a strong bimodal seasonal pattern (National Environment Management Authority, 2005).

2.3.4 Agricultural land use and access to land

Land is the most important resource in Kenya. However, of the total area of 582,646km², only 17% is suitable for rainfed agriculture. About 2.2% of the arable land is covered by forest reserves. Arid and semi-arid lands (ASALs), comprising grassland and savannah rangelands, cover the remaining 82%. The rangelands are home to 85% of total wildlife population, and 14m people practising dry-land farming and pastoralism (Mwagore, 2000). Furthermore, subdivision of land has resulted in very small farm sizes.

¹ http://en.wikipedia.org/wiki/Geography_of_Kenya

² <http://country-profiles.geog.ox.ac.uk>

³ <http://country-profiles.geog.ox.ac.uk>

Kenya's agriculture is determined by factors such as climate, hydrology and terrain. Such agro-ecological factors also determine the suitability of an area for a particular land use. Agricultural potential can be classified into high, medium and low (see Table 2.2). Intensive cultivation is prevalent in the high-potential highlands, where rainfall is high and soils rich. The high- to medium-potential land is estimated at 5.3m ha (20% of total land in Kenya) and receives consistent rainfall of above 1,200mm annually. Kenya's main crops are maize, beans, potatoes and tea (AfDB, OECD and UNECA, 2011). A lot of pressure from the fast growing population is exerted on high- and medium-potential areas (Mwagore, 2000).

Table 2.2 Distribution of the agro-ecological potential in Kenya			
Agro-ecological zones	Potential land use	Area ('000' ha)	% of total land
I-III	Medium to high: agriculture, livestock (intensive), forestry and water catchment	8,600	15
IV-V	Marginal to medium: agriculture (drought- tolerant crops), forestry, livestock (ranching), and wildlife conservation	11,500	20
VI-VII	Marginal: livestock (extensive pastoralism) and wildlife conservation	37,400	65
Total		57,500	100
Source: KLA (2000).			

Approximately 59% of the soils in Kenya have moderate to high natural fertility, making them suitable for growing a large variety of crops. Productivity is curtailed because only 17% of the country receives an average rainfall of more than 800mm per annum - the minimum requirement for rainfed agriculture (see paragraph 2.3.3). The ASAL area, comprising agro-ecological zones IV to VII, is approximately 49m hectares (ha). It covers most parts of the northern, eastern, and southern margins of the central Kenya highlands. In some areas there are true desert conditions. The semi-arid area covers about 20% of the entire land area and is inhabited by 20% of the population. The arid area covering 60% of the total land is inhabited by 10% of the population. In the ASAL, incidences of crop failure are common. The predominant land use systems are ranching, wildlife conservation and pastoralism (Mwagore, 2000).

Kenya's rapid population growth (see paragraph 2.5) and sub-division of land along inheritance lines has resulted in very small farm sizes. Furthermore, in densely populated regions, there is now major concern that land may have become too scarce to make any meaningful contribution to household incomes. This land scarcity suggests that agricultural activities may not remain the only, or even the main, source of income and therefore rural households may not climb out of poverty through growth in land productivity alone (Karugia et al., 2006).

2.3.5 Water resources

The average annual available water is estimated at 20.2bn m³, distributed within five drainage areas (Lake Victoria Basin; Rift Valley Basin; Athi River Basin; Tana River basin and Ewaso Ng'iro North Basin). For an estimated population of 33m people in 2004, the average water availability is 612 m³ per person per year. Kenya is therefore classified as a water scarce country. A country is categorised as 'water scarce' if its renewable freshwater supplies are less than 1,000m³ per capita per annum. Arising from the uneven distribution of water resources in space and time and with the increase in the frequency of extreme weather events, Kenya suffers water scarcity. Water resources are not only scarce, but also vulnerable to depletion while the country's socio-economic development is highly dependent on water (WWAP, 2006) and Kenya has a limited natural endowment of fresh water. In addition, there are the growing needs of an increasing population as well as a serious degradation of water resources. Furthermore, Kenya is highly vulnerable to rainfall variability, droughts are now endemic - severely affecting the northern and eastern areas - and floods occur quite frequently. Demand is high and growing rapidly in many sectors of the economy. The growing population (see paragraph 2.5) increases the demand for water for domestic use, food security and hydropower to the point where the needs are outstripping supply (WWAP, 2006).

Kenya's water scarcity makes orderly economic and social development, which depends on reliable water resources, more difficult to achieve. Water is important for food production, hydropower generation (65-70% of electricity), manufacturing, fisheries and livestock, tourism as well as basic human health and wellbeing. Sustainable utilisation, development and management of water resources therefore fundamentally underpin the achievement of long-term socio-economic and economic goals (WWAP, 2006).

2.4 Physical infrastructure

Kenya's population and agricultural activity are heavily concentrated in the southern half of the country, along the corridor linking Mombasa to Nairobi and then on to Kisumu and into Uganda. Kenya's infrastructure backbones - including the country's principal road artery and its major power transmission and fibre optic backbones - have followed this route. The northern half of the country, by contrast, is sparsely populated and characterised by fragmentary infrastructure coverage. Kenya's infrastructure networks are largely isolated from those of its neighbouring countries. While there are some transport links with Uganda and Sudan, road connections with Ethiopia, Tanzania, and Somalia are of very low quality, while power and ICT backbones are not yet integrated across frontiers (AICD, 2010).

The main achievements and challenges in each of Kenya's major infrastructure sectors, with the key findings, are summarised in table 2.3.

Table 2.3	Achievements and challenges in Kenya's infrastructure sectors	
	Achievements	Challenges
Air transport	Leading regional airline Major air hub for Africa	Relieve capacity constraints at Jomo Kenyatta International Airport Achieve U.S. Category 1 security clearance
ICT	Major institutional reforms Very high GSM coverage	Strengthen competition to bring down prices Ensure competitive international gateway
Ports	Major regional shipping hub	Substantial investment to ease capacity issues Institutional reforms to increase efficiency
Power	Major institutional reforms Cost-recovery pricing Large efficiency gains by KPLC	Improve reliability through new investment Bring down costs of power supply
Railways	Strategic regional rail corridor	Revisit design of rail concession
Roads	Sound road fund in place	Major rehabilitation backlog Improve quality of public investment

Table 2.3 Achievements and challenges in Kenya's infrastructure sectors (continued)		
	Achievements	Challenges
Urban infrastructure		Very low levels of access to services High rates of tenancy and insecure tenure
Water resources	Water-resources management authority in place	Increase water storage capacity Increase irrigated area by 50% Strengthen WRM and river-basin institutions
Water and sanitation	Major institutional reforms	Address under-pricing of water Cut distribution losses
Source: AICD (2010).		

2.4.1 Roads

The length of the trunk network is more than adequate. Even if Kenya's road density indicators look relatively low by some standards, the trunk network provides basic regional and national connectivity, linking the capital to the coast, to international border crossings, and to provincial capitals in the interior (AICD, 2010). Beyond the trunk network, accessibility falls off. About 30% of Kenya's population lives within two kilometres of an all-weather road - well above the benchmark for low-income countries, but only half the level found in middle-income countries (AICD, 2010).

2.4.2 Rail

Kenya's rail corridor is of strategic importance to the region. Linking the port of Mombasa to Nairobi and continuing onward into Uganda, it is a key conduit for bulk freight, easing pressure and providing additional capacity along the northern corridor. Owing to deterioration of the infrastructure, freight traffic on the rail corridor has declined to less than 1m tonnes per year and handles less than 6% of the cargo passing through the northern corridor that links Kenya, Uganda, Rwanda, Burundi, the Democratic Republic of Congo, parts of Tanzania, southern Sudan, and Ethiopia (AICD, 2010).

2.4.3 Ports

Mombasa is one of the largest and busiest ports in Africa. With almost 0.5m TEUs (20-foot equivalent units) and 3.7m tonnes of cargo handled each year, Mombasa is the second-largest port in Sub-Saharan Africa after Durban in terms of tonnage and containers handled. With Dar Es Salaam, it is one of the key trading centres for the East Africa region. The port is also a natural transshipment centre for East Africa, with 27,288 TEUs of inbound transshipment and approximately the same amount outbound per year. However, Mombasa is straining to maintain that role because of significant capacity constraints. In terms of performance indicators, Mombasa fares relatively well compared with other ports in eastern and southern Africa. However, its container crane productivity, at 10 containers per hour, is far behind Dar Es Salaam (20) and Durban (15) (AICD, 2010).

2.4.4 Air transport

Kenya is a regional leader in air transportation. Kenya Airways is one of Africa's top three international carriers, with an extensive network across the continent and a safety record up to international standards. The success of the company is in large measure due to an innovative public-private partnership with a strategic investor - KLM - which has a minority stake in the company but is nonetheless fully responsible for management. Linked to the ascendancy of the national airline, Jomo Kenyatta International Airport in Nairobi has become one of the three main international gateways in Sub-Saharan Africa. Beyond its role as an international hub, Kenya has a domestic air transport market that is the fourth-largest in Sub-Saharan Africa (following South Africa, Nigeria, and Mozambique) (AICD, 2010). In total, Kenya has 230 airports, including 21 that are paved.¹

2.4.5 Telecommunications²

In 1999, the Communications Commission of Kenya was established to regulate telecommunications and radio communications in the country. In recent years, the telecommunications sector has become one of the vibrant facets of the economy of Kenya. The country's telecommunications sector has witnessed an

¹ www.nationsencyclopedia.com/economies/Africa/Kenya-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html

² www.nationsencyclopedia.com/economies/Africa/Kenya-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html

exponential growth since it was liberalised about a decade ago. Kenya has made tremendous progress in expanding its GSM network. The country has achieved one of the highest rates of GSM coverage in Africa. Over 90% of the Kenya's population lives within range of a GSM signal. This is one of the highest rates in Africa. It is likely that another 7% could be profitably served by private operators. Prices for ICT services in Kenya remain relatively high. Charges for fixed-line, mobile, and international calling, and for Internet access, are significantly higher in Kenya than in comparable African countries.

2.4.6 Electricity

Kenya Electricity Generating Company Limited (KenGen) is the leading electric power generation company in Kenya, producing about 80% of electricity consumed in the country. The rest is either supplied by independent power producers or imported from neighbouring Uganda. The company utilises various sources to generate electricity ranging from hydro, geothermal, thermal and wind. Hydroelectricity is the leading source, with an installed capacity of 766.88 MW, which is 64.9% of the company's installed capacity. Since 82.74% of the power supply comes from hydroelectricity, power outages and blackouts have become increasingly common as a result of chronic drought. In 1999-2000, Kenya experienced its worst drought in 40 years, a development that forced the Kenya Power and Lighting Company (KPLC) to introduce an emergency rationing programme in July 2000, under which electricity supplies have been cut off for 12 hours a day. Adding further to the problem, hydro equipment tends to be outdated and poorly maintained. Consequently, the government is eager to further develop both thermal and geothermal sources of power. In 1998, total electricity production in Kenya equalled 4.23bn kWh. Only 8% of the Kenyan population is connected to the national grid. Kenya has no proven hydrocarbon reserves and imports all its crude petroleum requirements from the Middle East. Upwards of 25% of the national import bill is attributable to petroleum imports.¹

Institutional reforms have led to efficiency gains of 1% of GDP. Kenya's power sector has gone through a number of important institutional reforms in recent years. The national power utility was unbundled into a generation and transmission utility (KenGen) and a distribution utility (KPLC). Since the early 2000s, the hidden costs associated with the distribution utility - in the form of under-pricing, collection losses, and distribution losses - were as large as 1.4% of GDP. In the

¹ www.nationsencyclopedia.com/economies/Africa/Kenya-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html

run-up to the adoption of a management contract, revenue collection improved substantially - from 81% in 2004 to 100% in 2006. Distribution losses also began to fall, though more gradually, reflecting the greater difficulty they present. Power-pricing reforms also allowed tariffs to rise in line with escalating costs, from USD0.07 per kWh in 2000 to USD0.15 in 2006 and to USD0.20 cents in 2008. In 2011, the statistics bureau reported that the cost of consuming 50 units of electricity increased by about 10% to KES721 in September from 657.5 in July.¹ As a result of these measures, the hidden costs of the power sector had fallen from 1.4% of GDP in 2001 to 0.4% of GDP in 2006 and were largely eliminated by 2008, reaching one of the lowest levels in Africa (AICD, 2010). Challenges are to improve reliability and bring down costs of power supply (see Table 2.3).

2.5 Demographic change

In 2011 Kenya's population was estimated at approximately 41m people (CIA, 2011). Currently over 70% of the population is under 30 years old (Republic of Kenya - EC, 2007).

Kenya's population is growing fast, increasingly so in cities. It has doubled over the last twenty-five years and rapid population growth is set to continue over the next forty years. As of 2011, Kenya's population growth rate is estimated at 2.462% per year. As a result, each year the country gains some 1m new citizens. At this rate, Kenya's population will reach about 63m by 2030 and 85m by 2050 (World Bank, 2011). This demographic transition will be accompanied by a geographic transformation. First, countries with larger populations tend to have larger cities. Second, urbanisation and the type of demographic transformation experienced by Kenya reinforce each other: fertility tends to be lower in urban areas, and for young people with no or few children it is easier to migrate from rural to urban areas (World Bank, 2011a).

Kenya is still a predominantly rural country but is urbanising rapidly. Seven out of ten Kenyans live in rural areas. Agriculture remains a key contributor to growth and employs more than a third of adults. At the same time, the country is urbanising rapidly. Every year, some 250,000 Kenyans move to cities and formerly rural areas become increasingly urban. Twenty years ago, Kenya's urbanisation level was only 18%. By 2020, 40% of Kenyans will live in cities and, in 2033, Kenya will reach another tipping point because half of its population will

¹ www.standardmedia.co.ke/education/InsidePage.php?id=2000043766&cid=4&

then be living in urban areas (World Bank, 2011a). Today, some 30% of Kenyans already live in urban areas. This is slightly above the East African Community (EAC) average, but below the average for Sub-Saharan Africa (40%) and the world (50%). Globally, urbanisation, and GDP are strongly correlated, and based on this relationship alone, one would expect a country with Kenya's income per capita level to have an urbanisation level of 35% (World Bank, 2011a).

2.6 Poverty

In 2010, Kenya's labour force was estimated at 17.9m with an unemployment rate of 40% (2008 est.).¹ In 2009, the proportion of the population living below the poverty line was estimated at 47% (World Bank, 2011b).

The average Gross National Income per capita in Kenya in 2009 was USD760 (World Bank, 2011b). Social inequality in Kenya is significant. Recent studies rank Kenya among the top ten most unequal countries in the world and the fifth in Africa (Ministry of Foreign Affairs of Denmark, 2006). Inequalities in Kenya are manifested in various forms. Differences in share of income and social services are observed across regions, genders and even specific segments of the population. The country's top 10% of households controls 43% of the total income, while the bottom 10% controls 1%. Three-quarters of the poor live in rural areas, but urban poverty is increasing with the growth of informal settlements with little or no access to public services. There is scarcity of arable land in Kenya, where 80% of the country is classified as arid and semi-arid land (ASAL). These areas support 25% of the population. The low level of productivity is aggravated by poor cultivation practices, leading to soil and environmental deterioration, and by land tenure and land subdivision, with plots being too small for subsistence farming. The supply of water is inadequate in relation to the needs of humans, livestock, crops and wildlife (Ministry of Foreign Affairs of Denmark, 2006).

More women suffer from poverty than men. In general, female-headed households are worse off than male-headed households; women's participation in decision-making remains far below that of men; female illiteracy is almost twice that of males; and violence against women remains widespread. Cultural and traditional practices restrain women's access to economic resources, including land, despite the fact that 69% of the active female population work as subsistence farmers. Women in the ASAL spend much of their time fetching wa-

¹ <https://www.cia.gov/library/publications/the-world-factbook/geos/ke.html>

ter and fuel. Other groups vulnerable to poverty include the landless, pastoralists, urban slum dwellers, orphans, unemployed youth, victims of HIV/AIDS and people with disabilities (Ministry of Foreign Affairs of Denmark, 2006).

HIV/AIDS has been declared a 'national disaster' by the Kenyan government. Although the national HIV prevalence is difficult to ascertain because of poor data, it is estimated to be around 6.7% (2003) of the population. Currently, AIDS-related deaths represent about 40% of total mortality and 1.5m Kenyans have already died from AIDS. There are 1.2m HIV/AIDS orphans in Kenya (Ministry of Foreign Affairs of Denmark, 2006).

2.7 Food security

2.7.1 Rural food insecurity

The national Long Rains Assessment estimates that 3.75m people in pastoral and marginal cropping lowlands are food insecure in Kenya. Of most concern are the 1.4m pastoralists at Emergency levels (IPC Phase 4) in the north and north-eastern districts. Kenya uses the Integrated Food Security Phase Classification (IPC) tool as the classification system for the bi-annual food security assessment (i.e. national Long and Short Rains Assessments).¹ Improvements to Crisis levels (IPC Phase 3) are likely following the onset of the short rains in October and continuation of relief interventions. However, households remain extremely vulnerable to additional shocks as the severe drought has compromised pastoral assets (USAID, 2011).

Pastoral conditions continue to deteriorate as the lean season progresses, following less than 10% of normal rains during the 2011 long-rains season and less than 20% of normal short rains in 2010. Livestock mortalities are worsening due to extreme water scarcity and upsurges in livestock disease. Sedentary household members (women, elderly and children) are most affected because milking herds at homesteads are largely unproductive. In addition, food supply at the household level is severely constrained by deteriorating pastoral terms of trade as livestock body conditions decline, while cereal prices are up to 100% above the five-year average. Emergency levels of food insecurity are exhibited in extremely high levels of child malnutrition, with global acute malnutrition prevalence of over 30% in some parts of Turkana, Marsabit, Mandera, and Wajir (USAID, 2011).

¹ www.ipcinfo.org/index.php

However, improvements to Crisis levels are expected following anticipated normal to above-normal rains in pastoral areas beginning in October. With the rains, livestock that migrated earlier in the year are expected to return to areas of origin in late October. Kidding, lambing and calving from herds in migration, though at below-normal levels, will nonetheless increase milk availability. Furthermore, the rapid decline in maize prices in September in key markets is likely to be transmitted to pastoral markets from October through the end of January (USAID, 2011).

The expected improvements through December may be short-lived given that the underlying environmental conditions remain, and most livestock require several good seasons to consolidate the recovery process. Although animals typically migrate to dry-season grazing areas during the January-March dry spell, most animals will not be strong enough to cope with renewed lengthy migrations. The agro-ecology in many areas has been devastated by over-utilisation of graze, browse, and water, and regeneration of resources will be slow. Most middle and higher income pastoralists will focus on restocking, increasing livestock prices. Poorer households, many of whom have little or no livestock left, will not have resources to restock, and will largely depend on humanitarian assistance and petty trade (USAID, 2011).

