Chapter 3

Kenya's Fishing Industry

3.1 Introduction

In this chapter, Kenya's fishing industry is described. The chapter commences with an overview of the entire fishery sector in the country and follows this with a detailed analysis of the fisheries of Lake Victoria, the subject of this study. In presenting an overview of the country's entire fishing industry, we seek to show that despite the sector's small contribution to the gross domestic product (GDP), it is a significant source of livelihood and employment for many Kenyans. The dominance of Lake Victoria fisheries in the industry is emphasised as a justification for the choice of these fisheries as the subject of the research. To motivate the subsequent analysis, the factors responsible for biodiversity loss in the Kenyan fisheries of Lake Victoria are discussed in detail. The chapter, in addition, presents a comprehensive analysis of fish marketing and pricing and their socio-econo-environmental effects. Since fish is a nutritionally rich food, we assess its position, relative to other foodstuffs, in the country's national food policy. Existing literature and data, together with the micro-data obtained from the survey described in Chapter 2, are used.

3.2 An Overview of the Industry

Role of the industry in the economy

Kenya is a coastal state and like other coastal states has jurisdiction over 200 nautical miles of the ocean from its shore, thanks to the 1982 Law of the Sea Conference. The country, therefore, has rich marine resources along its coastline of 640 kilometres. Technological capacity constraints have, however, meant that the potential of these resources has remained largely inaccessible to Kenyans. Hardly surprising, therefore, that marine fisheries contributed only 3% of the 193,789 tonnes of fish produced in Kenya in 1995.[12] The rest of the fish was harvested from inland fresh waters, including lakes, rivers, dams and fish farming in ponds. Lakes account for the lion's share of the total output, 95% in 1995. In fact, one of the lakes, Lake Victoria, dominates the country's fishing industry. The lake accounted for 98.6% of the total catch obtained from lakes in 1995 and 94% of the country's total catch that year.

Fishing makes a small but increasing contribution to Kenya's GDP. The sector accounted for an average 0.2% of the country's annual GDP between 1971 and 1981. This, however, increased so that by 1989/90 fishing accounted for about 2% of the GDP attributable to the non-monetary economy and 4.4% of the monetary sector's GDP. This marked improvement in

[12] These figures and most of the others used in this chapter, unless otherwise stated, are obtained from issues of the Fisheries Department's *Fisheries Annual Statistical Bulletin.*

performance is attributable to the exports of filleted Nile perch that began in earnest in the mid-1980s.

The relatively small contribution to the GDP notwithstanding, the fishing industry is the lifeline for the Kenyan communities living around Lake Victoria and the Coast. In 1995, for instance, the Fisheries Department estimated that 798,000 Kenyans were, directly or indirectly, supported by the sector compared to 720,000 in 1993. In 1995, there were 34,000 fishermen with an estimated 238,000 dependants and 526,000 other people engaged in the provision of support and ancillary services such as trade in fishing inputs, fish handling, processing and marketing. This is extremely important particularly for the lake region where alternative economic prospects are limited. Rainfall is low and soils poor in the region, severely limiting agriculture. Paid jobs in the region, like in the rest of the country, are very scarce.

In 1995, fish trade earned fishermen Kshs 5.2 billion while the retail value was estimated at Kshs 19.5 billion, in nominal terms. These figures have been increasing every year. The country earned Kshs 1.5 billion in foreign currency from fish exports in 1995. These foreign exchange receipts are actually underestimated as they exclude earnings from sporting activities. Today, sport fishing in both inland waters and at the coast is just as important to tourism as are the wildlife resources in the National Parks.

The industry is, moreover, an increasingly important source of food even for people living far away from the fish producing areas. Not only is it a significant source of animal protein, accounting for about 5.6% of the total on average, but per capita fish consumption in the country has been on the increase. While per capita consumption stood at only 3 KGs in 1980, it had more than doubled to 7.5 KGs barely ten years later, reflecting increasing acceptance of fish as food even in areas of the country, notably Eastern, Central and North Eastern provinces, where consumption of the commodity was previously insignificant. These per capita fish consumption figures are inflated, however, as will be discussed later.

The fishing industry, in addition to the above roles, supplies raw materials to other sectors of the economy, notably manufacturing and agriculture. Thus, spoilt fish, by-products of fish processing, and some fish species such as *Rastrineobola argentea* and *Carodina nilotica* are processed into a valuable protein-rich animal feed. These animal feeds are important inputs in poultry, dairy and beef production.

The food policy of Kenya and the role of fish in this policy, together with the effects of fish export and the fishmeal industry on the livelihoods of the fisher-folk are discussed in greater detail in section 3.3.5 of this chapter.

Production trends

Fish production in Kenya has grown remarkably from 1965 when only 23,000 metric tonnes of fish were harvested from all of the country's fish sources. Table 3.1 and Fig. 3.1 show that Kenya was producing about eight and half more fish in 1995 than it did in 1965. This remarkable growth is attributable to the Nile perch that was introduced into the lake in 1954 and became commercially important in the early 1980s. In 1978, only 1,000 tonnes of Nile perch were produced from the Kenyan portion of Lake Victoria. This had increased to 23,000 tonnes by 1981 and peaked at 123,000 tonnes in 1991. In terms of value, the performance was, in fact, more impressive. Thus, as is apparent from Table 3.2 and Fig. 3.3, the real value of fish produced in Kenya in 1995 was 21 times higher than that produced in 1965.

Until the 1990s, the general trend in aggregate production was an upward one. Growth in quantity of catch was positive until 1990 when it peaked at 201,780. Production dropped in the subsequent three years to 183,081 tonnes in 1993 but picked again to reach the highest level, so far, of 202,865 tonnes in 1994. Since 1994 there has been declining fish catch in spite of increasing fishing effort[13], indicating that resource productivity limits are becoming increasingly stringent. Nile perch landings in Kenya have been on a downward trend from the peak of 1991. In 1996, only 96,500 tonnes were harvested.

Table 3.1: Quantity of fish (Tonnes) landed in Kenya, 1965-1996

SOURCE	1965	1970	1975	1980	1985	1990	1995	1996
1.L.Victoria	13,000	16,988	16,581	26,914	88,589	185,101	181,888	166,460
2.L.Turkana	1,095	4,854	4,236	12,384	7,460	3,180	2,232	4,799
3.Others*	3,050	4,003	1,993	2,988	2,630	2,552	2,591	2,723
4.Fish Farming	130	-	-	596	1,085	975	1,083	89
5.All Fresh Water	17,275	25,845	22,810	42,882	99,764	191,808	187,794	174,071
6.Marine Fish	5,725	7,910	4,531	5,336	6,209	9,972	5,995	6,283
7.TOTAL CATCH	23,000	33,755	27,341	48,218	105,973	201,780	193,789	180,354
1/7 (%)	56.52	50.33	60.65	55.82	83.60	91.73	93.86	92.30
1/5 (%)	75.25	65.73	72.69	62.76	88.80	96.50	96.86	95.63
4/7 (%)	0.57	-	-	1.24	1.02	0.48	0.56	0.05
6/7 (%)	24.89	23.43	16.57	11.07	5.86	4.94	3.09	3.48

* This category includes other fresh water sources of fish such as lakes, rivers and dams.
Source: Compiled from issues of *Fisheries Annual Statistical Bulletin*, Fisheries Department, Kenya.

Owing to rising prices, the nominal and real value of fish landed has maintained non-faltering increase since 1975 except in 1994 when the increase was less than expected because of dampened demand following media reports of sightings of dead human bodies, victims of the Rwanda genocide, in Lake Victoria. These media reports led to an unprecedented downward pressure on fish prices. Thus, while the average price for Nile perch was Kshs 26.40 per kilogram for the whole of 1994, it had fallen to as low as Kshs 15 in April-June when the bad publicity was at its peak. Nominal revenue, based on ex-vessel prices, generated by the fisheries sector increased by 187% from Kshs 1810 million in 1990 to Kshs 5204 million in 1995. The corresponding increase in real value was only 33.6%, however [Table 3.2]. This performance is attributable to price increases resulting from increased demand for fish in both local and external markets.

[13] The number of fishermen and vessels increased by 15% and 7%, respectively, between 1993 and 1995. This, in fact, does not include the increase in fishing effort by already existing fishing units in response to declining CPUE.

Fig. 3.1: Quantity of fish produced.

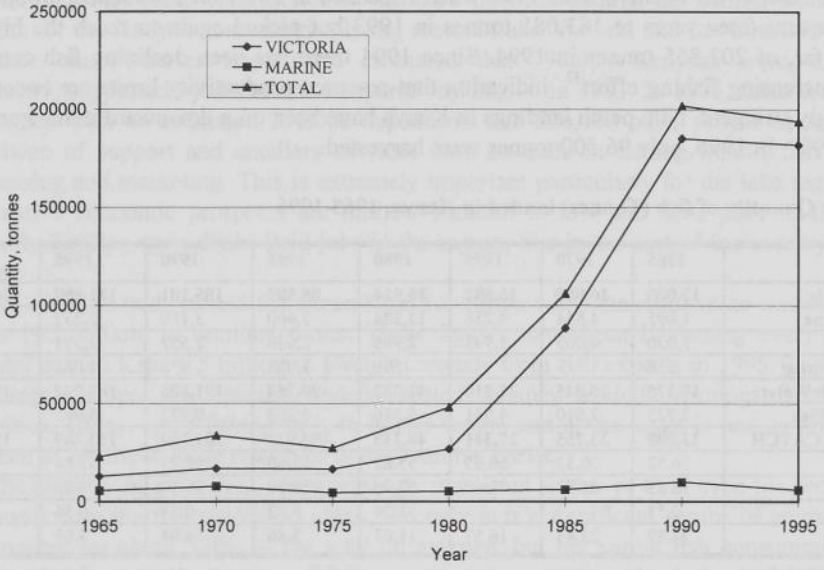


Table 3.2: Value of fish (Kshs millions) landed in Kenya, 1965-1996 (constant 1990 prices).**

SOURCE	1965	1970	1975	1980	1985	1990	1995	1996
1.L.Victoria	**74.67**	**96.46**	**81.96**	**145.93**	**281.06**	**1,532.96**	**2,173.86**	**2,608.44**
2.L.Turkana	0.77	6.16	11.22	23.82	18.78	10.59	10.88	15.44
3.Others*	2.97	22.44	10.65	23.13	21.64	20.44	23.48	19.27
4.Fish Farming	-	-	-	3.62	50.03	39.47	48.03	0.93
5.All Fresh Water	**78.41**	**125.06**	**103.73**	**196.50**	**371.50**	**1,603.46**	**2,256.25**	**2,644.08**
6.ALL Marine Fish	34.87	60.91	51.35	74.76	88.33	207.16	162.11	148.73
7.TOTAL CATCH	**113.28**	**185.99**	**155.08**	**271.27**	**459.84**	**1,810.62**	**2,418.36**	**2,792.81**
1/7 (%)	65.92	51.86	52.85	53.80	61.12	84.66	89.89	93.40
1/5 (%)	95.23	77.13	79.01	74.26	75.66	95.60	96.35	98.65
4/7 (%)	-	-	-	1.33	10.88	2.18	2.00	0.03
6/7 (%)	30.78	32.75	33.11	27.56	19.21	11.44	6.70	5.33

* This category includes other fresh water sources of fish such as lakes, rivers and dams.
** This value is based on beach ex-vessel fish prices. Retail value is, on average, 3.5 times higher.
Source: Compiled from issues of *Fisheries Annual Statistical Bulletin*, Fisheries Department, Kenya. A GDP Deflator series (1990=100) for Kenya, obtained from IMF's *International Financial Statistics Yearbook*, is used to calculate real values.

Fig. 3.2: Value of fish produced annually in Kenya.

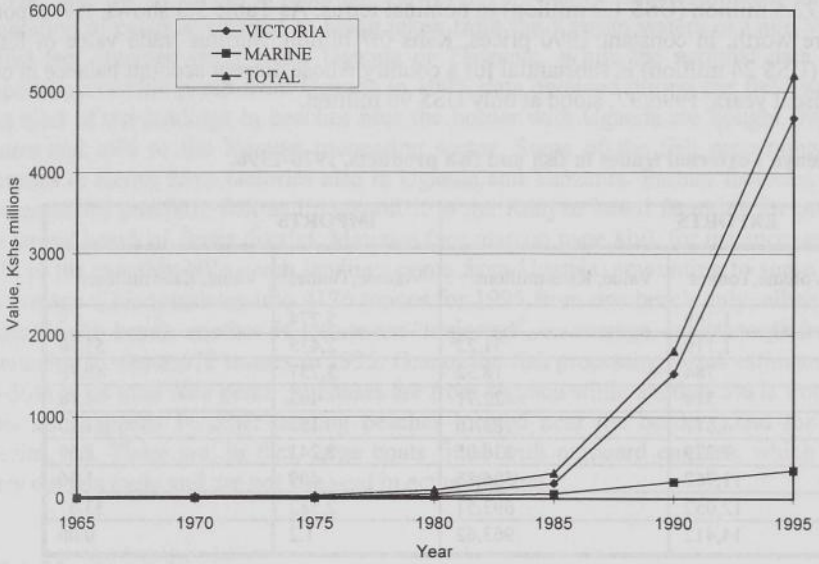
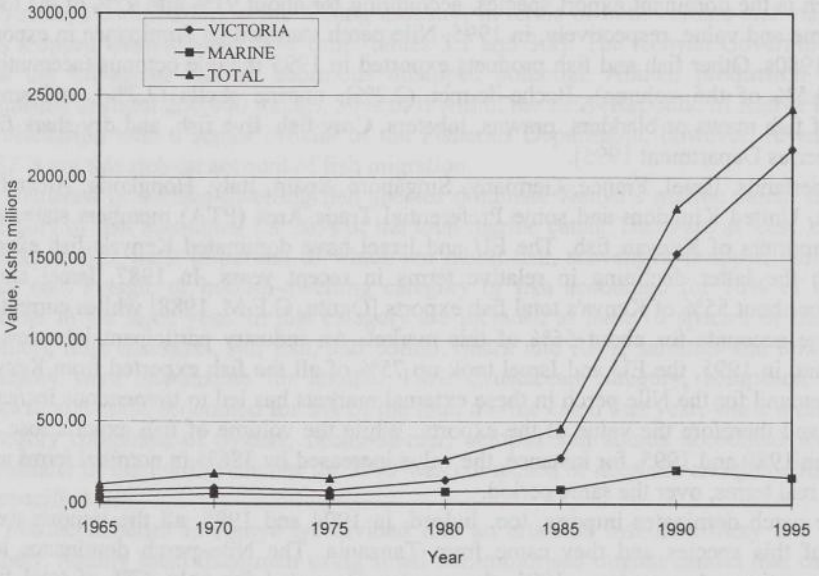


Fig. 3.3: Value of fish produced annually in Kenya.