2.7.2 Urban food insecurity

The Kenya Food Security Steering Group (KFSSG) carried a detailed household survey in high population density urban centres across all livelihoods. Across the country, an estimated 3,900 households were interviewed and 5,180 children surveyed, to establish the characteristics of urban food insecurity and nutrition. One-third of Kenya's 38.6m people live in urban areas, out of which 40% reside in slums. Preliminary results from the baseline survey were telling - rising food insecurity was precipitated by several factors, including rapid and rising urbanisation - the current population in urban centres is eight times what it was at independence; a high dependence ratio, such that dependents exceed the wage earners; unpredictable rise in food and non-food prices; insecurity; and growing unemployment (KFSSG, 2011).

In spite of deteriorating food security and income indicators in high population density urban centres, urban migration is rising steadily. The rise is attributed to declining land holdings in rural areas coupled with significant disparities in development and income earning opportunities. The survey outcomes indicated that up to 45% of slum dwellers had no access to safe drinking water, while sanitation coverage was less than 40%. In addition, close to 50% of

overall household income was allocated to food purchases, a clear indication of heightened vulnerability due to volatility in food prices, amidst unstable labour opportunities. A large proportion of urban dwellers were unable to meet food needs on a sustained basis over an extended period, adopting instead detrimental coping strategies such as increased child labour, skipping meals and foregoing non-food expenditures, so as to bridge significant deficits (KFSSG, 2011).

2.8 Education

Formal schooling in Kenya consists of eight years of primary education, four years of secondary education and four years of university education, referred to as the 8-4-4 system. Basic education is defined as 12 years of primary and secondary education. According to the draft *Sessional Paper No. 1 of 2005 on a Policy Framework for Education, Training and Research: Meeting the Challenges of Education, Training and Research in Kenya in the 21st Century* the Government is trying to include ECD for ages 4+ and 5+ as part of basic education. Since 2003, primary education has been free but not compulsory. Children are expected to start formal schooling at age 6+. In addition to higher education offering bachelors, masters and doctoral degrees, other types of post-secondary education programmes include technical education and professional training at diploma and certificate levels (UNESCO, 2005).

Parallel to the formal system are non-formal education programmes catering for disadvantaged populations in arid and semi-arid regions and urban slums. Programmes teaching literacy, vocational and other skills are provided by NGOs, religious organisations and local communities. However, after the introduction of the Free Primary Education (FPE) policy, the Ministry of Education (MOEST) began providing some financial support to non-formal schools offering the national primary education curriculum under the 8-4-4 system (UNESCO, 2005).

Kenya's adult literacy rate (for ages 15+ and over) of 84.5% is slightly higher than the world average of 77.5%. However, there is considerable regional disparity: Central Province has the highest literacy rate of 83.9% compared with 62.8% in Coast Province, the lowest in Kenya in 2000 (UNESCO, 2005). The gross enrolment ratio (GER) in pre-primary education in Kenya was about 40% in 2001, superior to the median of developing (35%) and sub-Saharan African (5.8%) countries. Kenya's net enrolment ratio (NER) in primary education stood at 70% in 2001, lower than the weighted average of 83% for developing coun-

tries. Its NER in secondary education was 24% in 2001, which was below the weighted average of 48.5% for developing countries. Internal efficiency in secondary education is not a major problem, but enrolment is (UNESCO, 2005).

2.9 Economy

The macroeconomic performance of the Kenyan economy improved significantly in 2010 compared with 2009. While the economy grew by 2.6% in 2009, it is estimated that the growth rate of gross domestic product (GDP) nearly doubled to reach 5.0% in 2010. The increase in growth can be attributed to the good rainfall during 2010 and higher prices for Kenyan exports on world markets. The abundance of agricultural output, coupled with increased competition in some key services, helped contain inflation in 2010 (AfDB, OECD and UNECA, 2011).

In 2010, Kenya's economic performance continued on a positive trajectory as it recovered from past internal and external shocks. The post-election violence, drought and food and financial crises had led to a slowdown of Kenya's normally strong economic growth. Between 2004 and 2007, the country had registered growth rates between 5.1 and 7.1%. The 2010 referendum on the constitution has now been held in a peaceful and transparent manner. A new constitution was adopted in August 2010. Favourable weather conditions since November 2009, in particular good rainfall, have enabled Kenya to secure reliable energy supplies and to increase agricultural output. In 2010, Kenya also benefited from the global economic recovery as well as higher prices for its exports. The agriculture and manufacturing sectors became Kenya's new growth drivers after two years of weak performances (AfDB, OECD and UNECA, 2011).

2.9.1 Agriculture

The rebound of agriculture, coupled with increased competition in some key services, helped contain inflation in 2010. High growth can also be attributed to increased public investment under the Economic Stimulus Programme (ESP) implemented by the government at the end of 2009. Large investments were undertaken in key sectors of the economy, namely agriculture, infrastructure, services, and health and education. Improved and well-distributed rains starting in November 2009 and continuing into 2010 contributed to the recovery of the agricultural sector. The sector had started to recover in 2009 with the margin of decline improving from -4.1% in 2008 to -2.6%. In the third quarter of 2010, the sector continued its recovery, expanding by 6.8% compared with a contrac-

tion of 3.4% in the corresponding quarter of 2009. Despite the increase in the first three quarters of 2010, agricultural output still has not reached the pre-crisis growth levels recorded in 2007 (AfDB, OECD and UNECA, 2011).

Kenya's main crops, namely maize, beans, potatoes and tea, recorded significant increases in production in 2010. However, horticultural products, coffee and sugarcane recorded lower levels of output and export in 2010 compared with 2009. Flight cancellations due to the volcanic eruption in Iceland, insufficient rainfall and depressed demand from Kenya's traditional flower markets aggravated by the global economic recession are among the main challenges faced by Kenya's horticulture exports in 2010. As a result, horticultural exports grew only marginally, by 3.7%, while horticultural production increased by 5.7% (AfDB, OECD and UNECA, 2011).

2.9.2 Tourism

Tourism has suffered since the December 2007 post-election violence and has yet to achieve its pre-violence performance. In 2010, however, tourism did experience significant gains. According to government estimates, Kenya will have received 1.2m tourists in 2010, and earnings should exceed KES100bn. Even though the number of tourist arrivals in 2010 is still below those in 2007/08, confidence is gradually being restored and the Kenya Tourism Board (KTB) has mounted intensive marketing campaigns in European and Asian markets (AfDB, OECD and UNECA, 2011).

2.9.3 Manufacturing

Kenya's manufacturing sector contributed significantly to total output and export earnings in 2010 and has a strong potential to create employment. It is dominated by food processing. The post-election crisis had strongly impacted the manufacturing sector - it recorded a dismal growth of 3.6% in 2008 and further plummeted to 2% in 2009. These negative results were mainly attributed to the high cost of production, competition from cheap imports, high taxes and minimal credit financing. More stable energy supplies enabled the sector to rebound in 2010. It grew by 7.8% in the third quarter of 2010 compared with a decline of 0.5 percentage points in the previous year (AfDB, OECD and UNECA, 2011).

Growth in manufacturing was mainly attributed to the strong expansion of food manufacturing, beverages and tobacco which increased by 12% in the third quarter of 2010 compared with a decline of 1% over the same period in 2009. Cement production increased by 11.4% between 2009 and 2010. In ad-

dition, an expanding informal sector is engaged in small-scale manufacturing of household goods, motor-vehicle parts, and farm tools (AfDB, OECD and UNECA, 2011).

2.9.4 Outlook

The outlook for 2011 is promising and a combination of trends could contribute to ensure positive prospects in the short to medium term. The approval of the constitution continued investment in infrastructure and government policies targeting development in the private sector should all enhance Kenya's business environment and reinforce a dynamic private sector. Second, deepening regional integration and the launch of the East African Community common market are creating a single trading and investment environment in which Kenyan firms have access to a larger market. Last, prudent monetary and fiscal policy is expected to reduce inflation and keep interest rates low, creating a credible and stable macroeconomic environment. Given these prospects, the Kenyan economy is forecast to grow by 5.3% in 2011 and 5.5% in 2012 (AfDB, OECD and UNECA, 2011).

This positive outlook may however be subject to two main challenges. First, Kenya will need to reduce its high reliance on agricultural outputs to limit its vulnerability to climate hazards by diversifying the economy. Second, Kenya may be vulnerable to another political shock as it faces 2012 elections. Contributing further to the uncertainty weighing on the political environment is the indictment of six high-level Kenyan officials - including the current finance minister and deputy prime minister - by the International Criminal Court for alleged crimes connected to the 2007 post-election violence (AfDB, OECD and UNECA, 2011).

In September 2011, the Kenya National Bureau of Statistics said that on a year-on-year basis, east Africa's biggest economy grew a revised 4.8% in the first three months of the year, down from an earlier estimate of 4.9%. High energy costs arising from soaring crude oil and electricity prices coupled with high inflationary expectations curtailed growth of some sectors of the economy. Despite the lower than usual rainfall, agriculture and forestry realised a significant growth of 5.2 per cent during the quarter compared with a growth of 3.0% in the same quarter 2010, mainly driven by horticultural exports.¹

¹ www.standardmedia.co.ke/InsidePage.php?id=2000043766&catid=4&a=1

2.10 Macroeconomic policies

2.10.1 Fiscal policy

The Kenyan government is committed to pursuing prudent fiscal policies over the medium term, focusing on strong revenue collection underpinned by deepening tax administration reforms and modernisation. It plans to contain the growth of total expenditures, thus creating the fiscal space to shift resources from recurrent to capital expenditures. In particular, the government plans to shift resources significantly towards Vision 2030 priority economic and social sectors, and to contain the growth of domestic debt to sustainable levels so as to ensure that private-sector borrowing is not crowded out (AfDB, OECD, 2008).

In 2010, the Kenyan government continued to implement its Economic Stimulus Programme (ESP), funding public projects in agriculture, services, infrastructure, health and education as well as various community-based initiatives through the Constituency Development Fund and Group funds. To mitigate the impact of multiple shocks, the government eased its macroeconomic policies. The deficit of the primary balance increased from 3% of GDP for the fiscal year 2008/09 to 3.2% in 2009/10. It is expected to deteriorate further down to a deficit of 4.1% of GDP for fiscal year 2010/11. The overall deficit also grew from 5.4% of GDP in 2008/09 to 5.8% in 2009/10 and is forecast to increase to 6.8% in 2010/11 (AfDB, OECD and UNECA, 2011).

2.10.2 Monetary policy

In 2010 the Central Bank of Kenya (CBK) implemented a flexible monetary policy. It aimed to keep inflation low by setting an inflation target of 5%, ensuring stable long-term interest rates and competitive exchange rates. It supported the economic activity by facilitating the private sector access to credit. The CBK has cut the Central Bank Rate (CBR) four times, amounting to a total reduction of 100 basis points in 2010, from 7% in January to 6% in July 2010. In addition, the CBK reduced the Cash Reserve Ratio from 6 to 5% in the first half of 2010 (AfDB, OECD and UNECA, 2011).

By implementing these measures, the government expects to revive lending and stimulate the economy through increased consumer consumption. This monetary stimulus has been successful and resulted in increased access to credit for the private sector as well as recovered consumption growth. The credit allocated to the private sector grew dramatically, registering a 17% increase in the first half of 2010. The major part of this growing credit was cap-

tured by credit to households, which grew by 30% over the same period (AfDB, OECD and UNECA, 2011).

In September 2011, the Kenya National Bureau of Statistics said that Kenya's year-on-year inflation rate rose for the 11th month in a row in September to 17.32% from 16.67% in August, driven by higher energy and food prices.¹ The overall year-on-year rate of food inflation stood at 24.37%. Transport costs have also surged, to record a year-on-year rise of 24.77% in September. A weak shilling has been hurting the balance of payments, which means import costs, particularly those that are energy related, are likely to continue increasing. The central bank has said it expects the year-on-year inflation rate to slow to 7.5% by the end of 2011, arguing that the rising food and fuel costs are due to external factors, which are likely to ease.²

2.10.3 External position

The main exports in the first half of 2010 were tea (23.6%), horticulture (14.5%), manufactured goods (12%), raw materials (4.4%), coffee (3.9%) and oil products (2.2%). Improved commodity prices in the international markets and growing domestic production led to an increase in the value of merchandise exports of 8.4% between August 2009 and August 2010. This increase was mainly attributed to tea exports whose value increased by 37.5%. Over the same period, receipts from other exports also increased. Horticultural exports increased from USD673m to USD709m. Oil products exports increased by 21.7% from USD91m in August 2009 to USD110m in August 2010 (AfDB, OECD and UNECA, 2011).

Almost half (46%) of Kenya's exports for the year up to August 2010 went to African countries. The main destinations for exports were Uganda (12.4%), Tanzania (8.4%), Egypt (4.5%) and Sudan (4.3%). Outside Africa, Kenya mainly exported to the United Kingdom (UK) (10.7%), the Netherlands (6.9%), the United States (US) (4.5%), Pakistan (4.5%), and United Arab Emirates (UAE) (4.4%) (AfDB, OECD and UNECA, 2011).

The main sources of foreign direct investment (FDI) were Australia (KES16bn), Israel (KES4bn), the UK (KES738m) and India (KES434.3m). On external grants, commitments amounting to KES40.4bn have been received for the fiscal year 2010/11. Remittances flows for 2010 are estimated at USD642m, from USD609m in 2009. These flows to Kenya are a critical source

¹ www.standardmedia.co.ke/InsidePage.php?id=2000043766&catid=4&a=1

² www.standardmedia.co.ke/InsidePage.php?id=2000043766&catid=4&a=1

of foreign currency, even if the remittances are mostly used to pay for daily needs (AfDB, OECD and UNECA, 2011).

2.11 Business climate

2.11.1 Ease of doing business

According to *Doing Business 2011: Making a Difference for Entrepreneurs*, an annual report published by IFC and the World Bank, Kenya ranks 98 out of 183 economies. Out of other countries that are part of the East African Community (EAC), Kenya ranks 2nd after Rwanda (see Table 2.4).

Table 2.4 How Kenya ranks within the East African Community in 2011		
Country	Global rank	EAC rank
Rwanda	58	1
Kenya	98	2
Uganda	122	3
Tanzania	128	4
Burundi	181	5
Source: World bank (2011); Ranking out of 183 economies: 1= best and 183 is the worst performer.		

Table 2.5 Selected business indicators in the East African Community in 2011					
Doing Business 2011	Burundi	Kenya	Rwanda	Tanzania	Uganda
Ease of Doing Business	181	98	58	128	122
Starting a Business	135	125	9	122	137
Dealing with Construction Permits	175	35	82	179	133
Registering Property	115	129	41	151	150
Getting Credit	168	6	32	89	46
Protecting Investors	154	93	28	93	132
Paying Taxes	141	162	43	120	62
Trading Across Borders	176	144	159	109	148
Enforcing Contracts	171	125	39	32	113
Closing a Business	183	85	183	113	56
Source: World Bank (2011); Ranking out of 183 economies: 1= best and 183 is the worst performer.					

Table 2.4 provides some more detailed information on doing business in Kenya and other EAC countries. In 2011 Kenya's rank is lower compared with 2010, when it ranked 94. The overall score has slightly declined this year, reflecting lower scores for five indicators. Improvements are made on the indicators 'Employing workers', and 'Paying taxes'. However, 'Starting a business', 'Registering Property', 'Paying taxes' and 'Getting credit' did not improve and stayed at the same level.¹

2.11.2 Business constraints

Although Kenya has recorded some improvements in the past four years, including an increase in productivity, Kenyan firms still face an adverse business environment. In fact, the total losses incurred by businesses because of power outages, theft and breakage during transport, payments of bribes, and protection payments are much higher than total losses experienced by the middle-income countries in Africa and by China and India. The top constraints identified by the Kenyan managers were tax rates, access to finance, corruption, security, infrastructure services (electricity and transportation), and business licensing (Iarossi, 2009). Table 2.6 shows a full list of business constraints. According to the latest Enterprise Surveys (World Bank & IFC, 2007), the top three constraints to investment in Kenya include Tax Rates, Access to Finance and Practices of the Informal Sector.²

¹ www.doingbusiness.org/data/exploreeconomies/kenya

² <http://rru.worldbank.org/besnapshots/BecpProfilePDF.aspx?economy=kenya>

Table 2.6 Ranking and Rating of Business Constraints in Kenya (% of firms)			
Indicator	Ranking	Indicator	Rating
Tax rates	54	Tax rates	58
Access to finance (availability and cost)	33	Access to finance (availability and cost)	42
Corruption	31	Practices of competitors in informal sector	41
Practices of competitors in informal sector	26	Corruption	38
Crime, theft, and disorder	25	Crime, theft, and disorder	33
Transportation	24	Tax administration	32
Electricity	23	Transportation	31
Business licensing and permits	20	Business licensing and permits	28
Tax administration	15	Electricity	28
Macroeconomic instability	11	Customs and trade regulations	24
Telecommunications	10	Macroeconomic instability	19
Customs and trade regulations	7	Telecommunications	16
Access to land	4	Regulations on pricing and mark-ups	15
Regulations on pricing and mark-ups	4	Functioning of the courts	13
Political instability	3	Political instability	10
Inadequately educated workforce	2	Access to land	7
Functioning of the courts	2	Labour regulations	4
Labour regulations	2	Hours of operation	3
Zoning	3	Inadequately educated workforce	3
Source: Iarossi (2009).			

Negative perceptions vary across sector of activity as well as firm characteristics. Both manufacturing and retail complain about tax rates; the manufacturing sector also complains about transportation and electricity, and the retail sector complains about access to finance. A larger share of small firms (compared with medium and large firms) perceived tax rate, access to finance, and practices of competitors in the informal sector to be severe constraints. Similar-

ly, more firms outside Nairobi indicated these three constraints as binding compared with those in Nairobi. Finally, the share of non-exporters complaining about tax rate and access to finance is higher than that of exporters (Iarossi, 2009).