External trade

Kenya is a net exporter of fish since mid-1980s [Table 3.3]. In 1995, the country exported 12,052 tonnes of fish worth Kshs 1.5 billion (US$ 25 million) and imported 2,582 tonnes worth Kshs 72.5 million (US$ 1.2 million) in nominal terms. As Table 3.3 shows, fish exports in 1995 were worth, in constant 1990 prices, Kshs 0.7 billion. Surplus trade value of Kshs 1.43 billion (US$ 24 million) is substantial for a country whose current account balance in one of the best fiscal years, 1996/97, stood at only US$ 90 million.

Table 3.3: Kenya's external trades in fish and fish products, 1970-1996.

YEAR	EXPORTS		IMPORTS	
	Volume,Tonnes	Value, Kshs millions*	Volume,Tonnes	Value, Kshs millions*
1970	1,369	-	5,274	-
1975	1,119	31.22	2,435	55.58
1980	784	18.32	3,757	49.75
1985	514	22.71	403	4.46
1987	4,677	183.16	155	1.20
1989	7,279	336.05	2,241	8.60
1992	11,762	506.86	409	1.56
1995	12,052	693.51	2,582	33.67
1996	14,412	963.62	1.2	0.06

* Values are in constant 1990 prices. A GDP Deflator series (1990=100) for Kenya, obtained from IMF's *International Financial Statistics Yearbook*, is used to calculate real values.
Source: Compiled from issues of *Fisheries Annual Statistical Bulletin*, Fisheries Department, Kenya.

Nile perch is the dominant export species, accounting for about 91% and 92% of the total export volume and value, respectively, in 1995. Nile perch stamped its dominance in exports in the mid-1980s. Other fish and fish products exported in 1995 include octopus (accounting for about 3.5% of the volume), Beche-de-mer (2.2%), marine shells (2.2%), and small quantities of fish maws or bladders, prawns, lobsters, Cray fish, live fish, and dry shark fins [Kenya Fisheries Department 1995].

The Netherlands, Israel, France, Germany, Singapore, Spain, Italy, Hongkong, Australia, USA, Japan, United Kingdom and some Preferential Trade Area (PTA) members states are the main importers of Kenyan fish. The EU and Israel have dominated Kenya's fish export market with the latter declining in relative terms in recent years. In 1987, Israel alone accounted for about 55% of Kenya's total fish exports [Ogutu, G.E.M. 1988] whiles currently, the EU alone accounts for about 56% of this market. An industry participant interviewed estimated that, in 1995, the EU and Israel took up 75% of all the fish exported from Kenya. Insatiable demand for the Nile perch in these external markets has led to tremendous increase in its price and therefore the value of the exports. While the volume of fish exports rose by 66% between 1989 and 1995, for instance, the value increased by 386% in nominal terms and by 106% in real terms, over the same period.

The Nile perch dominates imports, too. Indeed, in 1994 and 1995, all the imports were composed of this species and they came from Tanzania. The Nile perch dominance has increased over time. As recent as 1991, the species accounted for only 37% of total fish

imports. Imported Nile perch is filleted, together with the Kenyan catch, for export and for the Kenyan market.

The amount of imports reported, however, is clearly underestimated. A significant proportion of catches reported as being taken from the Kenyan waters of Lake Victoria is in actual fact obtained from either Uganda or Tanzania. While the national data indicate no importation of Nile perch from Uganda in 1995, data obtained during our field-work indicate that most of the landings in beaches near the border with Uganda are bought from Ugandan waters and sold to the Kenyan processing sector. Some of the fish processing firms with factories in Kenya have factories also in Uganda and Tanzania. Partner factories in the other two countries purchase fish and transport it to the Kenyan based factories for processing. In the largest beach of Busia district, Marenga (see map on page xiv), for instance, an average of 67% of the monthly Nile perch landings come from Uganda, amounting to some 348 tonnes, on average. This translates into 4176 tonnes for 1995 from one beach only, albeit the largest. From Nambo beach, another 56 tonnes are "imported", on average, every month from Uganda, amounting to about 672 tonnes in 1995. One of the fish processing firms estimates that about 10-30% of its total Nile perch purchases are from Uganda while another 5% is from Tanzania. This also happens in other landing beaches located near the borders, and for the Tilapia species, too. There are, in fact, large boats fitted with outboard engines, which exclusively carry out this trade and are not engaged in actual fishing.

3.2.1 Marine fisheries

In spite of Kenya having jurisdiction, like other coastal states, over a 200 mile EEZ in the Indian Ocean, the marine fishing sub-sector remains small. In 1995, the sub-sector produced only 6000 tonnes of fish; the same as it produced 30 years earlier [Table 3.1; Fig. 3.1]. The sub-sector's contribution to the fishing industry, in terms of both volume and value of catch, has dropped tremendously over time [tables 3.1 and 3.2]. The Kenyan Government believes that the sub-sector has an enormous untapped potential. Annual production potential is estimated at about 260,000 tonnes, 50% of it within the EEZ [Republic of Kenya 1994, 1997]. A discussion with a senior official of the Fisheries Department, however, revealed that the EEZ is not this rich on account of fish migration.

Demersal or surface-dwelling fish species dominate Kenya's marine catch. In 1995, this category of fish accounted for 36% of the total marine catch. There are at least 13 species of Demersal fish, most important of which are rabbit fish, scavenger, snapper, parrot fish, and rock cod. Pelagic or bottom-dwelling category of fish accounted for 16% of total marine catches in the same year. In this category are included at least 10 species of fish, including mullets, little mackerel, sail fish, and bonito. Shark and Rays, sardines and mixed fish as a category were responsible for another 19%. Crustacean category, composed of lobsters, prawns and crabs accounted for 8% of the total marine catch that year, while a miscellaneous category composed of oysters, beche-de-mer, octopus and squids accounted for 15%. The remainder of the marine catches for 1995 was composed of deep sea and game fish and other unspecified fish.

Marine fisheries in Kenya are divided into an artisanal inshore fishery and an offshore fishery. Mainly local fishermen using small non-motorised dugout canoes that can hardly go

beyond 5 nautical miles from the shore exploit the artisanal fishery. These shallow waters, together with reef, are estimated to account for about 80% of the entire marine catch. According to the Fisheries Department, this inshore fishery is fully exploited and there is growing concern over possible overexploitation. Fishing communities relying on this inshore fishery have been severely affected by the growth of tourism. Mushrooming hotels and marine parks have denied these communities access to the marine resources and threaten to completely marginalise them. The level of production from the artisanal marine fishery is not only dictated by the weather (rough sea makes it risky to fish using their small crafts) but also culture. Culturally, these fishermen do not go to fish when they have money in their pockets.

Kenyan and foreign vessels exploit the offshore fishery. This fishery has not been fully utilised due to lack of technology appropriate for deep-sea fishing. The Government aims at tapping the existing potential in the EEZ through the encouragement of joint ventures with private investors, licensing of foreign fishing vessels and improved capital accessibility to the local fishermen. There are currently 29 trawlers licensed for deep-sea fishing.[14] While most of these are, in reality, foreign-owned, they all have "Kenyan directors" and fly the Kenyan flag. They do this to avoid paying a high price for their licences. While a foreign vessel is required to pay an annual fee of US$ 20,000 to fish in the Kenyan EEZ, a local vessel or one jointly owned by a Kenyan and a foreigner is required to pay only Kshs 10,000 (equivalent to about US$ 170). These are the rates prevailing since 1991 when the Fisheries Act was revised. This kind of licensing has encouraged serious cheating about the true ownership of vessels.

Besides cheating regarding vessel ownership, the Government loses revenue from fish poaching. Unlicensed foreign vessels fish within Kenya's EEZ without much hindrance as the country, like other developing countries, lacks monitoring and surveillance capacity. Since over-capacity existing within foreign fleets is brought to bear on the Kenyan EEZ, much more fish than is reported in the statistics is obtained from the Kenyan marine fisheries. Moreover, the large potential the government believes to exist in the marine sector is largely illusory.

3.2.2 Fish farming

Aquaculture or fish farming is still on a very small scale in Kenya despite the huge demand for fish in the domestic and external markets. The sub-sector still produces only 1,000 tonnes of fish every year. Out of the 1,083 tonnes of fish produced from aquaculture in 1995, 50% was Tilapia, 18% Trout, and 33% Common carp. These are the main species farmed in Kenya.

Even before Kenya attained independence, the Government had realised the inadequacy of capture fisheries and sought to promote aquaculture, largely to raise rural nutritional standards. In pursuance of this objective, the Government set up a pilot prawn farming project at Ngomeni and a hatchery at Kiganjo to produce quality fingerlings for fish farmers. The Government, in addition, posted fisheries officers to all districts with the mandate of overseeing the management of capture (where they happen to exist) and culture fisheries. The Lake Basin Development Authority (LBDA), a parastatal, was formed in 1979 with one of its roles being the co-ordination of fisheries development in Western, Nyanza and part of Rift Valley provinces.

In spite of these early efforts, however, fish farming has performed dismally because of

[14] Personal communication with a senior official of the Fisheries Department.

several obstacles. The most critical of these is lack of capital. Fish farming is a high-risk, high-tech undertaking and therefore expensive. It is also difficult to transfer this high technology to the poor who are the target, not just because of capital but also literacy limitations. Estimates obtained from LBDA and District Fisheries Officers (DFOs) indicate that a 100 m^2 fishpond would require about Kshs 10,000 before it is operational and an extra Kshs 1,000 every year for maintenance. This is unattainable for the poor people. LBDA started extending credit to fish farmers but discontinued it as it proved ineffective. Covering only 18% of the initial cost, the credit was like a drop in the ocean and could not improve the uptake of fish farming technology. On account of low management standards, productivity of the fishponds is very low at about 350 KGs per 100 m^2 per annum. This is very poor in comparison with the high tech fish farms in Israel that can produce 3,500 KGs in a year from the same size of pond.

Poor species selection has also contributed to the poor performance of fish farming in Kenya. Tilapiine species are the dominant farmed species in Kenya, yet they are the most difficult to culture. These species are very prolific, producing very many fingerlings. They therefore require excessive feeds, which cannot be provided by the poor farmers. *Clarias* and Trout have proved the most suitable culturing species in the Kenyan context. There is also a significant problem of otter predation.

Open access to capture fisheries has provided a disincentive for fish farming in the areas they exist, by providing softer options for people contemplating fish production. Thus, there were only 327 fish farmers in the whole of Siaya district in 1994 and 111 in the larger Homabay in 1995.[15] Culturally, fish farming is regarded as a dirty enterprise in some of the areas surrounding Lake Victoria. In some areas without capture fisheries, on the other hand, fish is still an alien food. Uptake of aquacultural technology in these areas has been insignificant due to lack of promotional campaigns.

Poor performance notwithstanding, fish farming is expected to play an important role in Kenya. According to the 1994-1996 Development Plan and the Economic Survey for 1997, the potential of fish farming is estimated at 50,000 tonnes per annum. Realisation of this potential will undoubtedly call for substantial effort in the tackling of the obstacles facing this enterprise. One of the notable strategies being pursued to tap this potential is the integration of aquacultural research into Ministry of Agriculture's irrigation programmes. This research is targeted at the development of agro-aquafarms, involving farming of fish and crops together in irrigation systems.

3.2.3 Fresh water fisheries

Kenya's inland fresh water bodies, excluding fish farming ponds but including lakes, rivers and dams produce the bulk of the country's fish. In 1995, for instance, their share of total fish production stood at 96% by volume and 91% by value. Three decades earlier, in 1965, the corresponding figures were 75% and 69%, respectively. Lake Victoria accounts for almost all the fish produced from fresh water sources in the country, at 96% in 1995 and an annual average of 85% since 1965. Being the focus of this thesis, Lake Victoria fisheries are discussed in detail in section 3.3.

[15] Personal communication with DFOs.

Lake Turkana is the second most important source of fresh water fish in Kenya. Tilapia is the main species of fish produced in Lake Turkana. Others include *Alestes*, *Bagrus*, *Barbus*, *Clarias*, *Labeo* and Nile perch. Production from Lake Turkana reached a peak of 16,000 tonnes in 1976 and started a steady decline, to only 871 tonnes in 1993. Falling water level has been held responsible for the near collapse of these fisheries. The Fergusson gulf, traditionally the most productive part of this lake, has almost dried up largely due to the diversion of water from River Omo, the main inlet into the lake, for irrigation in the Ethiopian highlands.[16] The only other source of water for the lake, Turkwel River flowing from Kenya's Mount Elgon, was dammed for hydroelectric generation. There is also a high rate of water loss through evaporation on account of the aridity of the area, leading to increase in the salinity of the lake. The daily temperature averages 35°C. The 37 species of fish existing in the lake are being seriously affected by this salinity.

On account of increasing water level, fish output from Lake Turkana has started picking up again, however. Between 1993 and 1996, the annual rate of growth of quantity of fish harvested from the lake has averaged at an impressive 113%. In 1996, about 4,800 tonnes of fish were produced from the lake.

The other sources of fresh water fish are Lakes Baringo, Naivasha, Jipe, River Tana, and dams. In Baringo, *Barbus*, *Clarias*, *Protopterus* and Tilapia species are produced. Black Bass, Tilapia, and Cray fish are produced at Naivasha while in Lake Jipe *Clarias*, Tilapia and Sardines are harvested. Along River Tana, *Barbus*, *Clarias*, *Labeo*, *Mormyrus*, Tilapia, Carps and Eels are harvested.

Lake Naivasha is perhaps one of the lakes that has suffered the largest number of problems but also one that has the brightest prospects. The lake suffers from serious pollution because of intensive horticultural production in the adjacent areas. These are the country's leading producers of cut flowers, which are both fertiliser and pesticide intensive. The lake suffers also from serious poaching and use of illegal gears, driven by very high demand for fish as Naivasha is very near to Nairobi. The horticultural farmers and other farmers who use the lake water for irrigation have formed a Riparian Owners Association which has established a code of conduct to guide its members in the use of the lake water. The code is intended to mitigate the adverse effects, on the lake ecosystem, of agricultural and other non-fishing activities. Fishermen have also been encouraged to draw their own code of conduct.

3.2.4 Institutional and regulatory framework

Exploitation of fishery resources in Kenya has been legally regulated since 1901 with the promulgation of the Fish Order No. 9 that mainly covered the coastal fisheries [Hayanga 1988]. The Governor subsequently promulgated rules for the regulation of inland waters on a piece-meal manner. Lake Victoria Nyanza rules, for instance, were promulgated only in 1940 after those for rivers Tana, Athi, Tsavo and Thika and Lake Naivasha [Hayanga 1988]. The rules for Lake Victoria were, however, the most detailed and covered fishermen licensing, registration of boats, selling of nets of set dimensions and only to licensed fishermen, catching of fish of only the permitted size. Catching of juvenile fish, especially Tilapia, which was considered endangered, was severely restricted. Exploitation of other fish species was,

[16] This is a good example of what Folke et al. (1995) refer to as the new type of "transboundary pollution" in which biodiversity loss in one country or region results from ecosystem modification done elsewhere.

however, not regulated. Entry into the fishing industry has remained open so long as one was able to raise the money required for annual licensing, boat labelling and registration, and was able to purchase or hire a fishing vessel and fishing gears, or was able to find employment. By 1978, the cost of annual licensing, boat registration and labelling amounted to Kshs 50 only, but varied from area to area [Oduor-Otieno et al. 1978].

The Government of Kenya, aware of the immense importance of and potential the fisheries subsector has, has charged three bodies with the responsibility of managing and developing the resource. They are the Fisheries Department, the Kenya Marine and Fisheries Research Institute (KMFRI), and the Lake Victoria Basin Development Authority (LBDA).[17] These are not the only players in the management of fisheries, however. The National Environment Secretariat (NES), various government ministries, international organizations like the United Nations Environmental Programme (UNEP) and the Food and Agriculture Organisation of the United Nations (FAO), Universities, other training and research institutions, Non-Governmental Organisations (NGOs), the private sector, and bilateral donors such as Belgium, Netherlands, and USA all play some role, financial or otherwise. The overall responsibility over the fisheries sector is, however, placed on the Director of Fisheries, the head of the Fisheries Department.

The Fisheries Department is mandated to manage fisheries with the objectives of attaining the Maximum Economic Yield (MEY), maximizing benefits to fishermen and the entire fishing industry, increasing per capita fish consumption, reducing post-harvest fish losses, improving fish quality to protect consumers, and maximizing fish exports.[18] In a nutshell, these objectives are production oriented and are motivated by the government's rather myopic desire to uplift the nutritional standards and incomes of the rural people, expand employment opportunities, increase growth in GDP, and increased foreign exchange earnings. Conservation of aquatic biodiversity is not explicitly stated as an objective of fisheries management [Wangila 1993].

Pursuant to these objectives, the revised Fisheries Act (1991) spells out the duties and responsibilities of the Fisheries Department as the development of fisheries through the provision of necessary basic infrastructure and facilities; provision of extension services to capture fishermen and fish farmers to enhance their capabilities; management of fish resources to maintain their productivity with the application of best available scientific information; collection of revenues from fishing activities, processing and marketing of fish; identification of new fishing grounds through exploratory fishing operations; evaluation of the technical and economic feasibility of new fishing and fish farming techniques through applied research; development of human resources engaged in formal and informal fishery activities; and the maintainance of high quality standards for fish and fish products.

The fisheries management strategies of the government, spelt out in development plans and other policy documents, reflect these objectives and responsibilities. In the 1994-1996 Plan, for instance, they include the strict enforcement of regulations against fishing methods that lead to overfishing and/or destruction of fish breeding grounds; monitoring of pollution

[17] See, for example, Republic of Kenya, Development Plans 1979-83, 1984-88, 1994-96 and Sessional Paper No. 4 of 1981 on "*National Food Policy*".

[18] Kenya Fisheries Department (1995), *Fisheries Annual Statistical Bulletin*, p.3. In section 3.3.5 of this chapter, it will be argued that the objective of maximizing fish exports is inappropriate for a declining fishery and for a country whose population is suffering serious nutritional deficiencies.

threats; restocking of fisheries; provision of post-harvest fish preservation and storage facilities; upgrading of access roads to fishing villages; improved extension services, training, product quality and value added, marketing; and enhanced capacity building.

The Maritime Zones Act, passed in 1989, is another piece of legislation aimed at protecting Kenya's fishery resources, particularly the marine ones. The main goal of this act was to declare Kenya's sovereign and judicial rights over the resources located in its EEZ. This act was also directed at the conservation of the marine resources by regulating the methods of fishing and areas where these methods could be used. In the enforcement of regulations and the surveillance of Kenya's EEZ, the Fisheries Department is assisted by the Provincial Administration, Kenya Police, Kenya Navy, the Kenya Wildlife Service (KWS) and private sector organizations. Enforcement of regulations is so weak, however, that they are almost non-existent in reality. Factors responsible for this weakness are discussed in the context of Lake Victoria fisheries, in section 3.3.3 of this chapter.

KMFRI is charged with the primary task of conducting research on such diverse issues as marine and fresh water fisheries, aquatic biology, environment, ecology, chemical characteristics of water bodies to monitor pollution trends, physical oceanography, and socio-economics. The institute is also charged with the duty of developing aquatic technology that can harness fish production and also with training for industry participants, including staff, fishermen and fish farmers. In training, KMFRI is required to liase with the Fisheries Department, other training institutions such as the Naivasha Wildlife and Fisheries Training Institute, Farmers Training Centres, the Polytechnics and Universities.

On its part, the LBDA is a government parastatal aimed at promoting the economic development of the Western, Nyanza and part of Rift Valley provinces. Since Lake Victoria, Kenya's largest fishery resource, lies in this region, LBDA has a substantial role to play in fisheries development. As far as fisheries are concerned, the task for the LBDA is the coordination of the activities of the various agencies, including NGOs, international organizations and various ministries, that are involved in the fisheries sector. This is aimed at reducing or avoiding duplication of effort.

In general, management of fisheries in Kenya is characterised by weak political will; inadequate laws and regulations that are largely sectoral, outdated, non-harmonised, poorly enforced, devoid of incentives and woefly non-deterrent; inappropriate, inconsistent and inadequate policies; and an institutional setup that is weak, dispersed with little or no coordination leading to serious rivalry, duplication of effort and waste of scarce resources, and poorly funded [World Bank 1996; O'Riordan 1996; Wangila 1993]. The government departments charged with the responsibility of managing, regulating and monitoring the fisheries are poorly funded and politically marginalised [O'Riordan 1996]. Not only are development projects in the sector not undertaken owing to this limitation but the Fisheries Department rarely is able to carry out its monitoring and surveillance role.

Lack of consistency in fisheries policy has adversely affected the performance of the fishing industry. This has resulted from frequent tossing of the Fisheries Department from one ministry to the other. As the department was moved around in the ministries of Natural Resources; Environment and Natural Resources; Tourism and Wildlife Management;

Regional Development; Land Reclaimation, Regional and Water Development; and back to Ministry of Tourism and Wildlife Management so did fisheries policy [Wangila 1993]. Overall fisheries policy oscillated from, for example, sustainable exploitation in the Ministry of Natural Resources, sustainable exploitation based on environmental considerations in the Ministry of Environment and Natural Resources, and promotion of fish resources primarily for sport fishing (with consumption somehow peripheral) in the Ministry of Tourism and Wildlife Management. Lack of consistency is worsened by the location of the agencies charged with the management of fisheries in different ministries. KMFRI, for instance, which is the second most important institution as far as fisheries are concerned, is in the Ministry of Research, Science and Technology. Moreover, fishermen co-operatives which could play an important role in organising fishermen and even in the management of the fisheries are run under the Ministry of Cooperative Development, which knows only profits and no sustainability issues. The need for a coordinating agency like LBDA would not be felt and the management of the fishery resources would be better had all agencies with a role to play been placed under one umbrella ministry or organisation.

3.3 Lake Victoria Fisheries (Kenyan Sector)

3.3.1 Location and physical characteristics

Lake Victoria is the world's second largest fresh water body (after USA's Lake Superior), covering a surface area of 68,800 km². The Lake Victoria drainage basin actually covers a total area of 263,000 km² [Prado et al. 1991]. The lake lies between the two East African Rift Valleys, at an altitude of 1240 m above sea level. The lake is common property of the three East African countries, shared as follows: Kenya (6%), Uganda (45%), and Tanzania (49%). Each of the three countries manages its portion of the lake independently, so that there are different regulatory and enforcement strategies. However, the recently formed LVEMP has, as one of its key objectives, the formulation of a unified management and regulatory framework for the entire lake.

While Kenya's share of the lake surface area is only 6%, its share of the shoreline is about 22% or 760 km [Gréboval and Mannini 1992; Ogutu, G.E.M. 1988]. Kagera and Nzoia are the main rivers that feed the lake. With the exception of Kagera and Mara rivers, Nzoia and 6 other small rivers enter the lake on the Kenyan side. The lake, in turn, drains into the Mediterranean Sea through the Victoria Nile River, which joins the river Nile before entering the sea. The lake is generally shallow, with most of it less than 20 m deep and with mean and maximum depth estimated at, respectively, 40 m and 100 m [Ochumba et al. 1991; Dache 1991]. Water temperatures are generally stable throughout the year, averaging at 24°C at the mean surface and 23°C at the deepest surface. The major determinant of annual temperature changes and water column mixing is wind [Ochumba et al. 1991].

An important section of Kenya's lake portion, amounting to about 33% of the 4,100 km², is a narrow gulf that goes by several names in the literature. The gulf is variously referred to as Victoria Nyanza, Kavirondo Gulf, Winam Gulf and Nyanza Gulf[19]. We will, subsequently,

[19] See map on page xiv.

refer to this gulf as the Nyanza Gulf. This gulf has a 300Km irregular shoreline with many embayments, a mean depth of 6 m, and maximum depth of 43 m [Rabuor and Manyala 1991]. This gulf is important because it accounts for most of the fish caught on the Kenyan sector of Lake Victoria.

Economic significance

Kenya's share of the lake fisheries is the most heavily fished and commercialized of the three. In addition, it constitutes the largest fisheries in the country, accounting for more than half of her fish output since the 1960s and more than 90% of this in the 1990s [Table 3.1; Fig. 3.1]. It is estimated that Kenya's share of Lake Victoria's total catch of 555,355 tonnes in 1990 was 33% compared to Tanzania's 42% and Uganda's 25%. Fish production in Kenya reached a maximum of 202,965 tonnes in 1994, about 95% of which was captured from Lake Victoria. Between 1994 and 1996, however, there was an average annual decline of 5% in fish production. The decline in output from Lake Victoria was higher than this national average, at 6%. The real value of fish produced has, however, maintained growth every year since 1975 largely because of rising fish prices [Table 3.2; Fig. 3.3]. Between 1990 and 1995, for instance, growth in real value of fish obtained from Kenya's portion of Lake Victoria averaged 7% per annum. This was, however, much lower than the average annual rate of 74% for the period 1985-1990 [Table 3.2; Fig. 3.3].

The lake constitutes the main resource for an area that is highly populated (290 persons/Km^2)[20] and has very limited alternative means of livelihood. Most agricultural activities in the area are basically at a subsistence level, with cotton as the only cash crop [Ogutu, G.E.M. 1988]. The cotton industry, however, collapsed many years ago. This sector, therefore, does not serve as a viable alternative to fishing. Maize, beans, sweet potatoes, millet and cassava are the major food crops produced in the area together with cattle, sheep, goats and poultry. Fishing is the most important economic activity for most of the year except the periods coinciding with planting, weeding and harvesting, when demand for agricultural labour is high [Ogutu, G.E.M. 1988]. While this may have been the case in the past, however, rapid population growth and the lucrative nature of fishing since the mid-1980s has meant that majority of fishers are now permanent.

3.3.2 Ecology, biodiversity, and causes of biodiversity decline

Lake Victoria hosts a diversity of fish species unique to tropical lakes. The lake has fish belonging to 5 different Orders, 13 Families, 28 Genera, and an estimated 177 - over 200 species, all edible [Achieng 1988; Kenya Fisheries Department 1980]. The biological diversity of the lake has, in fact, declined. The diversity was estimated at 350-400 species of fish in the earlier years of this century. The lake fisheries have, therefore, suffered a serious decline and continue being threatened by further decline. The decline has been so severe that the lake fishery now supports a three-species commercial fishery only, based on the Nile perch, *Rastrineobola argentea* and the exotic tilapia, *Oreochromis niloticus*. The lake is, in fact, under intense pressure to reduce further into a two-species fishery as the share of the exotic

[20] This figure is obtained from Hoekstra et al. (1991) and differs markedly from the figure of 120 persons/Km^2 based on the 1979 population census. While the latter is based on the entire districts bordering the lake, it is not clear if this is the case with the former.