2.11.3 Foreign business start-up

With no additional procedures specifically required of foreigners, it takes as long to establish a domestic enterprise as a foreign-owned limited liability company (LLC) in Kenya (Nairobi). This process (34 days and 12 procedures) is faster than both the regional average for the IAB countries in Sub-Saharan Africa and the global IAB average. In addition, obtaining an Investment Certificate from the Kenya Investment Authority (for investments of USD100,000 and more) helps speed up the administrative start-up procedures, including the provision of various work permits. The Investment Certificate is valid for a 12-month period and consolidates the requisite health, safety, and environment licences into one. During this period, the foreign investor is permitted to begin operations and apply for all the general and sector-specific licences. The Advocates Act requires that an advocate of the High Court of Kenya prepare and submit the incorporation documentation. There is no minimum capital requirement and investors are allowed to hold foreign currency bank accounts.¹

2.11.4 Access to industrial land

In Nairobi, the process of leasing land is governed by several laws that deal with the registration and disposition of interests in land. Only companies that are 100% domestically owned can acquire land controlled under the Land Control Act, such as agricultural land. Nonetheless, foreign companies seeking to access land in Kenya have the option to lease or buy land from private and public landholders. Commercial leases cannot be issued for a period of less than 5 years and lease contracts can be as long as 999 years. Lease contracts can offer the lessee the right to subdivide, sublease, and mortgage the leased land. Land-related information can be found in the land registry and cadastre, which are located in different agencies and are not linked or coordinated to share data. Most of the relevant data related to land is available, in principle, but it may

¹ <http://rru.worldbank.org/besnapshots/BecpProfilePDF.aspx?economy=kenya>

be a time-consuming process to obtain the information, as it requires dealing with several different authorities.¹

2.11.5 Foreign ownership issues across sectors

Among the countries in Sub-Saharan Africa covered by the report, Kenya restricts foreign ownership in more sectors than most other economies. Foreign capital participation in telecommunications is limited to a maximum of 70%. However, the law provides foreign investors with a grace period of 3 years to build up the required domestic capital contribution of 30%. In the transportation sector, there are ownership restrictions in railway freight, port and airport operation, in which foreign investment is allowed only up to 50%. On the other hand, unlike in most other countries covered by the Investing across Sectors indicators, domestic as well as international passenger air transportation is fully open to foreign capital participation. The tourism sector, one of the country's most prosperous industries, is fully open to foreign companies as well, as are other manufacturing and primary sectors.²

2.11.6 Commercial dispute arbitration

Kenya's Arbitration Act (1996) is closely based on the UNCITRAL Model Law. The Act applies to domestic and international arbitration, and there is no difference in treatment between the 2 arbitration regimes. Additional provisions regulating arbitration are found in Chapter 21 of Kenya's Civil Procedure Act (2009) and in its Civil Procedure Rules. Kenya has 2 principal arbitral institutions: the Chartered Institute of Arbitrators and the Dispute Resolution Centre (Nairobi). There are no legal restrictions on the disputing parties' ability to organise the arbitration proceedings as they see fit. Despite Kenya's strong legal framework, there are problems with the length of arbitration proceedings and the enforcement of arbitration awards. Arbitration takes one year and 7 months on average, from the filing of an application of enforcement to the final writ of execution attaching assets. The domestic court process is slow, which can further impede the efficacy of judicial assistance in arbitrations. On average, it takes around 35 weeks to enforce an arbitration award rendered in Kenya, from filing an application to a writ of execution attaching assets (assuming there is no appeal), and 43 weeks for a foreign award. Practitioners state that arbitrations are not

¹ <http://rru.worldbank.org/besnapshots/BecpProfilePDF.aspx?economy=kenya>

² <http://rru.worldbank.org/besnapshots/BecpProfilePDF.aspx?economy=kenya>

common in Kenya. Mediation is starting to be used as a dispute resolution technique, and on average, mediation cases are settled within 30 days.¹

2.11.7 Economic freedom

Kenya's economic freedom score is 57.4, making its economy the 106th freest out of 183 countries in the 2011 Index. Its score is virtually unchanged from last year, with gains in trade and investment freedom offsetting a significantly lower government spending score. Kenya is ranked 14th out of 46 countries in the Sub-Saharan Africa region, and its overall score is below the world average. Kenya's economy, one of Africa's most developed, has gradually emerged from political instability and the economic slowdown. Reforms in public finance management have continued, though progress has been sluggish. Weak protection of property rights and extensive corruption continue to hold back overall economic freedom.²

¹ <http://rru.worldbank.org/besnapshots/BecpProfilePDF.aspx?economy=kenya>

² <http://rru.worldbank.org/besnapshots/BecpProfilePDF.aspx?economy=kenya>



3 Aquaculture in Kenya

3.1 Key findings

- The fisheries subsector plays a significant role in the Kenyan economy and the health of its population. The sector supports about 80,000 people directly and about 800,000 people indirectly. In 2006 fisheries and aquaculture contributed 0.5% to the GDP. Per capita fish consumption is 5 kg, which is low compared with other countries in the region.
- The fisheries sector largely depends on capture fisheries in inland waters, which are concentrated on Lake Victoria (85% of captured volume versus marine fishing only 4%). Major species from Lake Victoria are Nile perch (mainly for export), sardines and tilapia. Catches in Lake Victoria are declining.
- Fish farming in Kenya started early last century. There was no spectacular progress in production until 2007, despite favourable climatic and geographic conditions for a variety of aquaculture.
- Aquaculture in Kenya consists of three sub-sectors: fresh water aquaculture in warm waters (mainly tilapia and African catfish in earthen ponds), cold fresh water aquaculture (trout in raceway culture systems) and marine aquaculture (underdeveloped, limited in number and small-scale backyard farms, there are no commercial farms).
- Fresh water aquaculture in warm waters is mainly practiced at semi-intensive levels using feeds and fertiliser as input with productions at about 3 tonnes per ha. Ponds and farm size are usually small, catering for local markets.
- There are only a few large-scale commercial fish farms. There are a number of companies that supply inputs (feeds, fingerlings, materials), but still many farmers produce their own feed.
- The fish value chain is not uniform and in many cases has a complex structure: processing can be at industrial level or artisanal level, markets differ depending on income, often no specific preferences for certain fish species (see also Chapter 5).
- The demand for fish is growing with supply generally lagging behind.
- The Kenyan government recognises the importance of aquaculture in relation to food security, poverty alleviation of rural populations, and reduction of fishing pressure in capture fisheries.

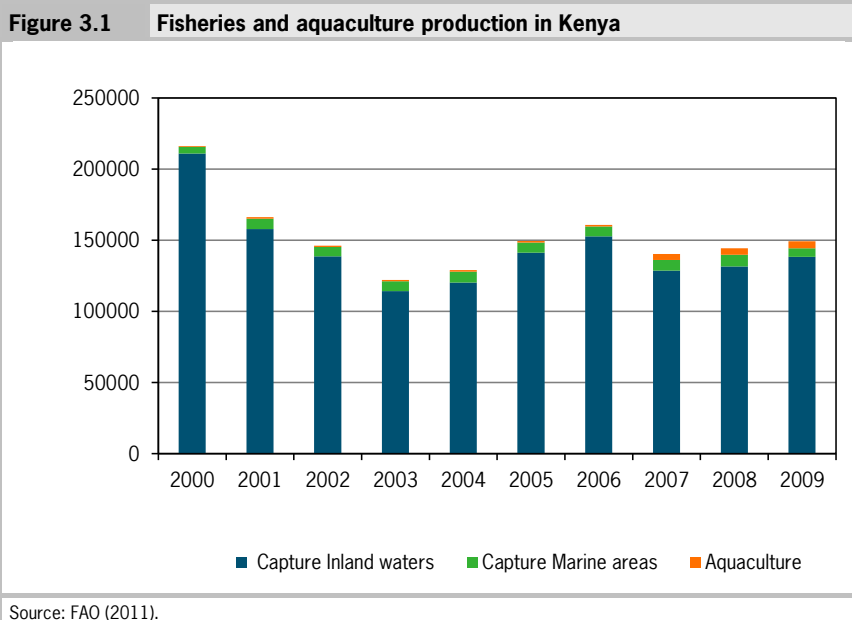
- A boost in fish production and the number of farmers engaged in fish farming occurred during the period from 2007 to 2009, mainly because aquaculture became a priority of the Kenyan government's Economic Stimulus Programme (ESP). The mixed culture of tilapia and catfish is promoted by the ESP: construction costs for fish ponds are subsidised as well as the costs for fingerlings and feeds. Production in 2010 reached approximately 5,000 tonnes.
- There is an extensive governmental infrastructure in support of aquaculture: governmental fish farms for research purposes, fingerling supply and training; fish farming extension officers are stationed throughout the country.
- In November 2010, the Ministry of Fisheries Development published the *National aquaculture strategy and development plan 2010-2015*. This policy paper serves as a road map and framework for aquaculture development in Kenya.
- The Kenyan government has realised that aquaculture should be considered as a commercial activity with the aim of making economic gains rather than as a subsistence activity.
- A number of bilateral and multi-lateral organisations support aquaculture development but mostly directed towards smallholders.

3.2 The fisheries subsector

The fisheries subsector plays a significant role in the Kenyan economy and the health of its population. Fisheries products provide high protein diet and contribute to improved nutrition and health of the communities living in the rural areas where fish is the main source of protein. Fisheries contribute to the country's economy through employment creation, generation of income and foreign exchange earnings. Per capita annual fish consumption is 5kg in Kenya, 10kg in Tanzania and 10kg in Uganda, which is below the world average of 16.5kg (FAO, 2009).

The fisheries subsector has grown rapidly and exports have generated considerable foreign exchange income. In 2006 fisheries and aquaculture contributed 0.5% to the GDP. Fisheries are an important economic activity to lakeside communities and are a major source of livelihood. The sector supports about 80,000 people directly and about 800,000 people indirectly. In 2006 a total of 159,776 tonnes of fish valued at USD91.5m was produced in Kenya. In the same year, fish exports earned the country approximately USD53m (Mbugua, 2008).

Figure 3.1 shows that the fisheries sector in Kenya largely depends on capture fisheries in inland waters, which are concentrated on Lake Victoria. There are some catch volumes from marine areas and there is some production from aquaculture operations, but these only represent a very small share of total production. Globally, Kenya's aquaculture production is insignificant. The next two sections elaborate shortly on respectively the fisheries and aquaculture sector.



3.3 Capture fisheries

Kenya has a long history of fishing. Even though Kenya is a coastal state, Lake Victoria continues to dominate Kenya's fishing output. The lake currently accounts for approximately 85% of captured volumes while marine fishing accounts for only 4% of the total volume. Other inland lakes are Lake Turkana, Lake Baringo, Lake Naivasha, and smaller lakes including Chala and Jipe. Fishing in Kenya is mostly carried out by artisanal fishermen operating small fishing boats in inland lakes and marine waters. There are around 15,000 small fishing boats across the country. Besides these small-scale fishing boats there are also a number of large industrial fishing vessels with on-board freezing facilities

(EPZA, 2005). Until 20 years ago, nearly all fish caught in Kenyan waters was consumed locally. Kenya started to export fish in the early 1980s, when fish processing factories were established around Lake Victoria. Over the past 20 years, then, the fisheries subsector has gradually evolved from a domestic oriented industry to an export oriented industry with value added processing being applied (EPZA, 2005).

Table 3.1		Capture fisheries production - Kenya (Volume in tonnes)					
Species	2001	2002	2003	2004	2005	2006	2007
Aquatic animals	13	68	27	28	19	18	17
Crustaceans	1,039	944	775	1,228	461	436	638
Diadromous fishes	67	112	29	34	36	33	34
Freshwater fishes	156,693	137,666	113,173	119,038	140,143	151,678	124,264
Marine fishes	6,106	5,439	5,733	6,213	6,212	6,103	6,399
Miscellaneous aquatic animal production	260	271	265	198	207	211	198
Molluscs	233	283	314	326	433	416	413
Total	164,411	144,783	120,316	127,065	147,511	158,895	131,963
Source: NFDS (2009).							

In 2006, a total of 159,776 tonnes of fish valued at KES8.7bn to fishers was produced (Mbugua, 2008). It is estimated that the fishing industry employs over 50,000 fishermen and women, and another 800,000 persons are engaged in fish processing and trade (USAID, 2008). The subsector growth was estimated at 4.1% in 2005 (Mbugua, 2008). There has been a decline in total fish production since the peak of 214,712 tonnes in 1999. This decline has been attributed to the decline in catches from Lake Victoria (Okechi and Owili, 2006).

3.3.1 Inland capture fisheries

Kenya is endowed with extensive inland waters, covering between 10,500 and 11,500km² depending on rainfall, but it is the country's 6% share of Lake Victoria that accounts for the majority (85%) of national freshwater fish production. Lake Victoria has a multi-species fishery of tilapiines and haplochromines, cichlids and more than 20 genera of non-cichlid fish, including Mormyrus, catfish, cyprinids and lungfish. Lake Victoria is the third largest freshwater lake in the

world, with an area of 68,000km². However, the lake is relatively shallow, with a maximum depth of 84m and a mean depth of just 40m, which makes it susceptible to pollution. The area of the lake is divided into the national waters of the bordering countries, with Kenya owning 6%, Uganda 45% and Tanzania 49% of the area. There has been a steady decrease in fish diversity and quantity due to increase in fishing effort as a result of commercialisation of fishing in the last two decades (USAID, 2008). The fishery is supported by three main important fish stocks, the Nile perch (*Lates niloticus*), Dagaa/Sardines (*Rastrineobola argentea*) and Nile tilapia (*Oreochromis niloticus*). Over 75% of Nile perch is sent directly to fish establishments for processing and export to overseas, especially to the lucrative European Market, while dagaa and tilapia serve the local region and domestic markets. Nile perch contributes to about 60% of the total catch from the lake fishery supplies, of which over 80% of the total fish and fish products have been exported to abroad/overseas markets (Georgsson and Thor- kelsson, 2009).

Fresh water capture fisheries potential

The fish stock of Lake Victoria is estimated at over 1,160,000 tonnes, with insignificant changes over the years. Significant changes are shown in the species composition; the dagaa/omena/mukene has increased tremendously, making it the dominant species. The Nile perch biomass has decreased and the haplochromines and other indigenous species, which had almost disappeared, are recovering. In 2005 the Nile perch biomass was 543,736 tonnes, dagaa was 495,362 tonnes and that of haplochromines and other species was 438,663 tonnes. By 2008 the biomass for Nile perch had decreased to 298,644 tonnes, that of dagaa had risen to 1,110,145 and that of haplochromines and other species rose to 625,180 tonnes. Similarly, the dagaa constitutes about 60%, Nile perch constitutes 23%, tilapia 5%, haplochromines 10% and other species 1% of the fish catches (FAO, 2009). The decline of the Nile perch fisheries has reduced fish supply to the fish factories and the small-scale fish processors of Nile perch by-products with serious consequences. Over 10 fish factories on Lake Victoria have closed and the remaining 25 are operating under capacity (FAO, 2009).

3.3.2 Marine capture fisheries

With an estimated 640-km long coastline and variety of marine and wetland habitats, the marine subsector is host to nearly 12,000 fishers, out of which 95% are artisanal. Fishing is carried out in the near shore areas using simple boats

and is heavily dependent on the monsoon wind patterns. The annual catch has fluctuated between 4,000 and 10,000 tonnes for the last 20 years, with some areas reporting overfishing. Lobsters, prawns, crabs, octopuses and squids are the main marine commercial species, but contribute only 4% of total fish landings (Okechi and Owili, 2006). While sport fishing and aquaculture are also important economic activities on the Kenyan coast, the offshore fisheries zone, which is believed to contain vast and valuable stocks of fishery resources, is exploited by vessels from Distant-Water Fishing Nations (DWFN) (Kamau et al., 2005).

Marine capture fisheries potential

Kenya's marine capture fisheries potential is estimated at 150,000 tonnes, but the current national production averages 7,500 tonnes, which is about 5% of this. This quantity is very low, despite Kenya having a 640-km coastline with 200 nautical miles of the Exclusive Economic Zone (EEZ). Its coast is also located within the richest tuna belt in the Indian Ocean; much of this tuna resource is caught by DWFN (NFDS, 2009).

3.4 Aquaculture

Fish farming in Kenya was introduced by the colonialists for the purpose of sport fishing at the beginning of the 1900s and it evolved to static water pond culture of tilapine fish in the 1920s, later supplemented by common carp and catfish. Trout was subsequently introduced as a riverine sport fish, to be able to produce seed for the warm water and cold water species for stocking of rivers, dams and ponds. The colonialists set up two fish farms in 1948, the Sagana Fish Farm (for warm water species) and the Kiganjo Trout Farm (for cold water species). Mariculture was introduced in the late 1970s with the establishment of the Ngomeini Prawn Farm as a pilot project. Although fish farming in rural Kenya has a relatively long history dating back to the 1920s, it was only made popular in the 1960s through the 'Eat More Fish' campaign. However, no spectacular progress has been achieved in this subsector since its introduction.¹ This situation changed in 2007, when the number of farmers engaged in aquaculture increased exponentially. The number of farmers engaged in aquaculture received a further boost in 2009, when the government, in its commitment to revitalise the economy, introduced an Economic Stimulus Programme (ESP) under which

¹ www.fao.org/fishery/countrysector/naso_kenya/en

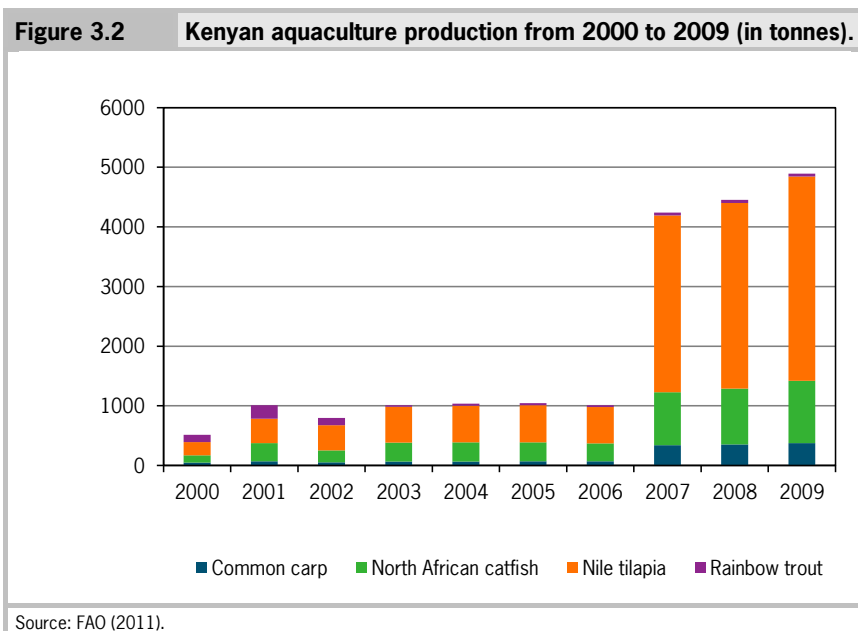
aquaculture was identified as a key pillar in the production sector (Ministry of Fisheries Development, 2010).

Aquaculture in Kenya can be divided into three categories (Mbugua, 2008):

- Warm freshwater aquaculture dominated by the production of various species of tilapia and the African catfish (*Clarias gariepinus*), mainly under mixed sex semi-intensive systems using earthen ponds;
- Cold freshwater aquaculture production of rainbow (*Oncorhynchus mykiss*) trout under intensive systems using raceways and tanks; and
- Marine aquaculture (Indian Ocean).