Tilapia is on the decline. While its share in catch volume rose to a peak of 23.4% in 1990, it dropped sharply to only 2.7% in 1995 [Table 3.4]. Conversely, Nile perch and *R. argentea* have experienced literally uninterrupted dominance so that the two species accounted for 87.6% of the lake's total landings in 1995.

Haplochromis dominated Lake Victoria in the pre-Nile perch period, constituting an estimated 80% of the lake's total biomass [FAO 1973]. The species, together with *Rastrineobola argentea*, were largely unexploited owing to low demand for them. Tilapiine species, particularly *Oreochromis esculentus* (an endemic Tilapia species) were the most important commercial species of the gillnet fishery introduced in 1905 [Achieng 1988; Ochieng'-Okach 1988].

The Nile perch was introduced (in August 1954), together with several species of Tilapia (between 1950 and 1962) to feed on macrophytes that were not being utilised by the commercial fish species existing at the time and/or supplement the declining fish stocks [Achieng 1988; Geheb 1995]. Even though a general decline in fish stocks of Lake Victoria was first noticed in the 1950s [Okemwa 1981; Ochieng'-Okach 1988], these introductions of alien fish species into the lake ecosystem triggered an enormous erosion of biological diversity.

The dominance of the introduced species, Nile perch and *Oreochromis niloticus* or Nile Tilapia (one of the alien Tilapia species) began in the 1970s and became increasingly evident since the 1980s. Thus, between 1970 and 1978 the stocks of *Haplochromis* and the endemic Tilapia, both of which had supported the commercial fishery of the 1960s, declined while *R. argentea* and Nile perch catches flourished, becoming the most important species of the new commercial fishery. Predation on the endemic species by the exotic Nile Perch reached its peak during this period and is widely believed to have led to the virtual disappearance of the endemic species from the lake [Ochieng'-Okach 1988; Achieng 1988]. The endemic fish species of Lake Victoria have virtually disappeared from the catches, including the native Tilapia species (*O. esculentus*) and *Haplochromis*, both of which are now believed to be massively extinct [Ochumba et al. 1991]. Nevertheless, small catches of *Haplochromis* and other endemic species such as *Bagrus*, *Synodontis*, *Protopterus*, *Clarias*, *Barbus*, *Labeo*, *Schilbe*, and *Mormyrus* are still realised.

The decline in the lake fisheries has not been manifested in the loss of biodiversity alone, however. Declining productivity, increasing juvenile fish harvest rates, worsening pollution, infestation of the lake ecosystem by the water hyacinth are some of the other manifestations of the decline. These are discussed in detail in this chapter.

Biodiversity loss is worrisome because not only do *"...organisms house the genetic library..."* but also *"...sustain a flow of ecological services that are prerequisites for economic activities"* [Folke et al. 1995]. Loss of biodiversity reduces ecosystem resilience and therefore threatens its functioning and, hence, the economic foundation and human welfare [Perrings et al. 1995]. For ecosystem life-support services to be sustained, a minimum composition of organisms is necessary to maintain critical relations between primary producers, consumers, and decomposers that dictate the flow of energy, cycling of elements, and vegetational patterns [Folke et al. 1995]. There are thus critical thresholds of diversity that vary on the basis of the environmental conditions facing the particular system. The higher the number of organisms in an ecosystem, the higher will be its resilience, its capacity to absorb disturbance without adverse consequences. In sum, biodiversity is the key to the survival of ecosystems

[Dasgupta and Mäler 1995]. Many managed ecosystems gradually become spatially uniform and lose resilience [Folke et al. 1995]. This is more worrisome because ecosystems often fail to signal their distress, continuing to function in the short run even when resilience is gradually eroding.

An understanding of the factors that have led to biodiversity loss and other forms of decline in the Kenyan fisheries is therefore critical. Broadly, failure of markets and government policies can be seen as the prime causes of biodiversity loss and other forms of resource decline [Folke et al. 1995]. Market prices do not reflect environmental effects of human behaviour. This implies that users of biological resources do not take the real cost of their actions into consideration when they determine the quantities to use. This is often exacerbated by government policies that, instead of correcting the market imperfections, subsidize resource users, widening further the gap between private and social cost of their behaviour.

Arising from these two broad failures, overfishing and interferance with the ecology and ecosystem of the lake are the main causes of biodiversity loss and general decline in these Lake Victoria fisheries. Interferance with the lake ecosystem has occurred through overfishing itself; enhancement of the fisheries; pollution from agricultural, industrial and municipal waste; agricultural activities and the associated swamp reclaimation, dyking and stream channelling; invasion by the water hyacinth; and frequent fish kills related to these factors and bacteria infections and other fish diseases. The lake has a long water residence time of 23.4 years, substantially raising its vulnerability to environmental changes occurring in the catchment area [Ochumba et al. 1991]. These factors, threatening the very integrity of the lake fisheries, are discussed in more detail.

Overfishing

The most serious problem facing the Kenyan fisheries of Lake Victoria is that of overfishing [FAO 1982; Garrod 1961; Cadwalladr 1968; Okemwa 1991; Republic of Kenya 1993], through the use of destructive fishing methods especially small meshed gillnets [Kudhongania 1972; Wanjala and Martens 1974], cropping of fish before they reproduce [Muller et al. 1982; Marten 1979] and a general increase in fishing effort. There is substantial evidence that these fisheries are now under both quantitative and qualitative overfishing. Quantitative overfishing is said to occur in a fishery when its total fish landings decline progressively every year [Achieng 1988]. Total catches from Lake Victoria (Kenya) have risen gradually over the years and attained the peak of 186,366 tonnes in 1991, suggesting an absence of quantitative overfishing over this period. It should be noted, however, that "*Increasing production is consistent with unsustainable production*" [Dasgupta and Mäler 1995:2376]. There was a huge decline of 19% in 1992,[21] followed by impressive increases of 16% and 11% in 1993 and 1994, respectively. In 1995, the fisheries recorded another decline of 6%, with landings of both Nile perch and *Rastrineobola argentea* declining in spite of a 20% increase in the number of fishermen and 7.7% in the number of vessels operating in the lake. There was another decline of 6% in 1996. These large and abrupt swings in landings are a new phenomenon, sufficient evidence of quantitative overfishing in the 1990s.

Studies by Zonneveld (1983) and Kongere (1979) indicate that the annual fish catch in the Kenyan waters of L.Victoria exceeds estimates of the Maximum Sustainable Yield (MSY), indicating biological overfishing. Zonneveld's annual MSY estimate of 26,000 tonnes imply,

[21] The Government, in the *Economic Survey* for 1993, attributed this decline to overfishing.

assuming that the environmental carrying capacity has not changed, that biological overfishing started as early as 1981 when the total landings from the Kenyan portion of the lake amounted to 38,179 tonnes. Zonneveld's estimate was obviously incorrect since as much as 7 times the estimated MSY has been harvested every year since the mid-1980s without the fisheries collapsing. Zonneveld obviously did not anticipate the explosion of the Nile perch species that has occurred since 1980.

Qualitative overfishing can be said to occur in a fishery when one or more of the following events are observed; decline in the average size of fish caught, appearance of juvenile or immature fish among the catches in large numbers, and the progressive disappearance of some species or groups of species from the catches. That qualitative overfishing has been a feature of these Kenyan fisheries for a long time is suggested by Table 3.4. This observation is buttressed by reports of a gradual decline in the average size, at capture, of fishes of nearly all species [Ochieng'-Okach 1988; Achieng 1988; Getabu 1991; Geheb 1995]. Tilapia is under severe overfishing as there are a lot of immature fish in the catches [Getabu 1991]. From an average catch of 25 Tilapia fish per net at the turn of this century within the Nyanza Gulf, there was a dramatic decline; to about 7 fish per net by 1920 and to 2 by 1940 [Geheb 1995]. Moreover, there has been a virtual disappearance of many species from the landings.

Overfishing (quantitative, qualitative, biological, and Malthusian) is, therefore, one of the principal causes of the decline that has occurred in these fisheries and a persistent threat to their sustainable use. Even low fishing pressures could lead to substantial biodiversity loss by interfering with species interdependency in the ecosystem [Konstapel and Noort 1995]. The gradual increase in fishing pressure that has led to overfishing and biodiversity loss has emerged from the rapid growth in the population of fishermen, followed by an increase in the number and variety of fishing crafts and gears. Table 3.5 depicts the growth in the number of fishermen and fishing vessels exploiting the fisheries. That the effort has grown phenomenally, notwithstanding the inaccuracy of its estimates, is unequivocal. Between 1973 and 1995, for instance, the number of fishermen increased by 200% while that of vessels increased by about 95%. This translates into an increase in the number of fishermen operating in one vessel from 2.5 to almost 4 over the period. The highest fishing pressure in the entire lake is to be found in the Nyanza Gulf. In 1985, for instance, it was estimated that between 25,000 and 30,000 fishermen operated in the gulf, representing about 50% of the fishermen exploiting the entire lake then [Ssentongo and Welcome 1985]. This means that 50% of the entire effort incident on the lake then was exploiting only 2% of the entire lake surface!

The identification of the forces underlying this explosion in fishing pressure is, manifestly, more important. Gréboval [1989] and Geheb [1995] attribute the intense fishing pressure in the Nyanza Gulf to a shortage of agricultural land and alternative employment and the specialization of the Luo, the Kenyan ethnic community inhabiting most of the area adjacent to the lake, to fishing. These factors have led to an increase in fishing pressure in the entire Kenyan sector, not only in the gulf. Besides these, there are other underlying forces driving this explosion in fishing pressure. Thus, the breakdown of the cultural based and enforced territorial rights that existed in the pre-colonial fishery, largely due to lack of alternative employment, declining fishing incomes, increasing demand for fish and commercialization of the fishery, and a gradual loss of control to the means of production and fishing market channels by the local fishermen, intensified the pressure exerted on the fisheries. Geheb (1995:100) summarizes this most succintly; "*Trapped between a resource base that is*

diminishing because of ecological upheaval and overfishing, and lost control over marketing, labour ownership and the means of production, fishermen today just cannot afford to ease fishing pressure and use legal mesh sizes".

Fish processing firms have been key in the commercialization of the lake fisheries. These firms have been attracted by the rapidly growing export market for Nile perch fillets fueled by low ex-vessel fish prices that hardly reflect the real cost of fish and a seemingly insatiable overseas demand [Gréboval and Mannini 1992]. Government encouragement and support for the fish export sector has, in addition, accelerated the expansion in the sector. The demand for the Kenyan fish both in the external and domestic markets has grown so much that supply cannot meet it. This has resulted in an unprecedented rise in fish prices especially after the mid-1980s that have, in turn, fueled the pressure on the exploitation of the lake resources. Pressure resulting from high demand for fish has been accentuated by low production costs. Low production costs coupled with high output prices make fishing profitable even with low catch realisations. Fishing firms that would have exited from the fisheries once they were no longer able to cover their variable costs of fishing remain because they are, under these favourable cost and price circumstances, able to make some profit. In fact, new fishermen are attracted into the fisheries.

Exploitative pressure on the lake resources has also been increased by substantial improvement in the communication network[22] around the lake, fish handling facilities at the beaches, cold preservation facilities provided by the large fish processing firms and the development of better processing methods such as smoking and frying by the artisanal sector. The impact of Nile perch processing, export, and price dynamics on resource sustainability and socio-economic welfare of the fisherfolk is discussed in greater detail in sections 3.3.4 and 3.3.5.

Table 3.4: Species composition of fish landings in Lake Victoria (Kenya), 1968-1996 (% of total weight landed).

SPECIES	1968	1970	1975	1980	1985	1990	1992	1994	1996
1. Haplochromis	25.53	34.39	28.97	13.78	0.01	0.00	2.00	2.17	2.35
2. Protopterus	19.15	10.46	9.21	1.40	0.17	0.05	0.99	0.10	0.09
3. Tilapia niloticus	**0.00**	**0.00**	**1.27**	**4.49**	**8.78**	**23.37**	**11.09**	**6.10**	**6.47**
4. Other Tilapiine	16.50	28.95	2.76	14.52	2.17	0.34	4.00	1.97	3.08
5. Rastrineobola	**4.99**	**3.36**	**28.52**	**35.80**	**30.00**	**28.52**	**23.42**	**35.70**	**29.84**
6. Lates niloticus	**0.00**	**0.18**	**0.32**	**16.34**	**58.02**	**43.64**	**51.14**	**53.70**	**57.95**
7. All others	33.83	22.66	28.95	13.67	0.85	4.08	7.36	0.26	0.22
8. TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
9. (3+5+6)*	**4.99**	**3.54**	**30.11**	**56.63**	**96.80**	**95.53**	**85.65**	**95.50**	**94.26**

* These three species currently dominate the fishery.
Source: Compiled from issues of *Fisheries Annual Statistical Bulletin*, Fisheries Department, Kenya.

[22] Even though not much has been accomplished in terms of the road network, investments in boats powered by outboard engines have been attracted in the industry to the extent that it is now rare that fish can remain unsold even at the remotest beaches during the rainy season. These boats, belonging to the fish processing firms or their agents, are able to reach literally all beaches and buy the fish. Fish prices, however, fall due to reduced buyer competition in such circumstances.

Table 3.5: Number of fishermen and fishing vessels, Lake Victoria (Kenya).