3.4.1 Aquaculture production

After years of stagnant aquaculture production, the situation changed in 2007, when the total aquaculture production increased by more than 300%, from about 1,000 tonnes in previous years to approximately 4,000 tonnes. By 2009 total aquaculture production reached 4,895 tonnes of fish country-wide (see Figure 3.2).



The rapid increase in aquaculture production in 2007 can at least partially be explained by government policies that supported the development of aqua-

culture operations as a means to increase the supply of fish to the domestic market and to create employment in rural areas. During the preparation of the Poverty Reduction Strategy Paper (PRSP) aquaculture was identified as a core activity for funding from the midterm expenditure framework budgeting system. The government has attempted to stimulate the sector by introducing training programmes and developing higher quality tilapia feeds and fingerlings which are now available to a part of farmers. However, the increase in aquaculture production is still hampered by the lack of quality seeds, access to proper feeds, proper pond management and coherent government policies (Mbugua, 2008).

Table 3.2 shows the total production per province in 2006. In the same report the government also gives an indication of the number of large-scale farmers - those who earn more than USD530 per year - in each province. Table 3.2 also shows the number of farmers that earn more than USD530 (KES50,000) and USD1,060 (KES100,000) per year per province. All other farmers earned less than USD500 per year. These data are based on the aquaculture survey conducted in 2006 (Mbugua, 2008).

Province	# Production units	Aquaculture area (ha)	Productivity (tonnes/ha/year)	Annual total production (Kg/yr.)	# producers earning >KES50,000/yr.	# producers earning >KES100,000/yr.
Coast	362	3.4	0.38	19,856	0	0
Eastern	636	46.9	0.59	273,896	9	4
Rift valley	1,285	372	73	2,172,480	34	13
Central	1,628	219.2	6.58	1,280,128	40	22
Nyanza	1,841	40.8	13.32	238,272	17	6
Western	2,274	40.1	13.45	234,184	51	25
Total	8,026	722.4		4,218,816	151	70

Source: Mbugua (2008).

Tilapia continues to dominate production, followed by African catfish and rainbow trout. In 2006 the production of tilapia and catfish was carried out by approximately 4,700 farmers, who own about 7,200 ponds. Average annual productivity lies around 5,8 tonnes per ha. Note that these figures might be

much higher as fish produced and directly consumed by farmers is not included. The number of farmers increased to 7,800 in 2007 (FAO country profile 2007). More recently, the number of farmers in 2011 was estimated at around 20,000.

3.4.2 The aquaculture environment

Kenya is endowed with climatic and geographic conditions favourable for a variety of aquaculture investments. As mentioned in paragraph 3.4, both cold water and warm water, freshwater and marine water aquaculture can be developed, depending on the location. In 1982 the FAO conducted a study about the possibilities for aquaculture development in Kenya. Some of the results of this study are presented in Table 3.3 and Map 3.1. Both table and chart indicate which species can be cultured in different areas of Kenya. As these fish species are still being cultured, it may be assumed that the suitability of each zone has not changed over the years.

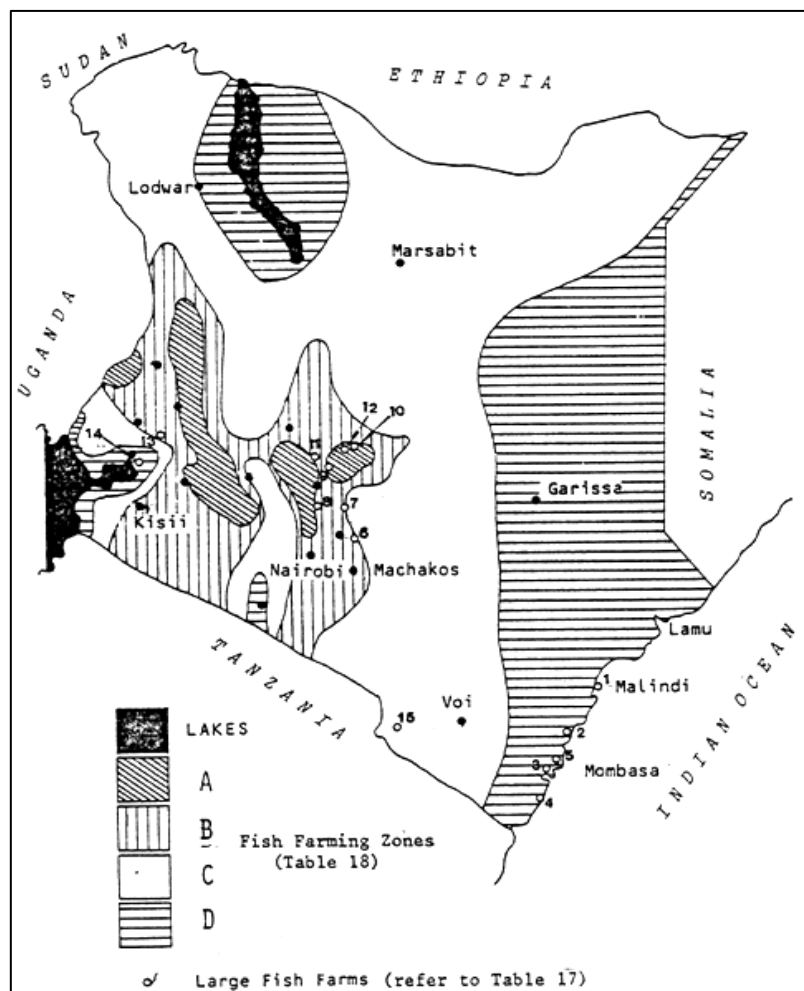
Table 3.3 Kenya provinces and suitability for aquaculture			
Zone	% of total	Common mean air temp. range	Fish species
A - Highlands	3.2	5-22 °C	Trout
B - Central Province and Rift Valley	11.6	10-26 °C	Trout Common carp Tilapia
C - Plains and Northern Province	51.9	15-30 °C	Common carp Tilapia Catfish
D - Coastal and Lakeshore Belts	33.3	22-34 °C	Common carp Chinese carps Catfish Freshwater prawns Shrimp

Source: FAO (1982).¹

¹ www.fao.org/docrep/field/003/P8766E/P8766E04.htm#ch3.1

Map 3.1

Potential fish farming zones in Kenya (corresponding to Table 3.3)



Source: FAO (1982).

3.4.3 Main aquaculture species

Commercial aquaculture in Kenya involves mainly production of tilapines, African catfish, and rainbow trout. Aquaculture in Kenya is mainly carried out in three

environments; marine, coastal (e.g. mangroves and estuaries) and freshwater (both cold and warm).

Table 3.4		Aquaculture production - Kenya (volume in tonnes)					
Species	2001	2002	2003	2004	2005	2006	2007
Common carp	70	52	64	67	71	68	338
Nile tilapia	412	421	600	614	622	609	2,965
North African catfish	304	202	319	320	318	302	890
Penaeus shrimps	-	<0.5	<0.5	-	-	-	-
Rainbow trout	223	123	29	34	36	33	47
Trouts	-	-	-	-	-	-	-
Total	1,009	798	1,012	1,035	1,047	1,012	4,240

Source: NFDS (2009).

In warm freshwaters, Nile tilapia (*Oreochromis niloticus*) and the African catfish (*Clarias gariepinus*) are the principal species cultured in Kenya and are well adapted to local conditions. Other species include riverine species such as Barbus and Labeo as well as the air-breathing lungfish (*Protopterus ethiopicus*). Tilapia species form about 90% of farmed fish in Kenya. Polyculture of the Nile tilapia (*Oreochromis niloticus*) with the African catfish (*Clarias gariepinus*) is often practiced to control the prolific breeding of the former and increase production per unit area (Ngugi and Manyala, 2009).

Some exotic species, including the common carp (*Cyprinus carpio*), rainbow trout (*Oncorhynchus mykiss*) and largemouth bass (*Micropterus salmoides*), were introduced into the country for sport fishing between 1930 and 1940 and later cultured (Ngugi and Manyala, 2009).

3.4.4 Fresh water aquaculture

Aquaculture practices include intensive, semi-intensive and extensive systems. The semi-intensive systems form the bulk of aquaculture production in Kenya, contributing more than 70% of the total production from aquaculture. Intensive systems are few, and are projected in the future to contribute far more significantly (Ngugi and Manyala, 2009).

Extensive systems utilise the lowest management levels in aquaculture with very little or no input being directed into production. Fish are stocked in floating cages, earthen ponds and other water impoundments and left to fend for them-

selves. These systems are highly dependent on the natural productivity and the physical conditions of the water. The stocking densities therefore depend on the natural carrying capacity of the environment. These systems are characterised by low stocking densities, minimal inputs and thus low yields. Extensive culture in cages is mainly carried out in lakes, rivers, dams and reservoirs distributed in the high aquaculture potential areas of the country. The fish depend on the organic matter suspended in the water flowing through the cages for their feed. The main cultured species are Nile tilapia, African catfish and common carp. According to Ngugi and Manyala (2009) this system has not been well documented, but it is estimated that annual production ranges between 0.5 and 1.5 tonnes per ha, contributing 10% or more to the total aquaculture production in Kenya (Ngugi and Manyala, 2009).

Semi-intensive systems are the major contributor to aquaculture in Kenya, with an average production of about 3 tonnes per ha, contributing to more than 70% of the total aquaculture production. Earthen ponds and cages are used as holding units for fish culture (*See photo page 64*). The ponds are fertilised using both chemical and organic fertilisers in varying proportions to enhance natural productivity. Exogenous feeding using cereal bran and other locally available feeds is done to supplement pond productivity. Polyculture of Nile tilapia, African catfish and common carp is practiced with various combinations of species. Annual production in these systems ranges between 1 and 2.5 tonnes per ha (Ngugi and Manyala, 2009).



Tilapia ponds at Sagana station.

Intensive aquaculture for rainbow trout is mainly uses raceway culture systems. These systems consist of a channel or tank with a continuous flow of water constructed or used for high-density fish production. For linear raceways, there is a continuous incoming water supply to provide a minimum velocity of 0.015 m/s flowing at a minimum average depth of 0.6 m. There are approximately two complete water exchanges per hour for a raceway length of 25 to 30m (Ngugi and Manyala, 2009). This method has supported the tourism industry, since rainbow trout is considered quite a luxury and is supplied to hotels catering largely to tourists. The contribution of this fish is therefore higher by monetary value than by weight. In 2009 a kg cost between KES300.00 and 1,200.00 (i.e. USD4.00-16.00) depending on the market's demand. Other intensive practices involve the use of various types of tanks, and sometimes floating cages, as holding units. In all of these systems, more fish are produced per unit area by complementing or substituting the natural productivity in the culture units by exogenous feeding, aeration and both mechanical and bio-filtration where necessary. There are very few such operations in the country. Annual production in these systems ranges from 1 to 80 tonnes per ha, depending on the management level employed as practiced at the Government of Kenya trout

fish farm in Kiganjo on the slopes of Mount Kenya, and private Trout Farm (Ngugi and Manyala, 2009). An exception is the newly constructed intensive catfish farm near Nairobi, the Jambo Fish Kenya. This farm consists of a hatchery and nursery using recirculation aquaculture technology (RAS), and a grow-out farm designed for an annual production of 75 tonne (*See photo below*).



Intensive catfish farm near Nairobi.

3.4.5 Marine and coastal aquaculture

Kenya has a shoreline of approximately 640km on the Indian Ocean. The majority of the coast is rather underdeveloped, and the combination with abundant unpolluted seawater provides opportunities for the development of coastal aquaculture. However, present mariculture operations are very limited and small scale (backyard). There are no commercial farms.

Mariculture of fish basically consists of community-based pond culture of milkfish (*Chanos chanos*) in polyculture with shrimp. The KWETU training centre for sustainable development - an NGO - supports a mariculture programme with demonstration, training and extension services. They have trained seven communities to farm milkfish in approximately 30 ponds of 340m² each (1 ha total).

The productivity ranges from 5,000 to 8,000 kg per ha. According to KWETU staff, the productivity can be increased if the ponds can be stocked with sufficient numbers of fingerlings.

Despite the presence of suitable sites and an interest from the business community, there are at present no commercial shrimp farms. The only large-scale shrimp farm (North of Malindi) has been out of operation for a while due to land tenure issues. The Kenya Marine and Fisheries Research Institute (KMFRI) will rehabilitate the farm for research and production of giant tiger prawn (*Penaeus Monodon*), as part of the Kenyan Coastal Development Project (KCDP).

The making of salt is an important economic activity in certain coastal areas. Both large-scale commercial and small, artisanal companies produce salt for export and the local market, respectively. The large companies (Kensalt, Krystaline, Malindi, Kemu, Tana, Mnakani and Kurawa) operate often on more than 1,000 ha of land. *Artemia* (a live feed used in the larviculture of freshwater and marine fish and shrimp) has been introduced in several salt works in 1984-1986 by KMFRI, and has since then remained. However, no regular production of *Artemia* cysts has been achieved. Recently, KMFRI, with Belgian development assistance and Belgian and Vietnamese expertise, has constructed an experimental *Artemia* and salt farm, with the intention to develop commercial cyst and biomass production techniques that can be used by the private sector. If this succeeds, the availability of relatively cheap *Artemia* cysts will contribute to enlarged and more reliable production of catfish fry.

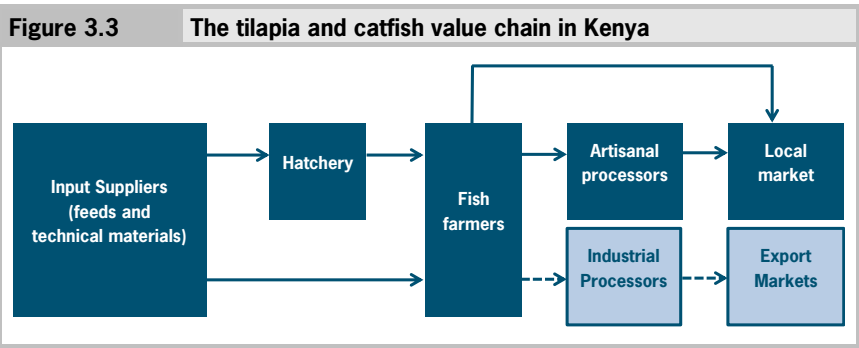
The farming of sea weeds (mostly *Eucheuma denticulatum*) is practiced by small-scale farmers. Started as a research project by KMFRI, now approximately 100 farmers culture seaweed on ropes. This off-bottom production technology is simple and does not require inputs, except for pools and nylon ropes. The sun-dried seaweed is sold to Zangue Aqua Farms (Zanzibar) at KES12-14/kg, for further export to the USA, EU and China. From the dried seaweed, products are obtained for use in foods, pharmaceuticals and cosmetics.

The farming of fresh water fish (tilapia and catfish) is practiced on a much larger scale than marine fish. This is possible due to a favourable temperature, the high demand for fish (prices of tilapia are often higher than that of marine fish), and the support for the culture of these species through the Economic Stimulus Programme (ESP). There are both intensive and extensive farms. The former Baobab farm 'Bamburi' produces approximately 30,000 tilapia fry per month, though not on a purely commercial basis. Similarly, Suleiman Masoud farm in Mtwapa produces over 500,000 Nile tilapia fingerlings per year in a flow-through system using borehole water.

In general, the commercial culture of marine fish and shrimp requires more capital and technology compared with tilapia or catfish farming, resulting in higher risks. Added to this, the difficulties in acquiring land with good soil properties, the absence of good quality stocking material and feeds, and competing interests with tourism, means that mariculture is not developed in Kenya. Recently the Kenyan government, together with multilateral donors, have initiated the 5-year KCDP project, with a total budget of USD25m. It includes a mariculture component (USD1.3m), aimed at the establishment of a marine hatchery, shrimp farm, and technology development and extension for seaweed, marine finfish, and Artemia farming. These project activities are implemented by KMFRI and the Fisheries Department.

3.5 The aquaculture value chain

Figure 3.3 visualises the different stakeholders that play a role in the tilapia and catfish value chain. The value chain for rainbow trout differs since trout is produced in small quantities and mostly sold directly to hotels and high-end market outlets in urban areas. This figure only includes those involved in actually producing or trading the product and does not include value chain supporters such as government agencies and credit providers. Industrial processors and export markets are nevertheless included because they are currently not part of the value chain. However, if production increases, they may become part of the value chain. Finally, it is important to note that other value chains, such as that of fish feeds, are also important for the sustainable development of Kenyan aquaculture. The structure of this particular value chain is also complicated, including processors and domestic and international traders in different ingredients and semi-finished products (see paragraph 3.5.1).



An overview of Kenyan business support organisations can be found in Appendices 3 and 4. Appendix 3 provides a list of sectoral technical and service support institutions that may help in alleviating unnecessary bottlenecks and bureaucracies. Appendix 4 provides a list of a number of non-governmental membership organisations or associations that work closely with the government and international institutions to facilitate business contacts and ease transactions in Kenya.

3.5.1 Fish farms and input suppliers

In this paragraph a number of fish farms and suppliers of inputs for fish farming (e.g. feeds and fingerlings) are listed. Some of these were visited (see Appendix 1). This is not an exhaustive list.

Aquaculture feeds

Mbugua (2008) notes that one of the main constraints to the further increase in aquaculture production is the lack of sufficient quality feeds and seeds.

AKEFEMA¹ is the association of Kenya's fish and livestock feed manufacturers. The organisation notes that in 2009 Kenya had 82 feed manufacturers, of which 32 were member of the association. It is unclear how many of the producers produce fish feeds.

There are a number of companies and shops that indicate that they distribute aquaculture feeds. However, the number of feed mills seems to be limited. Many fish farms and governmental stations use farm made feeds using low tech equipment and locally available ingredients. An exception is Dominion farms, which produces extruded tilapia feed on-farm. There are also farms that import fish feed from Uganda. This reinforces the idea that availability of good quality feeds is still a major problem.

Sigma Feeds

Supplier of extruded floating (and regular) pellets for tilapia and catfish. Production of 150 tonnes fish feed per month. A new factory is under construction and is scheduled to be operational by mid-2012. Contact Mr Vandan Shah, email: vandan@sigmakenya.com

¹ www.akefema.com/

Crop King Fish Hatchery

Suppliers of fingerlings, table size tilapia and catfish, and fish feeds. P.O. Box 17282, Nakuru. Contact Maingi Benson, email: maingibenson13@yahoo.com

Fish farms and hatcheries

There are a couple of hatcheries but the management of the level of quality is said to be low (Mbugua, 2008). The government is implementing programmes to increase the production volume as well as the quality of fingerlings.

Jambo Fish Kenya Ltd

With their Dutch partner company, *Fleuren & Nooijen BV*, this company is producing catfish fingerlings (RAS system) and table-sized catfish for the urban market. It sells also culture systems (RAS) and fish feeds from Skretting (Nutreco). Contact Sharon Momanyi, email: jambofishkenya@gmail.com. Rudy Van Dijck, email: rudyvandijck@yahoo.com

Mwea AquaFish Farm¹

This company sells tilapia and catfish fingerlings, and table sized fish. They also give technical advice on pond management and ongrowing. Contact Charles C. Ngugi or James B. Mugo P.O. Box 101040 Nairobi 00101. Email: mweafish@gmail.com

Dominion farms²

The farm is situated in western Kenya in the delta of the Yala River, where the equator crosses Lake Victoria. It is in Nyanza Province - forty miles northwest of the provincial capital of Kisumu. Prime Harvest Tilapia is currently sold as whole fish in northern Nyanza Province. Commencing in mid-2010, fresh tilapia filets (as well as whole fish) will be available in grocers' coolers throughout the Province and expanding to include most of Kenya by 2011. Contact: Calvin Burgess, President.

Former Baobab Farm (part of Bumudi group)

This farm produces approximately 30,000 tilapia fry per month, though not on a purely commercial basis.

¹ www.mweafish.com/

² www.dominion-farms.com/operations.html

Furrow Fish Farm

Tilapia Grow out and Catfish Hatchery. Box 16-40129, Oboch Via Sondu. Contact Raphael Owaka Were Also Aquashops Aquaculture Equipment and Feeds Supplier Email raphaelowaka@yahoo.com Tel 0726023519

Retailers and wholesalers

Although it is unclear how many, there is a number of shops that are specialised in technical materials that are needed for fish culture. A number of suppliers of feeds, fingerlings and technical materials are listed by the Sustainable Aquaculture Research Networks in Sub Saharan Africa¹ (SARNISSA):

Aquashops²

FARM-Africa's Aqua Shops Project, funded by DFID's Research into Use programme, will develop a network of outlets in up to six locations in western Kenya, which will provide things such as fish feed and manure, technical advice and market linkages to up to 1,000 smallholder farmers interested in using the ponds to set up their own fish farming businesses.

Monasa Nets (Kenya) Ltd.

Dealers in Aquaculture nets, gear, cage net and related supplies. Contact: Nasrulah Miraly. PO Box 9473 - 40141. Tel: 057 2024274/5 and 0713555416 and 0734600290. Fax: 0572023815. Email: canmonasa@swiftkisumu.com
Location: Odera Street, Kisumu

Navaqua Fish Farming and Agricultural Products Wholesaler

Contact Jamie Coulson navaqua@wananchi.com

¹ www.sarnissa.org/

² www.farmafrica.org.uk/kenya/aqua-shops-project

Facilities for training and research purposes

Besides these companies the government has set up a number of facilities both for research purposes as well as for training and the provision of fingerlings and sometimes table sized fish, the major are:

- National Aquaculture Research, Development and Training Center (formerly Sagana Fish Farm);
- Kiganjo Trout farm & Hatchery;
- Sangoro Research Station - Rachuonyo;
- Kibos Fish Hatchery - Lake Basin Development Authority - Kisumu;
- Chwele Fish Farm - Bungoma.

3.5.2 Collection and trade

Mbugua (2008) notes that most farmers sell their yields directly on the local markets or sell it to artisanal processors who dry or smoke the fish before selling it at local markets, shops and stores. There is not much known about the presence of middlemen or traders who function as intermediaries between the farmers on the one hand and processors or consumers on the other. Nevertheless, it is important to note that the value chain that was presented in figure 3.3 is a generalisation. During the fact-finding mission a number of other value chain structures were identified that include several more links between farmers and consumers. These links include a variety of traders/middlemen, agents and wholesalers, retailers, restaurants and hotels.

3.5.3 Fish processing

Some fish is sold fresh while a significant proportion is processed for later consumption. Artisanal Fish Processors (AFPs) prepare dried and smoked fish mostly for the local market, while Industrial Fish Processors (IFPs) freeze or chill fish for export and to a lesser extent, for consumption in Kenya's urban areas (mostly through supermarkets). Most cultured tilapia and catfish is sold as fresh products on the domestic market and not processed. For the seafood industry in general, IFPs have become the industry's driving force and if aquaculture production increases should be able to process and export these products as well. IFPs currently collect fish from the coastal beaches and villages around the inland lakes using refrigerated trucks, buying through intermediary medium and large-scale traders and process them for export.

The most recent data indicate that in 2003 there were 13 registered land-based industrial seafood processing companies in Kenya, all of which were ex-

port oriented (EPZA, 2005). Comparing the list of exporters in 2003 with the list of export companies licensed for exports to the EU in 2010 indicates that there are some new players in the market. However, it is also possible that some players left the market.

As of 30 July 2010, Kenya has licensed 11 seafood processing establishments that are licensed to export to the EU.¹ One of these is a freezing vessel while the others are land-based factories. Table 3.5 shows that most of these exporters specialise in Nile perch and are predominantly located near Lake Victoria. Others processors specialise in marine captured fish and crustaceans are located near the Indian Ocean in Mombasa.

From the website of the Kenya Fish Processors and Exporters Association (AFIPEK)² it appears that there are at least three other active seafood processors that are not licensed for the EU market. These are Wananchi Marine Products Ltd. (specialises in tuna), Samaki Ltd. (specialises in Nile perch) and the Alpha Group (sells a variety of marine captured products).

¹ https://webgate.ec.europa.eu/sanco/traces/output/FFP_KE_en.pdf

² www.afipek.org/

Table 3.5		Land-based seafood processing establishments that are licensed to export to the EU		
	Location	Main export product	Installed capacity 2003 (per day/tonnes)	Utilised capacity 2003 (per day/tonnes)
W.E. Tilley (Muthaiga) Ltd	Nairobi	Nile Perch	60	35
East African Sea Foods Ltd	Kisumu	Nile Perch	40	22
Capital Fish (K) Ltd	Homabay	Nile Perch	50	20
Fish Processors (2000) Ltd (part of prinsal enterprises)	Kisumu	Nile Perch	25	7
Pêche Foods	Migori	Nile Perch	15	7
J. Fish (K) Ltd. (part of the Tilley group)	Nairobi	Nile Perch	?	?
Amco Foods	Mombasa	Nile Perch, squid, octopus, prawns, etc.	?	?
Transafrica Fisheries Ltd	Mombasa	squid, octopus, prawns, etc.	29	22
Sea Harvest (K) Ltd	Mombasa	squid, octopus, prawns, etc.	5	3
Crustacean Processors	Mombasa	Lobster	0.5	0.2

3.6 Domestic and international markets for Kenyan fish products

Figure 3.1 shows that the total production of fishery products is around 150,000 tonnes. Table 3.7 shows that an additional 18,000 tonnes of seafood products are imported, while 20,000 tonnes are exported (see Table 3.6). This means that about 150,000 tonnes of seafood are consumed domestically. According to USAID (2008), there are four main markets for Kenyan fisheries products:

1. The export markets for industrially processed fresh and frozen Nile perch fillets;
2. The domestic markets for Fresh tilapia;
3. Artisanally processed fish (Nile perch, tilapia, catfish, omena);
4. Feed grade omena.

These freshwater species markets handle 96% of Kenya's annual fish production. In addition, a fifth set of markets are those related to Kenya's marine capture fisheries (shrimp, tuna, octopus, crab, etc.). Each of those markets is growing, with supply generally lagging behind demand (USAID, 2008).

Domestic consumption and consumer preferences

Maize is the basic staple of the Kenyan diet. Ugali, the main dish, is a thick porridge of maize meal that is usually eaten with a sauce of vegetables or meat, or simply accompanied with fermented milk. Dishes of boiled maize and beans (githeri) and maize, beans, vegetables and potatoes (irio) are also common. Mashed plantain (matoke) is an alternative to maize. Other staples are cassava and sweet potatoes, and rice in urban areas. Milk and dairy products are an important part of the diet, in all parts of the country, but especially in pastoral communities. Both fresh and fermented milk are consumed (FAO, 2005). Fish consumption patterns in Kenya were initially dictated by cultural tradition and proximity to fishing areas. Traditionally, the major consumers of fish, especially from Lake Victoria, have been the Luo ethnic group who inhabit areas around the lake followed by Luyia. The ethnic tag on fish has fast disappeared as more people have now embraced fish in their household menus. This has caused the demand of fish to rise fast.

Consumption patterns for most fish consumers depend on taste and availability. While many fisher folks prefer to eat fresh fish most customers based far from the source consume more of fried fish. In 1997 a study carried out indicated that only 9.3% consumed fried fish compared with 68% who consumed fresh fish. However, a similar study in 2005 indicated a completely different pic-

ture, where the proportion of those consuming fried fish had risen to 43%. The number of traders dealing in fried fish rose from 8% to 28% along the beaches but the number is higher in urban centres.¹

USAID (2008) reported that fresh tilapia is the preferred and most widely consumed fish product in Kenya. There is no official competition with fish imports, but unknown quantities of tilapia (and Nile perch) enter Kenya over water, as Ugandan fisherfolk bringing their catch illegally to Kenyan beaches. The export of tilapia is hampered by low production volumes and is also actively discouraged by the Kenyan government who sees tilapia as a key source of protein in the Kenyan diet.

Larger fish are usually graded as the most preferred. However, consumer preference studies are yet to be carried out for most parts of the country. In general different segments of society prefer different sizes of fish from the rich preferring larger fish and large households (usually the poorer) going for smaller fish. More information on market constraints and opportunities is given in Chapter 5.

Exports

Table 3.6 shows that in 2000 fish fillets (largely Nile perch) accounted for more than 90% of total exports. In 2008 the export products diversified and fish fillets accounted only for 15% while fresh and frozen fish meat accounted for 40% and prepared and preserved (entirely taken account for by tuna) for 30%.

Table 3.6 Seafood exports from Kenya											
Trade flow	Commodity	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Export	Crustaceans	412	570	329	534	584	530	536	325	373	
	Fish										
	Fish fillets, frozen	15,438	15,846	21,505	14,013	10,386	10,305	7,715	5,500	3,085	
	Fish meat, whether or not minced, and fillets, fresh or chilled	51	1,422	1,826	3,436	5,582	5,474	3,371	3,327	2,776	
	Fish meat, whether or not minced, frozen	35	39	114	40	43	161	428	2,210	5,867	
	Fish prepared or preserved	0	0	0	2	31	2	4	953	6,428	
	Fish, dried, salted or smoked	138	136	13	73	53	30	291	197	186	
	Fish, fresh or chilled, excluding fillets and meat	31	47	6	52	13	515	336	501	100	
	Fish, frozen, excluding fillets and meat	420	189	78	653	394	573	1,746	2,760	1,002	
	Fish, live	129	106	101	145	186	130	207	251	275	
	Fish	16,242	17,785	23,643	18,414	16,688	17,190	14,098	15,699	19,719	
	Molluscs, aquatic invertebrates	234	230	391	754	516	615	716	398	528	
Total Export		16,888	18,585	24,363	19,702	17,788	18,335	15,350	16,422	20,620	

Source: FAO (2011).

The shift in the export basket can partially be explained by the rise of tuna processing and exports but also partially by the diminishing competitive position of Nile perch in the international market. According to Mbugua (2008), Nile perch exports suffer from three causes:

1. competition in the EU market from cheap Vietnamese pangasius;
2. a reducing supply from Lake Victoria; and
3. import bans and Illegal Unregulated and Unreported (IUU) fishing regulations from the EU authorities.

In 2006 the total export value was USD58m. Traditionally, Nile perch represented the largest part of exports and was mainly destined for the EU. However, in recent years exports to the EU came down rapidly. This may be explained partially by the decreasing catches but also for an important part by increased Nile perch exports from Tanzania and Uganda (USAID, 2008). The problems of Kenyan fishery exports to the EU reached their peak with EU bans on fishery products from Kenya in 2003-2004 and renewed issues relating to IUU fishing regulations since 2009. Currently, tilapia and catfish are not exported but sold in the domestic market.

Imports

For imports (table 3.7) frozen fish other than fillets (whole fish) are the most important product. A closer look at the import figures reveals that this is largely taken account for by tuna (13,000 tonnes). Important to note is that while the import and export volumes are almost equal, the value of export is almost USD74m while the value of imports is only USD5,8m. This can be partially explained by the possibility that tuna is only imported to process it into canned tuna which is re-exported at a much higher value. However, it also confirms the observation that Kenyan consumers mostly consume unprocessed fish products which have a much lower value than high value processed products that are mainly destined for exports.

Table 3.7 Seafood imports to Kenya											
Trade flow	Commodity	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Import	Crustaceans	4	4	19	26	31	15	6	1	0	
	Fish										
	Fish fillets, frozen	13	1	1	65	4	57	109	87	60	
	Fish meat, whether or not minced, and fillets, fresh or chilled	135	0	0	0	2	132	111	11	2	
	Fish meat, whether or not minced, frozen	8	987	34	1,575	300	710	459	983	1,425	
	Fish prepared or preserved	72	137	65	91	97	70	208	240	67	
	Fish, dried, salted or smoked	1,058	109	2,169	50	15	18	19	125	5	
	Fish, fresh or chilled, excluding fillets and meat	628	84	0	22	5	1	19	288	211	
	Fish, frozen, excluding fillets and meat	9,358	15,749	6,703	5,498	13,148	20,028	26,185	22,182	15 921	
	Fish, live	1	10	8	0	1	10	2	2	5	
	Subtotal Fish	11,273	17,077	8,980	7,301	13,572	21,026	27,112	23,918	17,696	
	Molluscs, aquatic invertebrates	30	3	0	2	5	0	1	0	7	
Total Import		11,307	17,084	8,999	7,329	13,608	21,041	27,119	23,919	17,703	

Source: FAO (2011).

Source: FAO (2011).

3.7 Government Institutions and Policy

This paragraph provides an overview of the relevant government institutions, the government policy with regard to aquaculture, other supporting organisations a number of relevant international organisations and bilateral donors.

3.7.1 Government Institutions

There are several departments of the Kenyan government involved in the management and promotion of the fisheries and aquaculture sector.

Department of Fisheries Development

Until 2000, when Kenya was confronted with three consecutive EU bans on fishery products from Kenya, the Ministry of Health and the fisheries department therein together with the Kenyan bureau of standards were the authorities responsible for managing the fisheries sector. However, after the EU concluded that these authorities were not competent enough to safeguard food safety standards. The former ministry of Agriculture and Rural Development became responsible for the fisheries department and published 'The Fisheries (Fish Quality Assurance) Regulations, 2000' (Legal Notice No. 100), which created a single competent authority with powers to monitor and regulate all aspects of fish handling and processing. The department had the responsibility to oversee the implementation of these regulations. The regulations were revised in 2007 and are renamed 'The Fisheries (Safety of Fish, Fishery products and Fish Feed) Regulations, 2007', which came into force on September 21, 2007 as Legal Notice No. 170. The Department was elevated to a fully-fledged ministry on April 13, 2008. This is the current Ministry of Fisheries Development.¹ This ministry has been appointed by the EU as the competent authority for giving EU licences for processing establishments and for managing capture fisheries as well as aquaculture development and regulation.

Directorate of Aquaculture

Under the supervision of the Ministry of Fisheries Development the Directorate for Aquaculture facilitates extension services for the sector. The main objective of the Directorate of Aquaculture is to promote and facilitate development of sustainable commercial aquaculture in Kenya. The directorate provides a range of services, including:

¹ www.fisheries.go.ke

1. Information on:
 - General aquaculture development in the country;
 - Aquaculture investment in the country;
 - Aquaculture management practices;
 - Aquaculture produce processing and marketing.
2. Assistance in planning for aquaculture investment to investors;
3. Assistance for investors in aquaculture site and species selection;
4. Assistance for investors in farm management issues.

To be able to provide these services, the Ministry has trained and posted aquaculture extension officers (Fisheries officers, Assistant Fisheries Officers, Fisheries Assistants and Fish Scouts) to regions with aquaculture potential. Furthermore, the ministry developed aquaculture demonstration farms in regions with aquaculture potential to provide knowledge to fish farmers and developed fish seed production facilities. Extension officers are expected to provide the link between fish farming information and aquaculture investors. The services are available throughout the country at the fishery centres. Besides these activities, the directorate for aquaculture also manages a number of fish farms that are used as show models for local farmers.

The Kenya Marine and Fisheries Research Institute¹ and the Fisheries Department

The Kenya Marine and Fisheries Research Institute (KMFRI) and the Fisheries department are the two technical arms of the Ministry of Fisheries Development. The Department of Fisheries is a technical department of the ministry whose mandate is to provide for the exploration, exploitation, utilisation, management, development and conservation of fisheries resources, and undertake research in marine and fresh water fisheries. KMFRI is a state corporation that was established by an Act of Parliament (Science and Technology Act, CAP 250 of the Laws of Kenya) in 1979 and run by a Board of Management. The research mandate of KMFRI is defined by article No. 4 of the Science and Technology Act of 1979, CAP 250. The Institute is empowered to carry out research in Marine and Freshwater fisheries, Aquatic biology, Aquaculture, Environmental Chemistry, Ecological, Geological and Hydrological studies, as well as Chemical and Physical Oceanography.

KMFRI has adopted a multidisciplinary programme approach of which fisheries and aquaculture are core programmes. The aquaculture research and de-

¹ www.kmfri.co.ke

velopment programme is responsible for investigating new and adoptive culture species and techniques for enhanced fish. Similarly, the programme undertakes studies on for example integrated aquaculture production in irrigation systems, appropriate seed (fingerlings) production, feed formulation and production, hatchery development and operations techniques or genetic and hormonal manipulation for increased fish production in aquaculture systems.

Aquaculture research was recently elevated into a Research Division at KMFRI (Dr. Harrison Charo-Karisa is the Assistant Director Aquaculture Research. The programme directors are Dr. Betty Nyonje - Mariculture - and Dr. Jonathan Munguti - Freshwater aquaculture.

Export Processing Zone Authority¹ (EPZA)

Investor reports note the Export Processing Zone Authority (EPZA) as the one stop shop for investors who are interested to export fisheries products. The EPZA was established in 1990, by the Export Processing Zone Act CAP 517, Laws of Kenya. The Authority's mandate is to promote and facilitate export oriented investments and to develop an enabling environment for such investments. The EPZA is a State Corporation, under the Ministry of Trade and Industry. The authority provides information on all the Kenyan industrial sectors and investment opportunities. It also offers help to exporters and international buyers for attaining all necessary licences and other requirements for exports. Contrary to the Ministry of Fisheries Development this authority works not at the level of primary production but only at the level of exports and investments.