SOURCE OF DATA	FISHERMEN	VESSELS
Graham, M. (1929)	5,000	2,000
FAO (1973)	10,000	4,100
Fisheries Dept. (1979)	18,000	4,600
Greboval D. & J.E. Reynolds (1985)	21,500	5,500
Hoekstra, T.M. (1991)	24,000	6,229
Achieng, A.P. (1991)	30,000	7,000
Fisheries Department (1991)	25,000	7,279
Fisheries Department (1992)	"	"
Fisheries Department (1994)	"	7,425
Fisheries Department (1995)	30,000	8,000

The introduction of gillnets, which is the major technological development to have occurred in these fisheries in the beginning of the century raised CPUE but also initiated overfishing [Acere 1988]. Since then, intensive non-selective fisheries have emerged in response to declining CPUE. There has been a gradual shift from gillnets of appropriate mesh size to those with smaller mesh and from gillnets, longlines and traditional gears such as traps in favour of destructive technology such as Beach seining, Mosquito seining, and illegal trawling. Increasingly desperate, fishermen in Lake Victoria are now reported to be using even chemical poisoning as a fishing technology. Use of inappropriate technology has contributed to overfishing substantially by not only recruiting fish into the fishery that have not reproduced but also by destroying fish breeding grounds through abrasive and other forces. Besides declining CPUE, other factors responsible for this gradual switch to inappropriate technology include capital constraints, existence of a market for juvenile fish, poor enforcement of regulations, rampant theft of legal technology, and the open access nature of the fisheries. These factors are discussed in more detail in Chapter 5.

Entry into the lake fisheries has been facilitated by failure of the government to fill the restrictive vacuum created by the collapse of traditional management system, the relative ease of entry into the fishing industry, and the lucrative and liquid nature of the fishing enterprise. Public regulation is so weak that the forces driving overfishing play unhindered. These management failures are discussed, in greater detail, in section 3.3.3.

Fisheries enhancement

With the objective of enhancing the fisheries of Lake Victoria, several species of Tilapia and Nile perch were introduced into the lake ecosystem between 1950 and 1962. Within 10 years only, the new species, particularly Nile perch, had established themselves fully in the ecosystem. These new species have served the economic purpose for which they were intended but not without cost. Introduction of non-indigenous species threatens biodiversity [Konstapel and Noort 1995]. Moreover, studies in the Scandinavian lakes, Laurentian Great Lakes, Lake Tohae and Lake Kinneret show that the introduction of exotic species leads to irreversible changes in food webs [Ochumba et al. 1991].

The general conclusion of the large literature evaluating the impact of the new species on the Lake Victoria ecosystem is that Nile perch predation is partly responsible for the biodiversity loss.[23] Research based on the analysis of its gut contents indicate that Nile perch predates on many of the lake's endemic species including its own juveniles [Ochieng'-Okach 1988; Ogari and Asila 1987; DFK 1988]. Furthermore, the alien tilapiine species and Nile perch have reduced biodiversity through food competition with the endemic species, notably Tilapia, *Haplochromis* and catfish. Thus, besides the loss of consumption opportunities, the decline of endemic tilapiine and haplochromine species has had negative consequences on the lake ecosystem through disruption of food chains. Being consumers of bloom forming algae and detritus, their absence has been held responsible for the growth of algal blooms, detritus accumulation and the resultant oxygen deficiency in the water columns [Ochumba and Kibaara 1989; Ochumba et al. 1991].

Pollution

Pollution has also made a substantial contribution to loss of biological diversity and general fishery decline in Lake Victoria. Evidence of increasing pollution is overwhelming. Thus, compared to the 1950s and 1960s, anoxia (lack of oxygen) now affects up to 50% of the entire lake bottom and progressively shallower depths of water are anoxic [Ochumba et al. 1991; Hecky 1992; World Bank 1996]. Additionally, phytoplankton productivity has increased considerably resulting into increasing biomass; the phytoplankton population is dominated by the blue-green algae;[24] the zooplankton densities are low and the body sizes of the individual organisms are small; diatom and chlorophyte communities have been changing since 1920; while silica, phosphorus, and nitrate levels have generally risen over time. Compared to the 1960s the concentration of sulphur, for instance, has doubled leading to induced nitrogen deficiency and increased thermal stratification [World Bank 1996]. Aketch et al. (1992) have reported high loads of nutrients from urban centres, agro-based industries and soil erosion. Heavy metals such as iron, manganese, zinc, copper, nickel, chromium, cadmium, and cobalt have also been reported [Okello 1992].

The sources of pollution in the Kenyan part of the lake are many but principally industrial, municipal and agricultural.[25] As the lake's catchment area in Kenya holds 42% of the country's population and is drained by many rivers, agricultural, industrial and municipal wastes are washed into the lake through these rivers or runoff [Ochumba et al. 1991]. Several sugar and pulp and paper factories (Webuye pulp and paper factory, Nzoia sugar factory and Mumias sugar factory) discharge their waste into River Nzoia, one of the largest rivers draining into the lake. The wastes include wastewater, suspended solids, colour, foam, organic matter, chemical substances, and toxins such as resin acids [Wangila 1993]. Through River Kuja, coffee-processing factories in Kisii and sugar factories in Migori discharge their wastes into the lake. In addition to pollution from these factories, industries located in the towns surrounding the lake, notably Kisumu and Eldoret, also discharge their wastes either directly into the lake or into rivers draining into the lake. These industries include textile

[23] See, for example, Ogutu, G.E.M (1988), Ochieng'-Okach (1988), Ochumba et al. (1991), Geheb (1995), and World Bank (1996).

[24] According to World Bank (1996), there has been a two-fold increase in algal productivity, a four times increase in algal biomass and a three-fold decline in water transparency since the 1960s.

[25] These are also the same sources of pollutants on the Ugandan side of the lake according to Bugenyi and Balirwa (1989).

manufacturing, soap manufacturing, sisal factories, soft drink bottling, brewery, dairy industries, abattoirs, fish processing, and wood based industries [Wangila 1993; Ochumba et al. 1991]. The towns surrounding the lake and its feeder rivers pollute the lake ecosystem through another system; they discharge raw sewerage into it.

Industrial and municipal discharge has varied adverse effects on the lake and the associated riverline ecosystems.[26] Suspended solids reduce light penetration of the water and thus lead to anoxia, poor visibility of such species as Nile perch and *Bagrus* that feed by light, impaired gill respiration due to clogging, and choking of eggs resulting from adsorption of the solids and decomposition of the solids into nutrients leading to algal blooms. Colour discharged into the lake and rivers may block out the penetration of light energy of some wavelengths and consequently lead to the disappearance of species that utilize light of these wavelengths. Foam accumulation may interfere with water mixing and thus oxygenation. Toxins can kill fish, human beings, and animals directly. They can also lead to collapse of entire foodwebs, with disastrous effects on biodiversity, when they are bio-concentrated through the food chains. Atmospheric particulate and gaseous matter, largely from industries, is usually washed down by rain into water bodies as dilute acids such as sulphuric acid. These acidify the water with serious corrosion-related injuries to fish and other organisms. Organic and chemical discharges lead to excessive depletion of oxygen from the water bodies as they have high Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). Discharge of raw sewerage into the water bodies not only increases the level of the organic matter but also raises acidity.

Agricultural activities and land-use changes are also important determinants of pollution in Lake Victoria [Aketch et al. 1992; Wandera 1988; Wangila 1993; World Bank 1996; Ochumba et al. 1991; Okemwa 1991). Production of coffee, tea, sugarcane, cotton, pyrethrum, rice, maize, horticultural crops, and livestock are important agricultural enterprises in the areas surrounding the lake basin. The lake's catchment area hosts Kenya's largest sugarcane growers and sugar processing factories, including Muhoroni, Miwani, Mumias, Nzoia and South Nyanza Sugar Company (SONY). There is heavy use of inorganic fertilizers and other chemicals such as herbicides, insecticides, and fungicides in these areas. There is also serious soil erosion owing to poor land use systems. Vegetation removal through the cutting of trees for agricultural purposes, charcoal and firewood production has actually been cited as the most severe threat to the lake ecosystem, by Hanking (1987). Heavy chemical use and soil erosion coupled with intense precipitation have led to runoffs loaded with sediment and nutrients especially phosphorus and nitrates finding their way into the lake, leading to serious eutrophication. Nutrient inflow into the lake from the Kenyan catchment area has been estimated at 20 KG of Phosphorus/km²/year and 400 KG of nitrogen/km²/year [Ochumba et al. 1991]. These can cause either acute or chronic toxicity. Soil erosion increases suspended matter in the lake and thus reduces fish productivity.

Eutrophication in the lake has led to algal blooms [O'Riordan 1996; World Bank 1996; Wangila 1993; Ochumba et al. 1991]. Algal blooms are associated with such adverse effects

[26] For a detailed account of these see Wangila (1993).

as[27] fish deaths related to oxygen poisoning resulting from excessive oxygen levels during the day when algae photosynthesize; fish deaths from high carbon dioxide and low oxygen concentrations at night; low oxygen levels in the deeper water columns leading to the death of benthos that are an important part of foodwebs; and the depletion of oxygen because of the decomposition of the dead biomass of algae and phytoplankton. Severe pollution impacts on the Kenyan side of the lake are localized and coincide with spots of high algal bloom concentration and fish deaths [Ochumba and Kibaara 1989; Ochumba 1990].

One key reason why pollution of rivers and the lake has not been controlled is lack of coordination among the many government institutions charged with the responsibility of water management. These include the ministries of Water Development, Health, Agriculture and Environment and Natural Resources.

Wetland conversion and development

Another major problem related to agricultural activities that has negatively impacted on the biodiversity welfare and fishery productivity of Lake Victoria is wetland mismanagement and destruction [World Bank 1996; Wangila 1993; Ochumba et al. 1991; Okemwa 1991]. Wetlands have important roles to play in any ecosystem. In Lake Victoria, not only are they important spawning grounds for fish but they buffer the lake by filtering off nutrients, sediments and other pollutants from the water finding its way into the lake. These wetlands are being drained, converted and reclaimed for agriculture and development; polluted from siltation and the disposal of municipal and industrial wastes; dislodged by the floating water weeds; and over-harvested for such products as papyrus [World Bank 1996]. This wanton destruction and conversion of wetlands results into loss of resilience for the lake ecosystem.

Related to wetland conversion for development is the planned damming of the Amala river for hydroelectric power generation. Amala is a tributary of River Mara, which is one of the rivers that feed Lake Victoria. The planned regulation and damming will lead to adverse effects on the wetlands located downstream, particularly the loss of spawning grounds for such fish species as *Clarias* and *Labeo* [Wangila 1993]. Not only will these and other species using Mara River be endangered but the relocation of fish from the Amala into Ewaso Ng'iro through the regulation tunnel would interfere with the ecosystem.

The Mbita causeway built some years ago to provide a road link between Rusinga island and Mbita has facilitated development of the island but is now suspected of hindering the movement of fish and mixing of water [World Bank 1996; Wandera 1988]. This has been used by some to explain the abundance of fish in the side of Mfangano island relative to the Nyanza gulf and a floating bridge has been suggested as a replacement for the causeway.

Invasion by the water hyacinth, *Eichornia crassipes*

Lake Victoria is now facing an ecological crisis following invasion by the water hyacinth (*Eichornia crassipes*). This invasion can be partly[28] attributed to eutrophication resulting from sediment and nutrient deposition into the lake arising from soil erosion and other agents of

[27] See Wangila (1993) for details.

[28] There is uncertainty regarding the origin of the water hyacinth and how it found its way into Lake Victoria. One story is that the weed was brought into Africa from South America by foreign soldiers during the Second World War [*Kenya Times*, October 2, 1996]. As it had beautiful flowers and could survive for long in the sea, the soldiers found it the natural sentimental link to their homes while abroad. The weed subsequently found its way into River Kagera and was swept down into Lake Victoria, Ugandan side.

pollution. The water hyacinth is seriously affecting fish production, lake-transport, power generation, water supply, and human health. The massive floating vegetative cover hampers navigation and landing of fishing boats, leads to overheating of ferry engines and outboard motors and depletes oxygen from the water. The latter effect interferes with the biological functioning of fish, thereby impacting negatively on fishery productivity. The waterweed is also affecting productivity by disrupting important food chains. Through its vegetative cover, the weed shades phytoplanktons from sunlight, an important ingredient in photosynthesis. On transport, the weed, for instance, led to the indefinite closure of Kendu Bay pier at one time. In Uganda the effects on transport have been worse, necessitating huge financial and other resource expenditures in the weed's mechanical and manual removal. The weed, at one time, completely choked the power generation plant at Jinja and also clogged Kisumu's water supply pipes. The underside of the weed is said to harbour poisonous snakes and snails that carry disease vectors for bilharzia.

The weed has had at least one positive contribution. It has created such an outcry from the fishing industry that the governments of the three countries have had to come together in an attempt at finding joint solutions.[29] This has resulted, with the assistance of donor agencies such as the Global Environmental Facility (GEF) and the World Bank, in the establishment of the Lake Victoria Environmental Management Project (LVEMP). LVEMP is charged with not only the removal of the waterweed but also, with the broader task of environmental management of the entire lake. The three countries signed the agreement for the establishment of LVEMP in 1994. The control of the weed is expected to be achieved through an integrated approach, worked out with the assistance of FAO, that consists of mechanical methods and limited chemical intervention in restricted areas for short-term control and biological methods coupled with reduced nutrient inflows into the lake for long-term control. Already, the programme has carried out a study on the ecology of Lake Victoria and is applying biological control of the weed.

Under LVEMP, hyacinth control in the entire lake is projected to cost a total of US$ 3.172 million over the period 1997-2001 while the corresponding figures for industrial pollution prevention and water quality management are, respectively, 2.953 million and 3.038 million [World Bank 1996]. These figures are indicative of the enormity of the pollution problem.