3.7.2 Government Policy

In the 2008, the Directorate of Aquaculture said the following:

'The government recognises the constraints hindering aquaculture growth and development and realised that the subsector can play an important role in poverty alleviation of rural populations. It could also play a key role in provision of protein food and reduction of fishing pressure in capture fisheries. During the preparation of the Poverty Reduction Strategy Paper (PRSP), aquaculture development was identified as a core activity for funding through the Medium Term Expenditure Framework budgeting system. Following this development in addition to the reorganisation of the government functions, aquaculture has been prioritised and

¹ www.epzakenya.com

is now one of the four core functions of the Department of Fisheries. Given the fisheries potential, the Kenyan government has taken a keen interest and given aquaculture and fisheries in general the priority it deserves.'

Interesting and important to note is that the government does not explicitly note the export potential of tilapia or other cultured seafood products but emphasises the potential contribution of aquaculture operations to poverty alleviation and food security. The government identifies the following constraints to the further development of the aquaculture sector (Directorate of Aquaculture, 2008):

1. Uncoordinated promotion of aquaculture through too many institutions. This has not facilitated aquaculture growth because the farmer is left confused by many different extension officers who visit and give varying information.
2. There is no comprehensive policy on aquaculture which indicates the low priority given by the government to aquaculture as an economic activity.
3. Weak research programmes that are not demand driven.
4. Inadequate outreach programmes and inefficiency in dissemination of technology transfers to farmers. Many farmers with good land that can be put in to profitable aquaculture are not aware of the potential.
5. Poor record keeping by farmers and inefficient statistical data collection impedes data dissemination on viability of aquaculture
6. Low funding of the subsector activities by the government and low investments by the private sector.
7. Inadequate entrepreneurial skills by farmers and a lack of credit.

Further on in the report the government says that a paradigm shift is needed to solve these issues:

'In order to expedite aquaculture development in Kenya, there is great need for a paradigm shift. There is need to change the extension approach to aquaculture development for meaningful development to be realised. For this to take effect, aquaculture must be treated and operated as a personal enterprise with the sole aim of making economic gains to the investors. Therefore, the following strategic issues are seen as critical areas of intervention in the process of revitalising aquaculture development in Kenya'.

The government's view on aquaculture development is based on the opinion that currently aquaculture is solely seen by farmers as a subsistence activity and not as a commercial activity resulting in economic gains for farmers. To achieve the required paradigm shift the government identified in 2008 the following areas of intervention:

1. Policy and legal framework;
2. Market access;
3. Productivity and output;
4. Institutional capacity;
5. Monitoring and evaluation; and
6. Information technology.

Subsequently, in November 2010, the Ministry of Fisheries Development published the *National aquaculture strategy and development plan 2010-2015*. This policy paper was prepared by the Aquaculture Developing Working Group (ADWG) chaired by Dr. Harrison Charo, and serves as a road map and frame work for aquaculture development in Kenya.

The culture of tilapia and catfish is furthermore promoted through the Economic Stimulus Programme (ESP). Within the programme the government has set targets for the construction of 300-m² fish ponds: 28,000 ponds in 2009 and 20,000 ponds in 2010. Constructions costs are subsidised as well as the costs for fingerlings and feeds. Farmers receive training through the Directorate of Aquaculture. It is unknown if above targets have been realised. However, it is known that a number of ponds have been constructed at unsuitable locations. The subsidy on pond construction ends this year, and the subsidy on fingerlings and feeds will be gradually decreased from 100% in 2010 to 25% in 2012.

3.7.3 Supporting Organisations

Kenya Fish Processors and Exporters Association¹ (AFIPEK)

AFIPEK represents the industrial fish processors and exporters. The level of their influence is not completely clear but most of the processors and exporters are a member of the association.

Association of Kenya Feed Manufacturers (AKEFEMA)

AKEFEMA represents cattle, pig, chicken and fish feed manufacturers of the Kenyan industry. Also, their role and level of influence is not completely clear.

¹ <http://afipek.org>

Only about one third (32 out of 82) of the total number of manufacturers is a member of the association and it is not clear how many fish feed manufacturers are part of this group.

The Commercial Aquaculture Producers of Africa¹ (CAPA)

The association of the Commercial Aquaculture Producers of Africa (CAPA), has been formed as the representative body for leading freshwater fish farmers on the continent. CAPA and its members are setting the standard for sustainable aquaculture in the freshwaters of Africa.

3.7.4 International agencies and bilateral donors

A number of bilateral and multilateral organisations support aquaculture development, among these are:

United States Agency for International Development (USAID)

From 2000 onwards USAID has implemented a comprehensive research programme (Pond Dynamics/Aquaculture Collaborative Research Support Programme²) on tilapia seed and feed development and the introduction of alternative farming technologies.

Other bilateral donors with aquaculture programmes are DFID, JICA, Belgian Development Aid and Australian Aid.

The Sustainable Aquaculture Research Networks in Sub-Saharan Africa (SARNISSA)

The three-year project will strengthen alliances between languages and across borders among experienced and emergent players in the African and wider aquaculture scene. These alliances will build on an existing knowledge resource base and exchange platform - The Aquaculture Compendium³ - which will be made available throughout the project period to all key project stakeholders who will help provide new materials related to Sub-Saharan African development.

The Food and Agricultural Organisation of the United Nations (FAO)

For FAO, aquaculture is a strategic sector that plays a major role in providing food security. It not only provides alternative fish protein for declining fisheries,

¹ www.capafish.org

² http://pdf.usaid.gov/pdf_docs/PDACF693.pdf

³ www.cabi.org/compendia/ac/index.asp

but is also a cure for malnutrition in young children, and aquaculture helps to stabilise food prices due to scarcity of fish. FAO's aquaculture programme is mostly directed towards smallholders who produce fish for local markets.

The Gatsby Charitable Foundation¹

Gatsby has funded and implemented programmes in Africa since 1985 with the overall objective of creating jobs and improving incomes for the poor. Gatsby is now focusing on achieving this through a small number of ambitious sector development programmes across East Africa. Gatsby partners with governments and key private sector players to identify and tackle the constraints along the whole value chain - field to market - which are holding sectors back. Gatsby target high potential sectors where growth could benefit large numbers of poor people and where the pre-conditions for change - such as private sector momentum, political support and local champions - are in place. In Kenya, aquaculture is one of these high potential sectors.



4 Fish and food security in Kenya

4.1 Key findings

- Fish is a critical source of dietary protein and micronutrients for millions of people in Africa, both for rural and urban populations.
- Aquaculture can make a direct contribution to food security through the provision of high quality food, self-employment and income.
- Aquaculture can also contribute indirectly to food security through food supply to communities, employment opportunities for communities and infrastructure improvement.
- Small-scale subsistence aquaculture contributes only to food availability for local communities, while large-scale commercial aquaculture not only provides food, but also contributes to employment and economic growth.
- The demand for fish in Kenya is growing rapidly, due to its fast growing population and declining natural fish stocks in Lake Victoria.
- Increased domestic production of fish through aquaculture is preferred over imports of fish from abroad, provided that the fish can be produced at competitive prices.
- To maintain the current low level of fish consumption of 5kg per capita, in 2020 the total annual fish production has to increase by approximately 50,000 tonnes.
- Theoretically this increase can be achieved by digging an additional 418,000 (tilapia) ponds with a total area of about 12,500ha.
- Another option is the construction of less than 700 intensive (catfish) farms. This also requires a comparatively much smaller area of around 13ha.
- If it is desirable to increase the per capita fish consumption to 6 kg in 2030, an additional 1.5m tilapia ponds are needed.
- Considering these scenarios it seems doubtful that the current aquaculture policy will contribute sufficiently to food security.
- Therefore a complementary production model (i.e. more intensive culture systems) will be necessary.

4.2 Introduction

According to Bene and Heck (2005), as a source of 'rich food for poor people', fish can play an important role in improving Africa's food security and nutritional status; more than 200m Africans eat fish regularly. Fresh, but more often smoked, dried, or even as powder, fish is a critical source of dietary protein and micronutrients for many isolated communities in rural areas. Fish may also be the sole accessible or affordable source of animal protein for poor households in urban or peri-urban areas. Nutritionally, fish is therefore an extremely important direct source of protein and micronutrients for millions of people in Africa. But fish also contributes indirectly to national food self-sufficiency through trade and exports. In equivalent terms, 50% of the low-income food deficit countries' (LIFDC) import bill for food was paid in 2000 by receipts from fish exports (Bene and Heck, 2005).

The importance of fish as a crucial element in diets, especially the diets of infants, young children, pregnant women and people living with HIV-AIDS, is now widely recognised. In low-income countries, staples such as rice, wheat, maize and cassava make up the bulk of the food consumed by the people, and they supply the majority of energy and nutrients. However, some essential nutrients are not found in these staples, or are found only in small quantities, for example, iron, iodine, zinc, calcium, vitamin A and vitamin B. These nutrients must be supplied by other foods. The fish contribution in the supply of these elements can be particularly important as well as in the supply of fatty acids that are necessary for the development of the brain and body (Bene and Heck, 2005).

4.3 The role of aquaculture in food security

The contribution of aquaculture to food security can be divided into direct and indirect contributions: direct contribution through the provision of high quality food, self-employment and income and indirect contribution through food supply to communities, employment opportunities for communities and infrastructure improvement. As a result, in the discussion about the role that aquaculture can play in economic development, poverty alleviation and food security, there is a clear distinction between the contribution of small-scale aquaculture and the contribution of commercial aquaculture. A distinction is not only made between the impact of the two types of aquaculture on economic development, but there is also an ongoing discussion among policy makers and academics about which

type of aquaculture should be promoted to contribute to the eradication of poverty and food scarcity.

4.3.1 The contribution of small-scale aquaculture

In general it is expected that the contribution of small-scale aquaculture focuses on food security and poverty alleviation. Small-scale aquaculture mostly starts as a subsistence activity and if encouraged and stimulated might improve into a viable commercial economic activity. Fish produced by small-scale farmers is mostly consumed locally and contributes directly to the livelihoods and food availability for local communities. However, employment opportunities are often limited to the farmers and their families and productivity is often not optimal as a result of a lack of knowledge and capability. The contribution of small-scale aquaculture to economic growth is often considered small as it is practiced as a subsistence activity and not as a commercial enterprise. However, this may differ from one subsector and one country to another subsector or country.

4.3.2 The contribution of commercial aquaculture

Contrary to small-scale aquaculture, the contribution of commercial aquaculture is more focussed at poverty alleviation and economic growth. According to the FAO commercial aquaculture contributes directly and indirectly to economic growth (Hishamunda and Leung, 2009). Directly, commercial aquaculture contributes its production to economic performance. It can be measured by the value added and employment generated in the sector. Indirectly, the sector contributes through its impact on other sectors. The development of commercial aquaculture will not only increase its own output and create more jobs but will also fuel development in other sectors like fish restaurants, processing, etc. In general, FAO concluded that commercial aquaculture can contribute not only to economic growth but also to food security and poverty alleviation through employment, production and value added. Potentially, commercial aquaculture improves the availability of food, the access to food, the utilisation of food and transitory security, especially since commercial aquaculture is often more intensive and has a higher productivity. However, commercial production is often aimed at exports or the higher domestic market segments that are supplied with fish through the retail sector. As a result, commercial aquaculture so far does not always benefit food availability for local communities in production areas but does generate alternative food products for urban populations or for-

eign markets. Nevertheless, commercial aquaculture provides more job opportunities to local as well as more distant communities.

4.3.3 The contribution of fish trade

Global net exports of fish and fish products (i.e. the total value of fish exports less the total value of fish imports) have increased significantly in recent decades, growing from USD2.9bn in 1978 to USD9.8bn in 1988, to USD17.4bn in 1998, and reaching USD27.2bn in 2008. Low-income food-deficit countries are playing an active and growing role in the trade of fish and fishery products. In 2008, their net export revenues were USD11.5bn, while their fishery exports reached USD19.8bn (FAO, 2011).

There is a discussion about whether export promotion of fisheries products from developing countries conflicts with food security issues (Bene, 2008). It is argued that while food could be consumed locally, high foreign exchange rates encourage fish producers to sell their products to export companies. Many argue that the earnings of exports do not contribute to the livelihoods of poor communities, but are biased towards processing companies. However, others argue that export earnings enable a country to import cheaper food from other countries and moreover that export companies employ more people that could be employed if the fish would be marketed domestically.

4.4 The role of aquaculture in food security in Kenya

Even though Kenya has access to freshwater and marine fisheries Lake Victoria continues to dominate output. Since natural fish stocks in Lake Victoria are declining from overfishing and demand for fish is increasing, aquaculture is considered to be a more sustainable source of protein and income in Kenya. As a result of the subsidised construction of ponds within the framework of the Economic Stimulus Programme (ESP) and the declining catch from Lake Victoria the share of aquaculture has already increased to 7% of total production (see Chapter 3). The USAID funded Aquaculture Collaborative Research Support Programme (Aquaculture CRSP) demonstrated that aquaculture can be a lucrative business opportunity that can address the problems of poverty and food insecurity in rural poor areas. The on-farm trials of the programme in Kenya realised an increase of 350% in net average annualised production raising hopes to both potential and existing farmers (Mbugua, 2008). This was in accordance with the focus of the Kenyan Government on producing more food, earning higher in-

comes and improving economies in these rural areas and aquaculture provides the opportunity to ensure food security, alleviate poverty, and promote social equity and prosperity in such areas (Mbugua, 2008).

As was mentioned in Chapter 3, most Kenyan fish farmers are smallholders that operate ponds as a mainly subsistence activity. Only recently the Kenyan Government has been trying to make farmers more aware of the fact that if farming practices are improved, fish farming can be an economically profitable activity. If the government succeeds, an increasing number of farmers will become commercially oriented. However, the number of large-scale farms in Kenya as well as the employment generation from aquaculture is still limited. It is unknown what share of total aquaculture production comes from large-scale producers. There have been a number of large-scale aquaculture farms, but some of them have ceased production for unknown reasons. It is advisable to analyse the reasons why a number of these farms have stopped.

4.5 Towards a suitable production model

As mentioned in Chapter 3, in 2009 about 147,000 tonnes of fish were available for domestic consumption. As natural fish stocks in Lake Victoria are declining from overfishing and demand for fish is growing an increase in the supply of fish is not expected from capture fisheries and thus has to come either from imports or aquaculture. If fish can be produced in Kenya at competitive prices it is assumed that it is preferable to produce it domestically. If a per capita fish consumption of 5 kg and a population growth rate of 2.462% are then taken into account, the additional production volume required to maintain this level of fish consumption can be estimated for different years (see Table 4.1). Furthermore, if productivity of different culture systems is also taken into account the number of ponds or farms and the required area can also be estimated. The same can be done if it is assumed that as a result of a changing consumption pattern the per capita fish consumption is expected to increase to 6 kg (see Table 4.2).

Table 4.1		Additional production, area and number of ponds or farms required to maintain consumption at 5kg per capita by 2015, 2020 and 2030				
Year	Popula- tion a)	Additional annual production	Semi-intensive tilapia ponds b)		Intensive catfish farms c)	
	In million	In tonnes	In hec- tares	In ponds	In hec- tares	In farms
2011	41.0	0	0	0	0	0
2015	45.2	20,946	5,237	174,552	6	279
2020	51.0	50,164	12,541	418,033	13	669
2030	63.0	110,000	27,500	916,667	29	1,467
a) CIA 2011; b) Current system: 300 m ² semi-intensive tilapia pond with productivity of 4 tonnes/yr.; c) 200m ³ intensive catfish farm with productivity of 3,750 tonnes/yr.						

Table 4.2		Additional production, area and number of ponds or farms required to increase per capita consumption to 6 kg by 2015, 2020 and 2030				
Year	Popula- tion a)	Additional annual production	Semi-intensive tilapia ponds b)		Intensive catfish farms c)	
	In million	In tonnes	In hec- tares	In ponds	In hec- tares	In farms
2011	41.0	0	0	0	0	0
2015	45.2	66,136	16,534	551,129	18	882
2020	51.0	101,197	25,299	843,306	27	1,349
2030	63.0	173,000	43,250	1,441,667	46	2,307
a) CIA 2011; b) Current system: 300 m ² semi-intensive tilapia pond with productivity of 4 tonnes/yr.; c) 200m ³ intensive catfish farm with productivity of 3,750 tonnes/yr.						

As an example two scenarios will be discussed in more detail. First of all the 5kg per capita fish consumption in 2020 and second of all the 6 kg per capita fish consumption in 2030. To maintain the current level of fish consumption in 2020 total annual production has to increase by approximately 50,000 tonnes. Theoretically this increase can be achieved by digging an additional 418,000 (tilapia) ponds with a total area of about 12,500ha. Another option is the construction of less than 300 intensive (catfish) farms. This requires a much smaller number of farms (<700) and also a comparatively smaller area of around 13ha. To increase the current level of fish consumption in 2030 by 1kg to an annual

per capita fish consumption of 6kg, total annual production has to increase by approximately 173,000 tonnes. Theoretically this increase can be achieved by digging over 1.4m additional (tilapia) ponds with a total area of about 43,000ha. Another option is the construction of about 2,300 intensive (catfish) farms. This requires a much smaller number of farms (<700) and also a comparatively smaller area of around 81ha.

Based on the current situation it might be argued that the fastest impact on food security in rural areas might be achieved through improving production methods and training farmers to enable them to commercialise their operations. However, considering the scenarios mentioned about it seems doubtful that this strategy will improve food security in urban areas that are far away from production sites. Even to maintain per capita fish consumption at the present level a complementary production model (i.e. more intensive culture systems) will be necessary.



5 Aquaculture constraint and opportunities

5.1 Key findings

- The market potential for fish is high and the Kenyan government is actively promoting the consumption of fish for health reasons.
- Most Kenyan people are unaware when it comes to a preference for a particular fish species, although tilapia is currently most commonly eaten. There are no specific objections to catfish consumption.
- Three main market segments can be distinguished:
 - Low income living mainly in urban areas. They prefer small sized whole fish or small portions of a larger fish;
 - Middle income prefer small to medium sized whole fish;
 - High income prefer big fish.
- It may be more lucrative for fish farmers to produce small sized fish that fetch a higher price per kg, than larger fish that fetch a lower price per kg.
- Value adding (smoking or frying) and awareness raising on fish and fish preparation is needed.
- Production of fish can be increased by raising the production in currently existing ponds and by farming in new intensive systems.
- The major bottlenecks for (intensive) fish farming are: feed, sufficient numbers of fingerlings, water, farm management, organisation of the value chain, marketing, capital, supportive legislation and policy.
- Needed are: locally produced reasonably priced fish feeds, improved standards for hatchery and breeding programmes, sites for intensive aquaculture, training through the private sector, importation of knowledge, formation of fish farming clusters, legislation on standards for feed and fingerlings, exemption of the taxes on imported fish feed and feed ingredients, better market linkages.
- The feasibility of low cost closed recirculation systems for intensive catfish production should be investigated.
- Increased private sector involvement is crucial for the sustainable development of the Kenyan aquaculture sector.