Fish pathogens

Besides toxins, pollutants, and deoxygenated water, fish pathogens have led to occassional fish kills. Massive fish kills in Lake Victoria have been reported in 1927, 1953, 1968 and 1985 [Wandera 1988][30] An investigation into the causes of fish kills in the Kenyan side of Lake Victoria, carried out between 1985 and 1987, reached the conclusion that the main cause

[29] The weed has potential real economic value, however. It has been reported, for instance, that the weed is being used to produce biogas energy, purify water contaminated by raw sewage, produce manure and provide a substratum for the nourishment and breeding of some fish species [*Daily Nation*, November 13, 1997].

[30] One day, in August 1995, while this author was carrying out the field-work, fishermen at Got Kachola beach in Migori reported finding a lot of Nile perch floating on the water surface, dead or in distress. Consequently, all fishermen obtained large catches and the price at the beach dropped.

of these deaths was asphyxia, that is suffocation due to lack of oxygen [Wandera 1988]. It was, moreover observed that strong winds and storms tended to precede the fish kills, suggesting that these turbulations resulted into up-welling of the water thereby exposing fish to the bottom water that is deficient in oxygen. All factors that lead to the depletion of oxygen could, therefore, be held responsible for fish kills. Fish pathogens include bacteria, viruses, and parasites [Achieng 1988; Wandera 1988].

3.3.3 Management and regulation of the Lake Victoria fisheries

The pre-colonial period (up to year 1900)

During this period, the fisher community was responsible for the management and regulation of Kenya's Lake Victoria fisheries. In the Luo culture, only people born or married into sub-clans living near the lake could fish, with each of these clans' lake territory clearly demarcated so that members of one sub-clan were forbidden access into their neighbours' territory [Geheb 1995]. Thus, through territorial rules and regulations, access was limited to a particular group of people and to specific stock areas. Fishing effort was, moreover, controlled in other ways; even within the fishing sub-clans, only people of a set minimum age and who had acquired a certain level of knowledge in fishing and gear manufacture were allowed to fish [Geheb 1995]. Community traditions and culture, thus, provided a cheap self-regulatory mechanism through which resource conservation and sustainability was achieved. In this period, no external (that is, outside the clan) factors dictated the fisherman's choice of effort level as he controlled his means of production, owning the traps, nets and fishing knowledge he needed to produce fish. The clan, moreover, provided the `safety net' individual fishermen could fall back on in difficult times [Geheb 1995].

The colonial period (1901-1962)

Equilibrium between the resource users and the resource base started to crumble during the colonial period largely because of a considerable expansion in fishing effort. Geheb (1995) provides a detailed account of the factors that contributed to this rapid expansion of effort and the concomitant escalation of pressure on the existing customary restricted access mechanisms. Briefly, these include the enormous increase in the market and demand for fish engendered by the extension of the railway line from Nairobi to Kisumu in 1901; the introduction of taxes by the colonial government that thrust Kenyans into the cash economy; the introduction of more efficient but destructive fishing technologies such as the gillnet, in 1905, and the Beach seine; the rapid growth of the population of fishermen wrought by improved medical services and in-migration by people pushed off their land to create room for tea, sugar and cotton plantations in western Kenya; and lack of alternative employment.

The effects of progressively intensifying fishing pressure included falling CPUE, decreasing average size of fish caught, and collapse of the traditional regulatory mechanisms, all manifestations of a declining fishery. Indeed, all signs of territorial rights had vanished by 1960 [Geheb 1995]. The colonial government responded to these effects by introducing net mesh size and closed season regulations in the 1940s. Thus, the minimum legal mesh size was set at 5 inches (12.5 cm) while the closed season ran from April 1 to August 31 [Geheb 1995; Ogutu-Ohwayo et al. 1991].

Initial regulatory measures undertaken by the colonial government flopped. The agency

created in 1947 and mandated with the enforcement of the regulations, Lake Victoria Fisheries Service (LVFS), suffered from the same bottlenecks that confront its present-day equivalent, the Fisheries Department. Not only did LVFS face a manpower constraint but was inadequately funded and, therefore, ill equipped. The restriction on mesh size led to a rapid depletion of the stock of big-sized fish forcing fishermen, who lacked alternative employment and means of sustenance, to switch to the use of illegal mesh sizes. This switch was accelerated by the market situation; fish were sold in numbers rather than weight [Geheb 1995]. A fisherman using smaller mesh sizes caught more fish (in number) and received higher profits relative to the counterpart who used nets of larger mesh size. Realizing the unintended adverse effects of mesh size restriction, the colonial government repealed it in 1961.

The post-colonial period (since 1963)

Unlike the pre-colonial period, Kenya's Lake Victoria fisheries are now essentially accessible to anyone with the means of production. Access to the fishery resource is now determined by the capacity to invest in the means of production, principally boats, labour and nets [Geheb 1995]. Outsiders, including businessmen based in Nairobi and other large urban centres, whose motives are purely profit maximization, have edged the lakeside community off the control of the fishery resource, as the latter lack investment capacity. The majority of the lakeside fishermen can now participate only as labourers in the fishing industry. The lakeside fishermen can no longer ignore external factors in their choice of effort level to supply; they have lost control not only of the means of production but also the market of fish, where large refrigerated trucks and vehicles owned by fish processing firms and middlemen have taken control.

Currently, the management and regulation of these Kenyan fisheries is based on the 1989 Fisheries Act and its 1991 (revised) version. The focus of the Act is on the restriction of mesh sizes, fishing methods or technology, and closed seasons/areas for some species and/or fishing technology. Only a few of the management options legally open to the Director of Fisheries have been used in practice. The restriction on mesh size, repealed in 1961, was re-introduced in Kenya. The minimum mesh size for Tilapia gillnets is specified as 10.2 cm or 4 inches. A system of fishing boat registration, in addition, has been in place since the 1960s [Hoekstra et al. 1991]. Beach seining is prohibited during the closed seasons and for closed breeding areas. Closed seasons and areas have been used mainly to protect the Tilapia fishery. Thus, Beach seining and Mosquito seining are illegal over April-August period[31] as these methods harvest juvenile Tilapia. Known fish breeding areas such as sandy shores and shallow weed beds for Tilapia; river mouths for such species as *Labeo*, *Barbus*, *Alestes*, *Mormyrids* and *Clarias*; and swamps and wetlands for *Protoptrus* and *Clarias* are closed for specified periods. Trawling in the inland lake fisheries is also banned. Prior to its banning in 1993, trawling was legal so long as it was carried out outside five nautical miles of Kenya's territorial waters.

Personal communication with District Fisheries Officers (DFOs) confirm that minimum mesh size of gillnets, ban on Trawling, closure of fish breeding areas during the rainy season, trade in undersize fish and prohibition of Beach seining in fish breeding areas are the regulatory instruments being used in the current management of the fisheries. The regulations

[31] According to Gréboval [1989] this closed period runs from March 21 to August 1.

are, however, not uniformly enforced in all districts. Thus, while some districts enforce the minimum mesh size as 3.5 inches, others enforce 4 or 5 inches. Some districts, in fact, allow the use of Beach seine nets with meshes as small as 2.5 inches. The regulatory instruments used in the current management of the fisheries, thus, control only specific aspects of technology and do not restrict the amount of effort at all, reflecting the previously widely held opinion that the type of gear and fishing practices used were responsible for overexploitation [Gréboval 1989]. For example, the decline of tilapiine species, *Clarias*, *Labeo*, *Barbus*, *Bagrus* and *Mormyrid* fishes has been attributed to overfishing using illegal, small meshed gear.[32]

Lethargic enforcement of fishery regulations has led to an inexorable use of banned fishing technology and maintained these Kenyan fisheries as, essentially, open access resources. Thus in their survey of vessels exploiting these fisheries, Hoekstra et al. [1991] report that 20% of the boats are unregistered and that 9.2% of the boats operate the prohibited Beach seine gear. Licensing appears to have been motivated more by revenue collection than by management objectives [Van Marlen 1991]. The annual licence fees are simply too low to limit access. A typical fishing unit consisting of a canoe, 4 fishermen and their gears, for instance, requires only about Kshs 1,000 (US$ 15) for its annual licensing (boat, fishing, etc.) expenditure. Such a fishing unit could earn much more than this amount of money from a single day's catch. Moreover, since there is no policy of restricting the number of participants in the fishery, anyone interested in joining the fishery requires only fishing capital. Mesh size restriction and the banning of such fishing methods as Beach seining have simply, not been effective in the management of the lake fisheries [Okemwa 1991]. Moreover, trawlers continue operating in the lake illegally. The regulation of closed season, April-August, for designated fish breeding areas has not been successful either [Okemwa 1991].

According to DFOs, fishermen compliance with the regulations is extremely poor, with the most violated regulations being the use of small mesh nets and fishing in the breeding areas. This is because these nets and these areas guarantee higher catches and because small meshed nets are relatively cheaper. Geheb (1995) has attributed this low compliance with fishing regulations to their inconsistency with the socio-economic realities of the fishermen. For instance, fishermen may be willing to comply with the regulation requiring the use of gillnets of at least 5 inches but the cost of this could well be no catches at all as, according to fishermen, there are few fish of legal size remaining in the lake. It is widely acknowledged that fishermen compliance with regulations depends, to a reasonable extent, on the demands the regulations make upon them. Charles River Associates (1980: 1-1), for instance, notes that "*Regulations may imply changes in harvesting behaviour that contradict the fishermen's tradition or exceed their knowledge of how to earn a living*". Registration of vessels and fish movement licensing are also widely violated. Some of the junior fisheries officers have become fishermen, using the same illegal gears they are supposed to guard against, or fish traders completely forgetting their primary duties of data collection, enforcement of fishery regulations, and provision of extension services. This is a problem aggravated by the practice of keeping officers at one station for excessively long periods and by lack of regular impromptu supervisory visits from senior fisheries officers. Fishermen are, additionally, reported to be using poison to catch fish. Fishermen in Siaya district have, for instance, been recently reported to be using chemicals that are normally used to kill ticks in cattle dips as a fishing

[32] See Getabu [1987; 1991], Ogari [1991] and Okemwa [1991] for details.

technology.[33]

DFOs and other officials of the Fisheries Department cite financial and thus logistical bottlenecks as the leading hindrance to effective enforcement of fishing regulations. While many districts have either one or no patrol boats and an equal number of old landrovers, there is usually no money for fuel. The Fisheries Department is undermanned, underfunded and lacks the sophisticated technology required for lake-wide surveillance [Geheb 1995]. Moreover, trawlers use more powerful vessels and are usually armed. Trawling was administratively banned but was not legislated. Thus, in May 1995 for instance, a Kisumu court acquitted 10 trawl owners who had pleaded guilty to the charge of trawling as the charge is non-existent under the Fisheries Act.[34]

Serious corruption also hampers the enforcement of fishing regulations. This corruption takes many forms. At the highest level, senior and politically connected people, including former or current senior officials of the Fisheries Department, own the trawl boats and buy protection from the authorities. Fisheries officers often find themselves powerless against their current or previous bosses. At a lower level, juniour fisheries officers solicit for bribes from fishermen who use banned fishing gears and methods. According to one estimation, bribes range from Kshs 500 to 1,000 to secure the release of a seized illegal net to `soda' bribes to keep juniour fisheries officers amiable [Geheb 1995]. Arrested fishermen, moreover, rarely reach the courts because they can easily secure their freedom. The people charged with the responsibility of enforcing regulations at the local level, Chiefs, double up as fishermen, suffering from conflict of interest. In fact, beach leaders and leaders of fishermen co-operative societies facilitate bribery between fishermen and officers of the Fisheries Department [Geheb 1995].

It is also difficult to enforce the restriction on mesh size for gillnets as these nets are, in most cases, left set in the water. Moreover, the low selectivity of gear such as Mosquito seine (whose legal minimum mesh size is 10 mm) complicates the enforcement of mesh size regulations. Fishnet dealers apparently sell prohibited nets. These have been found in warehouses belonging to Fishermen Cooperative Societies who buy them from manufacturers for resale to their members. This is apparently the case because mesh size restrictions apply tc Lake Victoria fisheries only, so that the manufacture of nets of mesh size lower than 5 inches is perfectly legal. The closed season, April 1 - August 31, imposed for the *R. argentea* fishery is widely violated largely because this species of fish is harvested at night and sold off very early in the morning when the fisheries officers are off duty [Geheb 1995].

Lack of adequate and reliable data has also seriously affected the management of the lake fisheries, leading to the current fishery decline. In 1980, catch and effort assessment surveys were initiated and adopted as a permanent means of monitoring developments and trends in the fisheries of the Nyanza gulf. Prior to this, the East African Freshwater Fisheries Research Organisation (EAFFRO) conducted catch and effort assessment for the entire lake. Logistical problems and inadequately trained personnel have, however, seriously constrained the scope of these surveys, which are so crucial for more effective management of the fisheries. For example, out of more than 200 landing beaches along the Kenyan shore of Lake Victoria only 12 are sufficiently sampled by the Fisheries Department for catch and effort estimates [DFK

[33] *The Daily Nation*, 22 April, 1998.
[34] *The Daily Nation*, 13 May, 1995.

1988]. Not only is this a very small sample but also a biased one in that some days, notably weekends and public holidays, are skipped yet fishermen fish. KMFRI's sample consists of 25 beaches, which is also small [Ochieng'-Okach 1988]. It is not surprising, therefore, that data on fishing effort and other parameters from different sources for the same periods differ markedly (see Table 3.5, for example).

The last extensive stock assessment on the Kenyan side of Lake Victoria was carried out in 1971 [Ochieng'-Okach 1988], making management of the fisheries very uncertain. Management has often had to rely on localized bottom trawl surveys. It is encouraging that one of LVEMP's planned activities over the next five years is a lakewide stock assessment.

3.3.4 Fish marketing and price dynamics in Lake Victoria (Kenya)

Since marketing links the production and consumption sectors, it starts the moment catch is hauled into the fishing vessel in the fishing industry. It ends when the fish reaches the consumer. The marketing process, therefore, involves transportation, processing and distribution. The performance of the marketing system has significant implications for the production and consumption sectors as it, in the case of Kenya at least, determines not only the final prices that consumers have to pay but also the prices fishermen receive and, thus, the exploitation pressure directed at the resource.

From artisanal fish trading exclusively in dry fish in the past, the marketing of fish obtained from the Kenyan waters of Lake Victoria has developed to include not only trade in fresh fish at open air markets but also large scale and capital-intensive industrial processing and export [Adhiambo 1988]. Trading of fish at the beaches started in the 1920s with the fishermen not only producing but also processing and marketing the fish. Initially, only dry fish was traded in areas distant from the lake since transportation was slow and technology to keep the fish fresh was lacking. Sun drying was the only method of processing used at the time. Such trade involved barter exchange of fish with grain or livestock [Adhiambo 1988; Geheb 1995]. This was followed by the development of open-air markets near the landing beaches. Traders, mainly women, would buy fresh fish from the fishermen at the beaches and carry it with baskets on their heads and sell it at these markets. During the pre-colonial period, transportation and production capacity (the latter because fishing sub-clans were small) were the only restrictions to the market size [Geheb 1995]. The bicycle came into the picture around 1940 and facilitated distant trading of fresh fish by the local people. Elements of modern capital-intensive marketing were, however, visible as early as the first half of this century. For instance, Asian traders were buying fresh fish from beaches using motorized boats and distributing it to urban centres as early as 1930 [Ogutu, M.A. 1988]. The use of vehicles in relatively accessible beaches, mainly buses that ferried traders and their fish to urban centres, started in the 1960s. After independence in 1963, private companies dominated by Asians controlled a large share of the fish market, dealing exclusively in the distribution of fresh and filleted fish in Kisumu, Nairobi and other parts of the country.

There is now a combination of small scale and large scale, highly capital-intensive, marketing. This includes beach trading mainly in fresh but also processed fish, open air markets for both fresh and processed fish, foot and bicycle transport to proximate markets, motorized boat transport, vehicular transport with or without refrigeration facilities, highly developed industrial processing, and even sea and air transport to external markets in all parts

of the world.

The market structure differs from one fish species to the other. The large scale processing and trading companies have pushed out small-scale operators due to their superior infrastructural capacity and now dominate the marketing of Nile perch. The marketing of *Rastrineobola argentea* and Tilapia are also increasingly being controlled by medium scale and large traders. There is still a significant presence of small-scale operators, however. In the present situation, therefore, the lake fisheries are characterised by the co-existence of poor artisanal fishermen and a very successful commercial sector [Republic of Kenya 1989]. Competition within the large-scale fish-marketing sector, with the entry of more fish processing firms, and between this large-scale sector and the smaller sector has improved ex-vessel fish prices. Fishermen, particularly those operating from easily accessible beaches, can now choose the preferred buyer for their fish, to some extent.

Marketing of *Rastrineobola argentea*

This fish is usually cleaned in the lake before landing. It is mainly marketed in its sun-dried form but also fresh especially to local consumers. Regional and national markets for this species, however, are exclusively in the dry form. Sun drying is the only method used in processing *R. argentea* and takes 5-6 hours in the dry season and 2-3 days in the wet season [Kasirye-Alemu 1988]. In the wet season, there is a notable problem of quality loss resulting from moisture absorption and general pilferage during the drying process. There is also a problem of hygiene in that most small-scale dealers and fishermen dry fish on the bare ground in an area with very poor sanitation conditions. There are also birds that consume a substantial amount of the fish while it is spread out to dry.

In the past, this fish was used mainly for human consumption and its price was affordable to most people, as supply was adequate. Since the beginning of the 1990s, however, this species has found use in the animal feeds industry. Thus, the species in combination with small quantities of *Carodina nilotica* accounts for 70% of Kenya's total fishmeal production [Abila and Jansen 1997]. There are now 6 firms using about 70% of all the *R. argentea* harvested every year to manufacture fishmeal [Abila and Jansen 1997]. There is, furthermore, a large unsatisfied demand for fishmeal in the country. While fishmeal is also produced from Nile perch skeletons and some is also imported, the skeletons and *C. nilotica* are not as rich in proteins as *R. argentea* while the imported fishmeal is protein-rich but expensive [Abila and Jansen 1997]. The demand for, and therefore price of, *R. argentea* has, consequently, risen so much (from Kshs 20 per kilogram in 1990 to Kshs 60 in 1995) that the poor people who were relying on it as a cheap source of animal protein can no longer afford it. Fishermen targeting Tilapia and Nile perch used to sell all their catches and then buy some *R. argentea* for home consumption. They now find this, too, expensive and buy bread and soda instead. It is hardly surprising, then, that Kisumu which is the seat of the lake fishing industry has the highest (among Kenyan urban centres) percentage of its population suffering food deficiency and absolute poverty [Republic of Kenya 1997]. Moreover, close to 50% of the rural population living around the lake fail to get the World Health Organisation's (WHO's) minimum calorific intake of 2250 calories per adult equivalent day.

The marketing of *R. argentea* is mainly done by women, in small-scale, and by middlemen who have stores in beaches. The latter buy fish in large quantities, from various landing beaches, directly and/or through agents and dry it in the sun and store to await its collection

and transport to milling factories located in Nakuru, Nairobi, Kisumu and Migori. The millers, in turn, supply the milled fish to animal feeds factories located in various parts of the country.

Marketing of Tilapia

Tilapia is marketed either fresh (whole or fillet), fried (whole) or sun-dried (dissected), with the fresh form being the most prevalent in wholesale markets followed by the sun-dried form [Abila 1995; Kasirye-Alemu 1988]. The form in which the fish is sold largely depends on how far the market is and the condition of the roads connecting this market to the producing areas. Any unsold fresh Tilapia is taken home from the market and processed to await the market the following day. The distribution channel for Tilapia includes wholesale and retail operators for each of the product forms. There is a substantial presence of operators who use pick-up vehicles with ice for preservation. These buy fresh Tilapia from landing beaches and transport it to hotels or retail outlets. With the exception of the three fish processing firms currently filleting Tilapia, these "pick-up operators" are the most capitalised among Tilapia dealers.

Tilapia is the most popular fish in local, regional and national markets and its market is, therefore, very large. It is now common to find fried Tilapia being sold by the roadside as a popular snack, besides roasted maize and buns, in many urban centres of Kenya including Nairobi. Poor people can, however, no longer afford this fish owing to its high price. The market for Tilapia is largely domestic. Three of the twelve fish processing firms currently operating in Kenya, however, now fillet Tilapia in addition to Nile perch [Abila and Jansen 1997]. A small amount of the Tilapia fillet is exported. In the external market, Tilapia faces serious competition from Tilapia farmed in Europe.

Marketing of Nile perch

Nile perch, introduced into the lake ecosystem in 1954, became a phenomenon in Lake Victoria in the 1980s when annual landings of all fish species, from the entire lake, increased from an average of 100,000 tonnes in the 1960s and 1970s to about 500,000 tonnes by 1989, and a very strong export market developed. Since 1989, total annual landings from the entire lake have averaged about 4-5 times the catches experienced in the pre-Nile perch days, that is before 1980.

Although domestic demand for Nile perch was initially very low owing to its high oil content, it is currently very high in local, national, regional and international markets. The strong demand coupled with large fish supplies made fish business highly profitable and attracted into the lake fisheries massive hitherto lacking national and international capital. This capital was injected into the development of processing capacity, transport, cold storage facilities, and progressively into harvesting capacity. In a space of less than ten years, the number of firms established to process and export Nile perch grew dramatically in the three East African countries. Thus, while there were only 14 fish processing companies in Kenya by 1989 [Gréboval 1989], the number had increased to 35 by 1995, located mainly in Kisumu, Nairobi and Mombasa. Most of these processed Nile perch. In Uganda, the number increased from 2 (with total annual capacity of 9,125 tonnes) in 1989 to 12 by 1997, with annual capacity of over 73,000 tonnes. In Tanzania, there were a total of 10 processing factories in 1997, located at Mwanza [Goulding 1997]. Largely because of decreasing fish supply and stringent quality standards required to access the EU market (which currently absorbs 56% of Kenya's total fish exports), the number of processing firms in Kenya has fallen from the high

of 1995. Some have closed down while others have relocated to the other two countries where raw material supply is relatively higher. There is a larger processing capacity even with the smaller number of firms, however. According to a survey carried out in 1997, only 12 of the 15 registered Nile perch processing factories in Kenya are operating [Abila and Jansen 1997]. Nine of these factories are located at Kisumu and one each in Nairobi, Migori, and Homabay. These were estimated to have a total processing capacity of 380 tonnes of whole fish per day in 1996 even though only 200 tonnes of fish were actually processed per day or about 62,000 tonnes per year [Abila and Jansen 1997]. In terms of relative size, 25% of the largest factories account for over 50% of the total amount of Nile perch processed. The combined annual capacity of the 14 factories that existed in 1989 was 25,000 tonnes [Gréboval 1989].

Out of the 96,500 tonnes of Nile perch produced from the Kenyan side of Lake Victoria in 1996, about 64% were processed for export. Processing of 62,000 tonnes of Nile perch would yield 21,000 tonnes of fillet and 28,000 tonnes of frames [Abila and Jansen 1997]. In that year, 13,369 tonnes of Nile perch fillet were exported, meaning that about 7,000 tonnes of fillets were consumed in the domestic market. Besides the frames, therefore, only about 30% of the Nile perch produced remains in the local market, mainly the juveniles and those rejected by fish processing factories due to poor quality.

It is noteworthy that this tremendous growth in fish processing capacity in Lake Victoria, with the concomitant adverse effects on ecological balance, has been facilitated and aided by local, regional and international development and financial institutions who should know better. Most of the processing firms are foreign owned and have received financial assistance from such organisations as the World Bank's International Finance Corporation (IFC), African Development Bank (ADB), the Norwegian aid agency (NORAD), and the Aga Khan Foundation [Abila and Jansen 1997]. The Kenyan Government, in addition, grants these firms tax and tariff rate (on imported fishing and processing equipment) concessions.

With the exception of Uganda that has set up a fish export quota, at 60,000 tonnes annually, fish processing firms located in the other two countries can export as much fish as they can process. This has meant that given the almost insatiable demand in the export market and high profit margins, most of the Nile perch produced every year is exported, creating upward pressure on prices, in the domestic market, of not only Nile perch but also its `table fish' substitutes such as Tilapia. Approximately 39% of the 363,000 tonnes of Nile perch produced in the entire lake in 1994, for instance, was exported [Goulding 1997]. The highest proportion was in Kenya (47%), followed by Uganda (45%) and Tanzania (25%). In that year, the three East African countries earned a total of US$ 131.5 million from the export of Nile perch produced from Lake Victoria, distributed as follows: Kenya (US$ 49 million); Uganda (US$ 44.6 million); Tanzania (US$ 37.9 million).

Kenyan and Tanzanian firms export mainly frozen fillets while Ugandan Nile perch exports are predominantly (82% in 1996) fresh [Goulding 1997]. Frozen fillets are exported by sea in containers, at a cost of US$ 0.50 per kilogram for EU shipments. On the other hand, fresh fillets are airfreighted, usually in the evenings, by normal or charter flights at a cost of US$ 1.50-2.00 per kilogram for EU shipments [Goulding 1997]. In 1996, Abila and Jansen (1997) estimated that fish processing firms in Kenya incurred an average cost (all costs including raw material acquisition, marketing, transport, processing, storage, labour, taxes, etc.) of US$ 2.00 of fillet per kilogram but sold frozen fillets at the average price of US$ 3.5 per kilogram. The export market is differentiated on the basis of product form preferences and, therefore, prices.

The premium markets of Northern Europe, America and Australia prefer "deep skinned fillet" that is associated with a 30% yield [Goulding 1997]. The other markets are the Southern European market, including Spain and Greece, that prefers the relatively cheaper 35% yield fillet; the Israelian market that consumes an even higher yield (40%) fillet; and the Japanese market that prefers "skin-on scaled fillet" of 42% yield [Goulding 1997].

Nile perch is highly perishable but has a long shelf life of up to 27 days on ice.[35] This constitutes the principal reason why large-scale fish traders have succeeded in pushing their smaller competitors from the marketing of fresh Nile perch and, indeed, fresh Tilapia. Unlike the small trader, the large-scale fish dealer owns refrigerated vehicles, which are sent out every day to visit beaches and collect fish from agents or directly from fishermen. Fish collected at the landing beaches is packed in ice and transported in trucks to the factories for processing. Only fish of very high quality is processed for export [Goulding 1997; Abila and Jansen 1997]. Processing involves cleaning and manual or mechanical filleting. The process used for skinning fillets, and therefore the rate of yield, depends on the target market.

Fish processing firms source their supply of raw material through one or more of a number of strategies. In Kenya, half of the firms have established credit relationships with fishermen (or their co-operative societies) or with fish buying agents [Abila and Jansen 1997]. In this kind of relationship, the processing firm provides credit for purchase of nets, boats, and outboard engines while the fisherman or agent reciprocates by supplying fish exclusively to the firm. The money lent is gradually recovered from fish sales to the firm. Processing firms may also purchase fish directly from fishermen or their co-operatives at the landing beaches; use contracted or independent agents; obtain supplies from partner factories within Kenya or those located in the other two countries; or engage in fish harvesting by investing in harvesting and transport technology and employing fishermen [Abila and Jansen 1997]. The latter strategy is mainly used in the Ugandan and Tanzanian sides of the lake where fish processing companies obtain supplies this way and supply to their partner firms in Kenya for processing. There is both horizontal and vertical integration in the Nile perch processing industry.