5.2 Introduction

Towards the end of the fact-finding mission a workshop was organised in Nairobi. The aims of this workshop were twofold. First, to validate the findings from the desk study and the key informant interviews (see Appendix 1) and, second, to gain new insights into the constraints and opportunities for the sustainable development of aquaculture in Kenya. The set-up of the workshop was small to facilitate group work and discussions. The workshop was attended by 13 people from various lines of business including entrepreneurs (including fish farmers, a retailer, a fish monger and a feed producer), bankers, governmental staff and NGO staff (see appendix 2). The workshop consisted of five sessions; opening session, aquaculture markets, production models, bottlenecks & solutions and conclusion. The three thematic sessions consisted of a break-out in three small groups that was followed by plenary presentations and a groups discussion.

In the following three paragraphs the results of the three thematic sessions are presented. The last paragraphs includes the conclusions of the workshop.

5.3 Aquaculture markets

In general most Kenyan people are unaware when it comes to a preference for a particular fish species. For instance in supermarkets and local markets Nile perch and Common carp are sometimes sold as tilapia. Tilapia is currently the most eaten fish. Traditionally lakeside communities catch it and eat it and Kenyan children learn about it in school. Catfish is appreciated in certain regions, but overall it is still a niche product. Common carp is bony and thus less preferred as people are scared that the bones will get stuck in their or their children's throats. Besides communities that traditionally eat fish, other people eat it as a luxury meal or for health or medicinal reasons. The Kenyan Government has promoted the consumption of white meat (e.g. fish and chicken) instead of red meat because of the high and increasing rates of cardiovascular disease faced by the Kenyan population.

Different market segments can be identified, ranging from rural to urban, from high to low income, from high to low consumption and even the tourist segment. However, to provide the Kenyan consumers with what they can afford to buy in general three main market segments can be distinguished, namely:

- *Low income*

Families with a low purchasing power living mainly in urban areas (often slums). They prefer the relatively small portions of fish, either small sized

whole fish (e.g. 100-150gr of tilapia), or small pieces of larger fish such as catfish, because, at current prices, this allows them to buy one fish or piece for each family member.

- *Middle income*
The preference of families with a middle income can vary from small size to comparatively larger fish (e.g. 250-350gr).
- *High end markets (e.g. restaurants and processors)*
The preference of high end consumers focusses on big size fish with a size high above the 350-gr upper limit for the middle income segment.

Because of this situation there is no direct relation between the size of the fish and the price per kg. It may in fact be more lucrative for fish farmers to produce small sized fish that fetch a higher price per kg.

A number of challenges remain when it comes to product marketing. These challenges can mostly be traced back to the relative ignorance of the Kenyan consumer when it comes to a preference for a particular fish species. If, as was mentioned above, people are sold fish species that are unjustly labelled as tilapia, this may create a negative image if the fish does not live up to their expectations. Increasing awareness can be part of a marketing strategy, where value is added by either preparing the fish or show people how to prepare fish themselves at for instance farmer field days. Currently both value addition by traders (e.g. fish mongers) as well as consumer fish preparation and cooking skills are poor. Nevertheless people are aware that in general consumers will only come back to buy more fish if they had a good experience with the fish they bought earlier.

Opportunities lie mainly in value addition like smoked and fried fish or fish balls and fish samosa. However, there also appears to be a market for live catfish for mainly Muslim customers.

5.4 Production models

To improve or at the very least maintain the role of aquaculture in food security in Kenya, the participants of the workshop agreed on a dual approach to aquaculture development. On the one side this approach focusses on increasing the productivity of current ponds while on the other hand it tries to encourage farming in more intensive production systems. These approaches are similar in the sense that in both cases production should be market oriented and the private sector plays a central role in the implementation of both approaches.

Increased productivity of current ponds. The productivity of current ponds can be achieved through improved farm management and improving the quality of farm inputs. Construction of additional ponds (at a later stage) is not ruled out, but the driving force behind this should be the private sector rather than the government.

Encourage farming in new intensive culture systems. First of all this includes the farming of fish in higher production flow-through ponds or tank and/or cage systems. Furthermore it includes the application of new technologies, better water quality and feed management, and most likely other species (catfish is more suitable for intensive farming than Tilapia). Fish farming in intensive culture systems requires considerably less land than the currently more extensive production model, but requires more water, better feed, more capital and improved technology.

5.5 Bottlenecks & solutions

To effectuate the dual approach that was outlined in the previous paragraph a number of bottlenecks need to be overcome. The main bottlenecks that were identified during the workshop are related to farm inputs, farm technology, farm management, value chain and cluster organisation, marketing and policy support.

5.5.1 Farm inputs

As far as farm inputs are concerned feeds are considered to be the most important issue. High and stable quality fish feeds are difficult to find and high-priced and there are few Kenya manufacturers. High quality feeds are particularly indispensable for successful fish farming in intensive culture systems, but it is not feasible to carry out this activity based on imported feeds as a result of high tariffs. At the moment an enabling environment is lacking. Currently part of the ingredients are imported from Rwanda, Tanzania and Uganda, but as a result of an increased human - aquaculture competition for protein and increasing cost of petrol, the prices of fish feed and fish feed ingredients are increasing. It is important to take a closer look at options for feed formulation based on local (i.e. Kenyan) ingredients. The question is which feed ingredients can be locally sourced, either through local production (ingredients from plant origin) or through processing of local resources (e.g. meat and bone meal as by product from animal slaughtering), and how much still needs to be imported at what

costs. Finally there is the question of feed manufacturing, since extrusion is expensive as a result of the high cost of electricity. This situation is aggravated by power rationing, which interferes with a stable supply of power.

Technically the production of fingerlings is no longer a challenge, but since demand is increasing (e.g. for monosex tilapia fingerlings) there is a need for increased production and stable quality. Furthermore, the pricing is an issue since the government provides fingerlings at a much lower price than private hatcheries (KES5 compared with KES10 or 15 per fingerling). It is not about the quality of fingerlings, but the quality of broodstock as a result of inbreeding. There is a need for hatchery standards and a national breeding programme.

Particularly the farming of fish in intensive culture systems requires large quantities of water. If the supply of water and the water quality are compromised the intensive culture system cannot function. This requires careful site selection based on the right water quantity and quality requirements and other requirements (e.g. power hook-ups, temperature). Alternatively, one could look into the feasibility of low cost closed recirculation systems.

5.5.2 Farm technology and management

Improved farm management is a precondition to improve productivity. Like in any other business, fish farmers continue to learn through learning events and experiences. Training plays an important role in this process.

Many researchers and government extension officers do not have much practical expertise. This is a setback to fish farmers who depend on their advice. As a result people generally have low expectations of training provided by extension officers and farmers without proven experience (farmer-to-farmer and training of trainers). Exchange programmes (farmer to farmer training) or importing expertise can contribute to solving this problem if sufficient attention is paid to ensure a trickledown effect from these programmes. Furthermore, it is important that information is disseminated in the appropriate format.

It is the general opinion of most of the workshop participants that training through private parties is preferred as private players are better at this. As fish farming is a commercial activity, privately operated model farms are therefore preferred to government demonstration farms.

5.5.3 Value chain and cluster organisation

To facilitate the improved organisation of their value chain, farmers can organise themselves in clusters. These clusters have several potential advantages.

They can improve bargaining power when purchasing inputs, make it easier for farmers to jointly invest in cold storage and/or processing facilities and marketing (see paragraph 5.5.4). The value chain can be very complicated. For example, the seed cake value chain (fish feed ingredient) involves many different links, from cotton and sunflower seed producers to trader, to oil processors, to cake processors, to trader, to feed processor to farmers.

5.5.4 Marketing

As a structured clear cut market is lacking, marketing (e.g. creating awareness and product improvement) is crucial. Here it once again becomes clear that fish farming needs to be viewed as a commercial activity rather than a subsistence activity. Individual farmers can benefit from cooperation by using clusters or groups of farmers to improve their market knowledge by for instance gathering and sharing price information. They can also benefit from jointly planning stocking, harvesting and selling their fish (see paragraph 5.5.3).

5.5.5 Capital

Compared with traditional extensive and semi-intensive systems, intensive culture systems are more capital intensive. As a result access to credit becomes increasingly important. Banks say that as long as a business is commercially viable and not a subsistence activity they will provide capital for various links in the aquaculture value chain (e.g. starting capital, cold storage, processing, marketing). However, it is unclear if this is always the case as some apparently commercial fish farmers were unable to get credit.

5.5.6 Policy support

According to some of the workshop participants there exist no particular aquaculture regulation on feeds (incl. premixes), seed, etc. For instance standards need to be set for feed and seed and there is a need for a mechanism for certification of product quality. However, besides having regulations, it is also important to monitor compliance and enforce these regulations. Furthermore, the government should encourage aquaculture by loosening certain rules to provide incentives for aquaculture development (e.g. tax exemptions for feeds (or ingredients), drugs, marketing (e.g. branding and billboards). As Public Private Partnerships (PPP) makes it easy for all players management support should be

organised through the private sector (e.g. Aqua Shops¹ and other private farms/firms).

5.6 Workshop conclusions

At the end of the workshop the following main conclusions were presented:

- The presence of a market for aquaculture products is very important. The market potential is high, but the market should be segmented based on consumer preferences and the purchasing power of specific groups of consumers (e.g. low income). Fish farmers should then focus on producing a product that is not only preferred by consumers, but also affordable. To improve the market for cultured fish specific attention needs to be paid to diversification, value addition and awareness campaigns.
- The productivity of current ponds needs to be improved. However, to achieve national food security objectives the farming in new intensive culture systems should also be encouraged.
- Increased private sector involvement is crucial for the sustainable development of the Kenyan aquaculture sector.
- Market linkages need to be developed.
- Through appropriate policies and regulations the government should create an enabling environment for the development of aquaculture in Kenya.

¹ www.farmafrica.org.uk/kenya/aqua-shops-project



6 Aquaculture business opportunities

6.1 Key findings

- Fish culture in the Netherlands is small but unique because almost all of the fish is produced in indoor farms under controlled conditions with re-use of the effluent water. The major species are African catfish and European eel.
- The Netherlands based supportive aquaculture industry is large, international oriented, and includes multinationals like Nutreco (feeds), Hendrix Genetics (breeding) and Intervet (vaccines and medicines), but also a number of small and medium sized companies that supply complete fish farms, farming systems and farming materials like water treatment systems.
- Technology and knowledge is another important product of the Dutch aquaculture industry.
- A number of existing Dutch fish farms are confronted with limited possibilities for expansion and are looking for investment opportunities abroad.
- A number of horticulture farms in Kenya are interested in diversification and are looking at possibilities for fish culture.

6.2 Fish culture in the Netherlands

The culture of finfish for consumption purposes in the Netherlands took off in the 1980s with the availability of technology to culture fish under controlled conditions independent of their natural environment. These culture systems are named Recirculating Aquaculture Systems (RAS). RAS are land based fish production systems in which water from the rearing tanks is re-used after mechanical and biological purification to reduce water and energy consumption and to reduce nutrient emission to the environment. In this respect the Dutch finfish aquaculture sector is unique in Europe and worldwide because the entire sector is based solely on RAS. Compared with cages, flow-through systems or ponds RASs present several advantages. These are: water and energy savings, water quality control, low environmental impacts, high biosecurity and an easier control of waste production (Schneider et al., 2010).

There are currently approximately 40 companies growing fish for consumption in RAS, plus approximately five outdoor rainbow trout farms. The most popular species are European eel (3,000 tonnes) and African catfish and hybrids of

catfish (4,000 tonnes). In addition turbot, pike-perch and yellow-tail king fish are grown by a small number of pioneering farms.

6.3 Supportive industry

Despite a rather small fish culture industry in the Netherlands, the Netherlands-based supportive industry is large, international oriented, and includes multinationals like Nutreco and Intervet. Below an overview of the major companies that supply products and services for the aquaculture industry. Since the fishing industry in the Netherlands is much larger than the aquaculture industry, there are numerous companies that supply products for fisheries, fish handling and fish processing. Many of these products are also used in aquaculture, either directly, or are used in the value chain (processing of fish). A complete listing of all these companies falls beyond the scope of the present study. Additional information regarding companies involved in trade in fish and fish products can be found on the website of the Dutch Fish Product Board¹ and in the Handbook VIS Totaal 2010.²

Feed Industry (complete feeds and ingredients for fish feeds):

Nutreco Holding N.V.:

Nutreco is a global leader in animal nutrition and fish feed. In 2010 Nutreco had an annual revenue of 4,940m of which 38% in fish feeds (only 2% in Africa). In 2010 Nutreco employed a total number of 9,913 people. Nutreco is internationally active in a number of African countries with the export of fish feed from Europe. Produces fish and shrimp feed in a number of Asian countries. Nutreco's fish feed business Skretting has business units on five continents producing fish feed in 14 countries with sales in over 40 countries (www.nutreco.com).

Coppens International B.V.

Coppens International (CI) is specialised in developing en producing fish feeds for farming. Fish feeds. Employees: 40. Exports to Africa, is also engaged in local production and sales (Ghana).

¹ www.dutchfish.nl/uk/default.asp

² <http://handboekvistotaal.nl/>

De Heus Voeders B.V.

De Heus Voeders is an international company whose core activity is the manufacture and marketing of high quality feed. In 2010 De Heus had an annual revenue of 1,3bn and employed 1,700 people. It recently acquired a fish feed factory in Vietnam. Outside of the Netherlands De Heus has activities in over 30 countries. In Africa De Heus is active in Ethiopia and South-Africa. De Heus is also active on the Chinese market where they have an alliance with Wellhope Agri-Tech Co Ltd. Worldwide the company has over 1,700 employees (575 in the Netherlands).

Provimi B.V.

Provimi is one of the leaders in the international animal feed industry, specialising in the development and production of premixes, concentrates, additives and specialties for animal, fish and pet food. In 2010 Provimi had an annual revenue 1.6bn worldwide and employed 8,000 worldwide.

Medicines & vaccines

Intervet/Schering-Plough Animal Health

Intervet, Aquatic Health (now MSD Animal Health). Produces fish and shrimp vaccines, antiparasitics, anti-infectives, speciality pharmaceuticals and endocrine/fertility products. In 2009 MSD Animal Health had a revenue of USD27bn and employed 100,000 people.

Breeding

Hendrix Genetics B.V.

Hendrix Genetics is a leading multispecies breeding company, with 5 divisions including aquaculture breeding. Selective breeding technology of mainly salmon. Hendrix Genetics employs over 1,500 people including joint ventures with locations in more than 22 countries.

Til-Aqua International B.V.

Breeding and selection of Tilapia. Tilapia hatchery management, design and construction.

Fish culture systems

Aquaculture Consultancy & Engineering (ACE)

Specialised in design and construction of equipment and farm systems for aquaculture.

Fishion B.V.

RAS systems, processing equipment en consultancy.

Fleuren & Nooijen B.V.

Designing and constructing aquaculture recirculation systems, consultancy, production and export of African catfish fingerlings.

HESY Aquaculture B.V.

Design and construction of fish farms. Employees 15. In Africa HESY constructed fish farms in Benin, Morocco and Burkina Faso.

Fish Farmers

A number of Dutch fish farmers have shown interested to supply knowledge of reproduction, farming, fish farm management, and investment capital.

Fish culture equipment

Catvis B.V.

Supplier of quality equipment and larval feeds to the aquaculture. Water treatment, feeders, handling, aeration & oxygenation, off shore, systems.

Multivis waterbehandeling B.V.

Water treatment components and complete RAS systems for fish culture.

Paques B.V.

Develops and produces purification systems for water, gases and air, using biotechnology.

Technology and consultancy

Aquaculture Experience

Aquaculture Experience offers independent freelance consultancy services related with the aquafeed and aquaculture industry.

Sustainable aquaculture solutions (SAS consultancy)

Assistance and advice for aquaculture and aquaculture-related companies and organisations (mainly on aquatic health).

Holland Aqua B.V.

Advice and project management on aquaculture, air and water treatment systems, and process and product quality.

Vigon B.V.

Advice on aquaculture and waste water technology.

6.4 Horticulture

The integration of aquaculture with other types of agriculture (rice, livestock, horticulture) is a traditional practice in many Asian countries. Resources and waste products from one farming system can be used as inputs in another farming system: manure of ducks as fertiliser for fish ponds; nutrient rich water from fish to for the irrigation of crops. In the Netherlands, several studies have been undertaken on the possibilities for the integration of intensive fish culture with horticulture in green houses. Advantages of such an integration lie in the utilisation of nutrient rich fish farm effluent for irrigation and fertilisation of crops such as tomatoes, and the utilisation of the CO₂ from fish farms in greenhouses.

In a comprehensive two-year research project 'EcoFutura', implemented by the Dutch companies Priva, Aqua Terra Nova, Green Q and Groen Agro Control, the feasibility of an integrated tilapia nursery and a hydroponic tomato plantation was studied. Although the project concluded that the mutually beneficial relationship between the fish and tomatoes offers significant benefits with regards to cost and environmental impact, the practice is as yet not widely applied, mainly because of the low market prices of Tilapia in the Netherlands.

In Kenya horticulture is an important industry involving many Dutch companies. After tea, horticulture is Kenya's second most important export product accounting for 14.5% of total domestic export earnings in 2010 (AfDB, OECD and UNECA, 2011). Annually Kenya exports approximately 80,000 to 100,000 tonnes of cut-flowers. About 80% of this volume consists of roses over 50% of which are destined for Dutch flower auctions that re-export these flowers to other countries. Some of these companies are interested in diversification and are looking at possibilities for fish culture (e.g. Terrasol and Molly Flowers). Fish

culture could be an integral part of the horticulture operations, but the economics of such an integration needs to be further investigated. Alternatively, horticulture farms that use warm water from underground sources could use part of this water directly or indirectly (depending on the water quality) to grow fish. In this way the fish culture operations are largely separated from the horticulture operations, thus spreading the financial risks involved.



7 Recommendations and business opportunities

7.1 Main conclusions

- The potential for aquaculture in Kenya is good, despite sub-optimal environmental conditions (altitude, soil conditions, access to water) in certain regions for aquaculture development. The major advantage is the high (and growing) demand for fish, the relative high market prices of fish, the concentration of consumers in urban areas, the well-developed infrastructure, and the importance given to aquaculture by the Kenyan government.
- It is very unlikely that the present aquaculture policy will result in sufficient additional fish production to meet the demand of Kenya's rapidly growing population. This is the case even when fish consumption remains at its current relatively low level. This is mainly due to the emphasis that is given to smallholder development and the rather extensive farming systems being practised by these smallholders. Smallholders can play a role in the provision of fish protein for local markets. However, this business model will be unable to provide the quantities of fish protein that Kenya requires during this decade. Therefore we suggest a complementary model.
- This complementary business model comprises the intensive culture of African catfish. Catfish is relative easy to grow in high densities, thus making it an ideal species for the provision of cheap fish protein under conditions of limited natural resources (available land and sufficient amounts of suitable water). In countries such as the Netherlands, Nigeria and Vietnam there is a lot of experience with the intensive culture of catfish. Therefore, a substantial production increase can be realised through the development of intensive catfish culture in Kenya. This can be done in land-based farming systems, but possibilities for intensive fish farming in cages should not be ruled out.
- Compared with the current low productive forms of aquaculture, the development of intensive catfish culture requires an increased and stable supply of high quality inputs (e.g. water, feeds, fingerlings, technology and capital). As a result, it is more sensitive to fluctuations in cost price and the volatility of the Kenyan Shilling. Therefore, the production needs to be organised as part of an integrated value chain with access to different market segments.

This makes catfish farming a full-fledged commercial activity - as opposed to a subsistence activity - that needs to be run by the private sector.

- Dutch companies can provide feeds, farming and processing equipment and technology, know-how, value chain development expertise and investment capital. There is considerable interest from the Kenyan private sector (feed companies, fish farmers, horticulture farms) to link up with these Dutch companies.

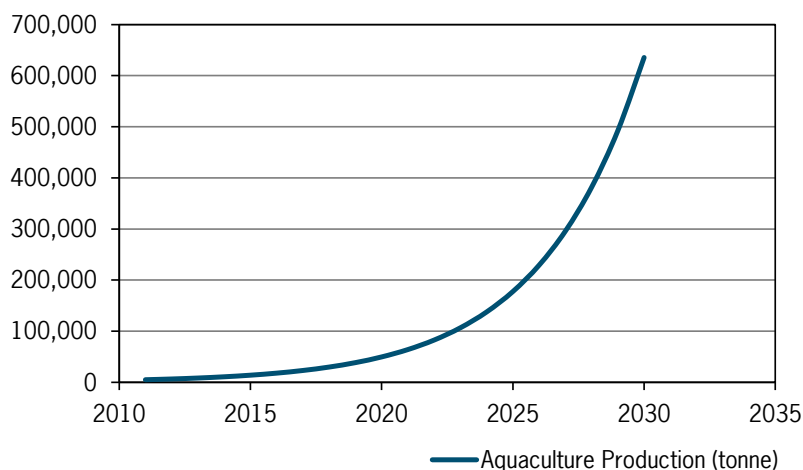
7.2 Plan of action

To facilitate the development of this complementary business model we advise the Embassy of the Kingdom of the Netherlands in Nairobi to act on two levels: 1) influence Kenyan government policy and 2) facilitate Dutch and Kenyan private sector involvement. Both levels are interrelated and should be initiated in tandem.

The most important policy issues are the taxes on imported fish feeds and feed ingredients, and the subsidised construction of fish ponds and the subsidised provision of fingerlings and fish feeds. The latter subsidies do not only result in the construction of fish ponds at unsuitable locations, but also create unrealistic expectations on the side of the fish farmer regarding the economic viability of the farm. Furthermore, the Kenyan government should set (and maintain) quality standards for locally produced fish feeds. Some progress is currently being made with regards to the setting of standards for tilapia feed.

For the facilitation of the Dutch and Kenyan private sector involvement in commercial aquaculture we propose an approach that can be used as a model for aquaculture as a supplier of affordable fish protein in East Africa.

We anticipate that, through the development of intensive catfish aquaculture, Kenyan fish production can grow from approximately 5,000 tonnes in 2010 to 50,000 tonnes in 2020, and eventually to over 600,000 tonnes in 2030 (see Figure 7.1). For this exponential growth in fish production, the first phase is the most critical. Therefore, Dutch support is particularly needed during this phase (2012-2015), when production needs to grow from 5,000 tonnes to 13,000 tonnes.

Figure 7.1**A possible scenario for increased intensive catfish production in Kenya**

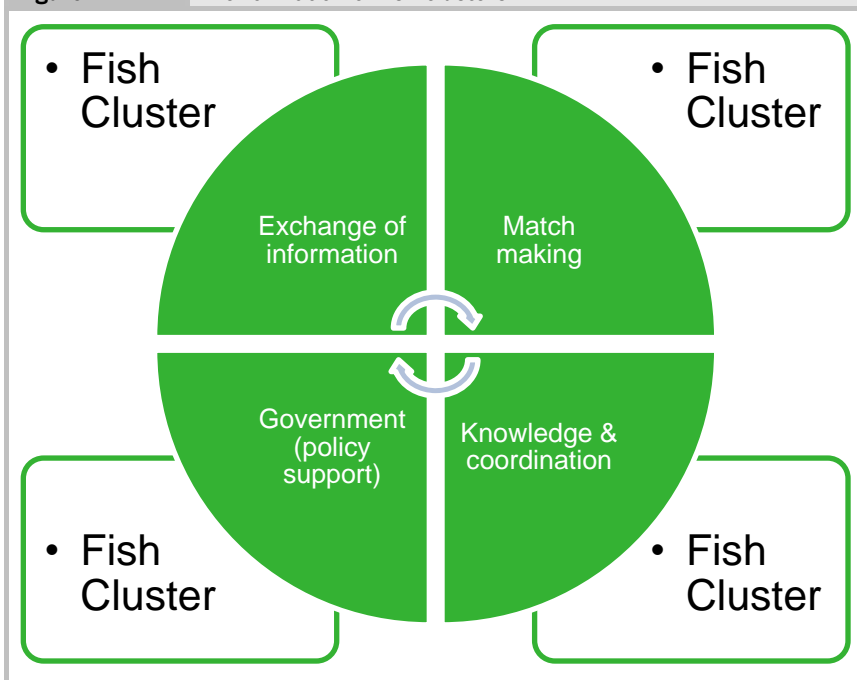
7.3 Supportive activities

- We propose to carry out the following supportive activities:
- To present our findings and distribute of our mission report to Dutch stakeholders (private sector companies and the Ministry of Economic Affairs, Agriculture and Innovation) (2011).
- To investigate the degree of interest and possible preconditions of Dutch companies to get involved in the development of commercial aquaculture in Kenya (2012).
- To gather necessary baseline information (2012). Most private companies will not engage in intensive aquaculture if there is no information on the available amount, quality and temperature of water, the availability, quality and price of fish feed, the number of farms that can be constructed, and the overall quantity of fish that can be produced in Kenya in the coming years. These factors determine which culture systems are the most feasible, and thus determine the cost price of fish produced. This in turn relates to the different market segments that can be supplied with fish with specific characteristics (e.g. size, volume, fresh). Fish feed, water resources and the organisation of the value chain are among the major constraints for intensive aquaculture in Kenya. Therefore, additional information is needed regarding

the possibilities and the feasibility to produce high quality fish feed in Kenya, and on the locations where sufficient water of appropriate quality is available. Furthermore, current market imperfections need to be addressed: what is the current market structure, how can cultured catfish fit in, how should the value chain be organised, etc.

- To form 3-5 fish clusters (2012). Once the baseline information is available, the formation of a number of fish clusters can start (see Figure 7.1). Each cluster consists of Dutch and Kenyan companies active in or along the fish value chain, and will supply the Kenyan market with fish and/or inputs for fish production. The clusters consist of fish farmers, input suppliers, processing and market companies. The clusters are initially supported by matchmaking, the exchange of information between clusters, policy support, knowledge and coordination. To encourage cluster formation, investment subsidiary programmes such as the PSI can be used.

Figure 7.2 **The formation of fish clusters**



- To coordinate and facilitate the visit of Dutch companies to Kenya, match-making with Kenyan companies and the formal launch of 'Kenyan-Dutch Fish platform' (2012).
- To continue to support the fish clusters (policy, knowledge and coordination), depending on the progress, existing bottlenecks and new occurring problems (2013-2015).

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Appendix 1

List of key informants

Name	Affiliation	Location
Harrison Charo-Karisa	Kenya Marine & Fisheries Research Institute (KMFRI); national aquaculture development working group (ADWG)	Sagana & Nairobi
Amir Parpia	Alpha Fine Foods (meat & fish processing)	Nairobi
Minaz Kurji	Alpha Fine Foods	Nairobi
Stanley Kimereh	FAO	Nairobi
Dan Rugabira	FAO	Nairobi
Bethuel Oduor Omolo	Dept. Fisheries & KMFRI	Sagana & Kiganjo
Paul Sagwe Orina	Dept. Fisheries & KMFRI	Sagana & Kiganjo
Rachid	Dept. Fisheries & KMFRI	Sagana & Kiganjo
James Bundi Mugo	Mwea Aquafish Farm	Wangúru
J.H. Sput Verwiel	Jambo Fish	Nairobi
Rudy van Dijck	Jambo Fish	Nairobi
Sharon Momanyi	Jambo Fish	Nairobi
Vandan Shah	Sigma Feeds	Nairobi
Salim Nyowe	Wanainch Marine Products Ltd. (fish processing)	Mombasa
Daniel Odiwuor	KMFRI	Mombasa
Ochuodho	KMFRI	Mombasa
Morine Mukami Ngarari	KMFRI	Mombasa
Brendan Muli	Kwetu Training Centre	Mombasa
Charles C. Ngugi	Ministry of Fisheries Development	Nairobi
Peninnah K. Kimweli	Kenya Commercial Bank Ltd. (KCB)	Nairobi
Joseph N. Oseko	Kenya Commercial Bank Ltd. (KCB)	Nairobi
Lena Munge	Kenya Commercial Bank Ltd. (KCB)	Nairobi
Wilfred Musau	Kenya Commercial Bank Ltd. (KCB)	Nairobi
Wakanyi Mwaura	Kenya Commercial Bank Ltd. (KCB)	Nairobi
Florence Nyawira Kariuki	Equity Bank	Nairobi
Dominic Kinuthia	Equity Bank	Nairobi
Suzanne Njeri Kuria	Kamiti Fish & Integrated Farm (KFIF)	Nairobi

Name	Affiliation	Location
Kinyua Kamau	Tea Holdings Limited (THL) & Roost Ltd.	Kiambu
Kabila		
Susan A. Otieno	Farm Africa	Kisumu
Sjaak Nannes	Terrasol	Nairobi
Warmolt Tonckens	Molly Flowers Ltd.	Nairobi
David Mathai	Greener Earth Technologies Ltd.	Nairobi
Susan Maina Lusega	Kenya Gatsby Trust (KGT)	Nairobi
Mehrdad Ehsani	Kenya Gatsby Trust (KGT)	Nairobi
Judith Waudu	Department of Foods, Nutrition and Dietetics	Nairobi
Mathew Ngila	District Fisheries Office	Lake Navaisha

Next to above, a number of markets, fish farms, seaweed farms, and an Artemia farm and a demonstration farm in the areas of Nairobi, Lake Navaisha, Sagana, Mombasa en Malindi were visited.

Appendix 2

List of workshop participants

Title: Aquaculture business opportunities in Kenya - with a special reference to food security
Date: 3 October 2011
Venue: Fairview Hotel, Nairobi, Kenya

Name	Institution/company	Telephone	Email
David M. Kieba	Davesiher White Nigri Cenipe	722244206	dkieba@yahoo.com
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Susan Otieno	Farm Africa	722363272	saotieno@yahoo.com

Appendix 3

Major economic and regulatory institutions in Kenya

According to the website of the Kenya High Commission UK¹ doing business with Kenya is simplified by the establishment of sectoral technical and service support institutions. These organs are well developed with updates and restructuring as necessary to meet the ever emerging challenges. They help in alleviating unnecessary bottlenecks and bureaucracies that may stifle the process of doing business, touring or investing in Kenya. The Government established these key, professionally run institutions to assist stakeholders in relevant sectors. The organisations aim at making it easy for a buyer of Kenyan products to identify his/her suppliers; tourist to know the products on offer including sites and attractions, and the investor to identify opportunities and set up projects. The organisations include the following:

1. *The Kenya Bureau of Standards*

The Bureau develops, supervises and harmonises standards of goods and services produced in Kenya for both local and international consumption and compliance. The Bureau also regulates, controls and insures quality compliance of foreign goods entering Kenya while recognising the international standardisation procedures and practices. For more information visit www.kebs.org

2. *The Kenya Plant Health Inspectorate Service KEPHIS*

KEPHIS undertakes regulatory procedures and practices on all phytosanitary requirements for the export and import services in Kenya. It is a dependable, effective, efficient and competitive regulatory service which ensures the quality of agricultural inputs and produce. For more information visit www.kephis.org

3. *The Communications Commission of Kenya*

Licenses and regulates telecommunications, radio communications and postal services in Kenya Potential investors in the sector of communications and postal service. For more information visit www.cck.go.ke

¹ www.kenyahighcommission.net/khccontent/doing-business-in-kenya.html

4. *The Centre for Business Information in Kenya*

A division within the Export Promotion Council, the Centre has the objective of providing a potential importer and exporter with a timely, reliable and updated business information at all enterprise levels. It operates as a hub of a national network embracing various sources of business information.

For more information visit www.epckkenya.org/

5. *The Horticultural Crops Development Authority*

This is a parastatal body established to advise growers, exporters and processors to facilitate and increase production of top quality horticultural produce for export and local market. The organisation is also charged with the responsibility of licensing horticultural exporters.

For more information visit www.kenyaweb.com

6. *The Kenya Tourist Board*

The Board is a parastatal organisation charged with the overall responsibility of marketing Kenya as a tourist destination of choice.

7. *The Kenya Tourist Development Corporation (KTDC)*

The Kenya Tourist Development Corporation was established in 1966 with main objective of developing the infrastructural facilities in the tourist industry in Kenya. The organisation has since developed investment strategy going into partnership with foreign and domestic private investors in tourism development.

8. *The Kenya Wildlife Service (KWS)*

The Service is a statutory body responsible for the conservation of biodiversity and sustainable development of natural resources in the national parks and reserves. As a custodian of biodiversity resources, KWS has the role of managing, protecting and conserving the country's natural heritage on which the tourism industry is economically dependent.

9. *The Investment Promotion Agency (IPA)*

The Agency is a statutory body originally established in 1986 as the Investment Promotion Centre to promote private investment in Kenya. Under its new mandate which it acquired in 2005, the IPA is a one-stop shop for investors intending to invest in Kenya. IPA helps facilitate the approvals, licensing of new investment projects, and organising investment promotion activities both locally and internationally.

In approving investment projects, IPA works in consultation with respective government authorities to facilitate the acquisition of relevant approvals, licences and permits. Upon project approval, IPA issues a General Authority Certificate which enables investors to commence immediate implementation of their project while obtaining the required licences within a period of six months.

The Agency is the one point to visit when intending to invest in Kenya in any sector of the economy. It has a list of project proposals which can readily be taken up by any interested foreign or local investor. The IPA has also listed all the investment opportunities available in Kenya in its databank and website.

The contact of the IPA is:

*The Investment Promotion Agency
National Bank Building
Harambee Avenue
P.O. Box 55704
Nairobi
Tel. 00254-20-221401/4
Fax. 00254-20-336663
E-mail: ipakenya@nbnet.co.ke
Website: www.investmentkenya.com*

Appendix 4

Business institutions and associations

According to the website of the Kenya High Commission UK¹ there are a number of non-governmental membership organisations or associations that work closely with the government and international institutions to facilitate business contacts and ease transactions in Kenya. These include:

1. *The Kenya National Chamber of Commerce and Industry*

This is an umbrella lobbying body for the business community in Kenya. It advises both the government and business community on the trend of local and international trade. The chamber of commerce and industrys membership in Kenya is voluntary. The one umbrella body with headquarters in Nairobi has countrywide branches in major cities.

For more information contact:

Kenya National Chamber of Commerce & Industry

P.O. Box 47024

Nairobi

Tel.00254-20-220867

'-20-333468

Fax.00254-20-334293

E-mail: inquiry@kenyachamber.com

or Uhcci@swiftkenya.com

2. *The Federation of Kenya Employers* established in 1959 looks after the collective interests of the employers mainly investors in all sectors of the economy in Kenya. For more information visit www.fke-kenya.org
3. *The Fresh Produce Exporters Association of Kenya* is a non-governmental membership organisation. Its main objective is to promote the horticultural sector by undertaking market intelligence, export promotion, technical support and training of the members. It works closely with Kenya Plant Health Inspectorate Service, Kenya Flower Council, and Horticultural Crops Development Authority for maintenance of high quality fresh produce in Kenya for

¹ www.kenyahighcommission.net/khccontent/doing-business-in-kenya.html

the local and export market.

For more information visit www.africaonline.co.ke/fpeak

4. *The Kenya Flower Council* is an organisation established by major stakeholders in the flower industry to foster responsible and environmentally safe production of cut flowers and related products to make Kenya flowers competitive and safe in both the local and export markets. The Council has established stringent code of practice and standards that members must adhere to, including six month continuous farm audits.

For more information visit www.kenyaflowers.co.ke

5. *The Kenya International Freight and Warehousing Association* ensures fairness, professionalism and efficient management of in and out going freight. Importers and exporters depend on the association members to move their goods to the markets. Contacts and information visit

Kenya International Freight & Warehousing Association

Bishop Garden Towers,

Bishops Road

P.O. Box 57969

Nairobi

Tel. 00254-20-2717071

'-20-2727806

Fax.00254-20-2722536

'-20-213952

E-mail: kifwa@nbnet.co.ke

6. *The Kenya Private Sector Alliance (KEPSA)* brings together all associations in the private sector in Kenya. It is a one-stop umbrella association to turn to in case of need to contact any product or service association or individual companies in Kenya. Any association not introduced in this website can therefore be traced by any investor, trader and service professional or consumer of any sector through KEPSA.

For more information contact Kenya Private Sector Alliance, Bishops Garden Towers- 1st Floor Bishops Road, P.O. Box 3556, 00100 Nairobi, Kenya: Tel. 00254-20-2730371/2, Fax. 00254-20-2730374 and e-mail: kepsa@kenyaweb.com

7. *The Kenya Association of Manufacturers* is an organisation established in 1959 to be the sole representative of the manufacturers in Kenya. Its objective is to drive industrialisation process in Kenya through promotion of competitive local manufacturing in a liberalised market environment.

For more information visit www.kenyamanufacturers.org

The mission of Wageningen UR (University & Research centre) is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine research institutes – both specialised and applied – have joined forces with Wageningen University and Van Hall Larenstein University of Applied Sciences to help answer the most important questions in the domain of healthy food and living environment.

More information: www.wur.nl