Agents are crucial and are used by all processing firms either as the sole strategy or in combination with other strategies [Abila and Jansen 1997]. Most agents have their own sub-agents stationed at the beaches and have established their own credit relationships with fishermen. The agents, handling a substantial amount of fish daily and claiming about 10% of the beach fish price, can be quite rich and powerful and through collusion with other agents, credit arrangements with fishermen, and control over market information (regarding prices processing firms are prepared to pay and the quantity of fish demanded) can offer fishermen prices way below market rates [Abila and Jansen 1997].

Through "client-patron" relationships between fish processing firms and/or their fish buying agents and fishermen either individually or through cooperative societies, these firms have effectively edged out small scale traders from the lucrative Nile perch trade. The relatively smaller trader lacks capacity for such deals. Local small-scale fish processors have also been edged out of the Nile perch business, as their technology is neither suited nor cost-

[35] According to Kasirye-Alemu (1988) and Ogunja (1988), poor handling aggravates perishability. Fish is usually transported to the beach exposed to the sun (and a sizeable proportion is already spoilt at landing), thrown down from the boat, dragged along to the weighing table, stepped upon, and mishandled in numerous other ways, increasing the risk of contamination.

effective for this oily fish.

The main challenges facing Nile perch processing firms is how to increase the utilization of their capacity and meet the high quality standards required to gain access into the EU and other export markets. As noted already, only about 50% of the established capacity is being utilized in Kenya while this is slightly higher in Uganda, at about 80%. In Kenya, capacity is underutilised because of inadequate supply of fish; the high quality standards required, dictating that only a limited volume of fish can be handled at a time; overseas market access difficulties for relatively young processing firms; and inadequacy of funds to secure enough fish from fishermen who demand cash on delivery [Abila and Jansen 1997]. While most of the processing factories in the three countries meet EU's hygiene standards of design and construction, unscrupulous processing by unregistered and unhygienic factories occurs and the conditions at the landing beaches are, generally, poor [Goulding 1997]. The large fish processing firms interviewed in 1995 noted that the major determinant of their performance in the overseas market was the quality of fish, a factor that made some of them to close down as soon as they had started operations. The firms indicated, further, that the most serious problem they faced was the large quantity of fish they got when it was already spoilt particularly from Uganda and Tanzania because of the long distance.

On account of poor quality control, East African fish consignments into Spain and Italy were found to contain unacceptably high levels of bacterial contaminants in March 1997, prompting stricter inspection procedures for subsequent consignments from the region. Following failure to arrest deteriorating quality standards and an outbreak of cholera in East Africa following exceptionally high rainfall, the EU banned fresh fish imports from Kenya, Uganda, Tanzania, and Mozambique in January 1998. This was a particularly heavy blow for the Nile perch industry in Uganda as 82% of her exports are in the fresh form. It was bad for Kenya, also, since the EU constitutes about 56% of her fish export market.

The EU ban had several effects on the Kenyan Nile perch industry.[36] The ex-vessel price of Nile perch fell by between 45% and 67%, depending on landing beach, in only 3-4 months. Most fish processing firms reduced operations, some by as much as 75%, while others laid off workers. For example, the largest of these firms in Kenya and the only that has acquired the ISO 9000 certificate of quality, Samaki Industries, reportedly laid off 150 workers and closed its factory in Tanzania. The ban, moreover, led to more rigorous examination of the frozen fish consignments that had been spared by the ban and contributed to increasing lack of confidence in East African fish even in markets outside the EU. Some fishermen and middlemen reportedly withdrew their boats from the lake when the business became unprofitable. The economy also lost substantially in lost tax income and income for people employed in the fishing industry. Even airlines that airlift fresh fish to EU lost substantial business. Lufthansa, for instance, was reported to have lost Kshs 30 million (US$ 0.5 million) per week in business opportunity.

The Kenyan Government reacted to the ban by enforcing strict adherance, by fish processing firms, to high hygienic standards. This was accomplished through visits to beaches and factories, and through the inspection of fish transport trucks. Hygienic standards were, subsequently, raised high enough to satisfy EC's Sanitary and Phyto-sanitary Council. The ban

[36] These are based on press reports appearing between January and July 1998. Sources include *The Nation*, *The EastAfrican*, *The Economic Review*, and *The Weekly Review*.

on Kenyan fresh fish exports was, consequently, lifted on July 1, 1998. There are, however, certain health standards that the country's fish industry is required to meet by January 1999 for restoration of full confidence in the quality of its fish products.

Small-scale traders are also engaged in marketing of Nile perch, although their share of the business is fast declining. Lacking cold preservation facilities, small-scale dealers in Nile perch can only participate in local markets. The bulk of the small-scale trade in Nile perch is, therefore, in the following preserved forms: smoked (whole or in pieces), deep-fried (whole or in pieces) or fried frame forms. Smoked Nile perch is the most preferred form at the Kisumu wholesale market, followed by fried, fresh and frame forms in that order. Smoking is the most important method of artisanal processing of Nile perch. It is usually done in traditional kilns that require 24 hours before one load of fish is ready [Kasirye-Alemu 1988]. This, of course, uses a lot of wood (wet acacia is the preferred type) and has serious environmental implications. Already, trees around the beaches have all been harvested and wood for smoking has to be "imported" from distant areas.

Small-scale trade in Nile perch frames (skeletons) is a spin-off of the fish processing industry. The frame, consisting of the skeleton, head, fins, and the attached fresh, is one of the by-products of Nile perch filleting and accounts for about 40.4% of the fish's entire weight [Ogunja et al. 1992]. The recovery rate of fillet from Nile perch is about 34.2% of the entire weight.[37] An estimated 60% of all Nile perch frames produced in Kenya are used in the production of fishmeal, while the rest are artisanally processed (deep fried in oil) and used for human consumption. However, as recent as the late 1980s, all the frames were either consumed by humans or discarded [Abila and Jansen 1997]. The frames are therefore increasingly getting out of reach for poor people largely because of rising prices resulting from demand in the animal feeds industry. There are two factories, located at Nairobi that use Nile perch frames to manufacture fishmeal [Abila and Jansen 1997]. Fish processing factories in Kenya have improved their fillet recovery rate, implying that the frames are less suitable for human consumption. Increasing use of the frames for fishmeal production has, in addition, led to the displacement of artisanal processors. These are switching to the processing of juvenile fish, with all the negative environmental effects it entails; juvenile fish is becoming more and more commercialized with its market developing rapidly.

Other by-products of the filleting process that have economic value are the swim bladders exported to Japan, oil used for manufacture of fishmeal and the skin that can be tanned into leather [Ogunja et al. 1992; Kasirye-Alemu 1988].

Marketing of other species of fish

Besides Nile perch, Tilapia and *R. argentea,* other species of fish are landed from Lake Victoria, albeit in small quantities. These include *Haplochromis*, *Clarias* and *Barbus*. On account of extremely high demand for these species coupled with very low supplies, they are marketed fresh for consumption along with Tilapia. *Haplochromis* is, however, often deep-fried usually in Nile perch oil. *Haplochromis*, immature Nile perch and immature Tilapia are not gutted before deep-frying.

Role of fishermen cooperative societies

Fishermen cooperative societies were registered as early as the 1950s but most started

[37] Kasirye-Alemu (1988), in contrast, estimates the recovery from large fish at 20-30%.

the enterprise, low initial capital requirements,[38] improved transportation through the "matatu" and the relatively low price of fish compared to beef [Ogutu, M.A. 1988]. In siaya and Busia, women dominated fish trade in markets near the lake but men controlled the markets that were far.

Fish price dynamics

Even though nominal fish prices have increased substantially over the years, particularly in the late 1980s and the 1990s (see Fig. 3.4), it is only in the case of a few species that the price has increased in real terms [Table 3.6; Fig. 3.5]. In 1995, the real price of Tilapia was only about 70% of the price in 1975, while for *R. argentea* the corresponding figure was 65%. The price of Nile perch in 1995 was 126% that in 1975, in real terms. Thus, even for Nile perch, the increase in real price over the last 25 years has been small. It is only in the 1990s that the real price surpassed the 1970 level, largely because of the fish export business that started booming in the late 1980s. It is understandable, from these price data, why fishermen refer to the Nile perch as the "saviour".[39] Since catch per unit effort (CPUE) has been falling over the years, these price statistics indicate that the livelihood of fishermen has substantially worsened over time, with the exception of those engaged in Nile perch based fisheries.

In the domestic market, there is price inelasticity of demand for table fish because table fish has no substitutes in the lake region [Gréboval 1989]. Its price, therefore, does not fall with decreasing size of individual fish. It is in this light that the existence of a huge market for

Table 3.6: Average ex-vessel prices for selected species, Lake Victoria (Kenya) (constant 1990 prices).

FISH SPECIES	Annual average ex-vessel price, Kshs/KG.								
	1970	1975	1980	1983	1985	1988	1991	1993	1995
Nile perch	6.48	8.60	6.06	2.84	2.93	4.07	10.02	11.58	10.85
Tilapia niloticus	-	15.17	15.02	11.33	10.41	13.24	7.09	11.05	10.76
R. argentea	9.81	6.69	5.44	2.22	2.26	3.63	4.92	2.20	4.36
Haplochromis	6.48	6.35	4.71	2.51	6.01	5.23	5.80	7.51	6.37
Protopterus	7.71	10.96	8.90	6.43	7.53	5.38	7.71	27.57	11.02
Clarias	7.52	7.42	7.31	4.51	5.43	4.71	3.91	12.99	9.54
Mormyrus	5.90	8.26	6.45	3.90	4.27	13.46	8.51	15.47	7.96

Source: Compiled from various issues of *Fisheries Annual Statistical Bulletin*, Fisheries Department, Kenya. The prices are deflated with the aid of a series of consumer prices for low income people in Nairobi (1990=100), obtained from the International Monetary Fund (IMF), *International Financial Statistics Yearbook* (various issues).

[38] In 1976 for instance, Ogutu, M.A. (1988) reports that a trading licence cost only Kshs 50 and, therefore, start-up capital of Kshs 50-100 was sufficient as fish buying prices were low. Depending on size, the price of one Tilapia fish, for instance, ranged from Kshs 2 to 3.50. By 1988, this start-up capital was Kshs 500 or less in addition to trade licence of Kshs 200 and a health certificate [Ogutu, G.E.M. 1988].

[39] See Gréboval (1989).

Fig. 3.4: Trend in Lake Victoria fish prices, nominal terms.

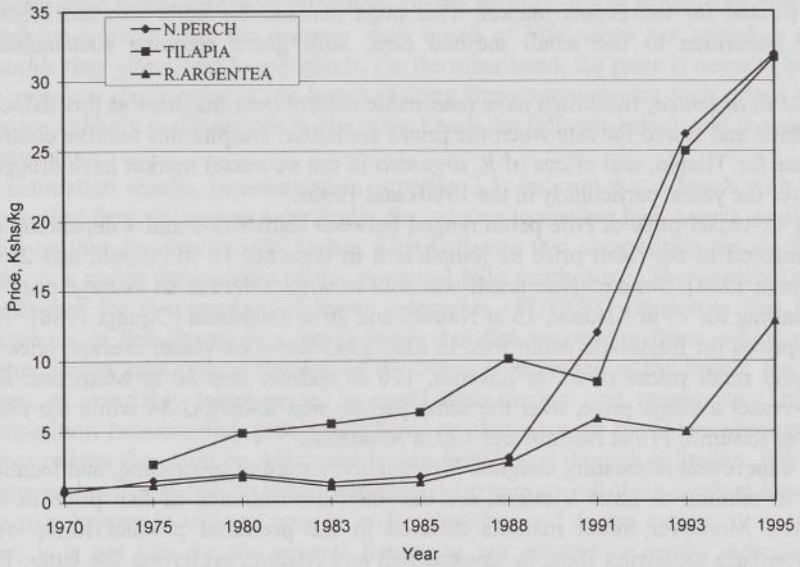
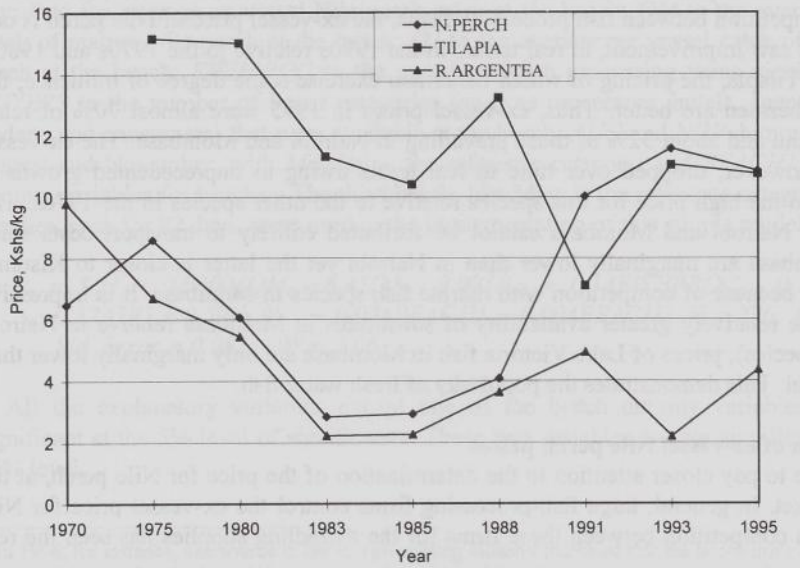


Fig. 3.5: Trend in Lake Victoria fish prices, constant 1990 prices.



medium and small sized Nile perch, Tilapia, and other fish species (excluding *R. argentea* and

Haplochromis) should be viewed. Thus, Tilapia and Nile perch are close substitutes in the domestic market with the price of the former, therefore, also indirectly affected by the huge external demand for Nile perch. The price of Tilapia is increasing, moreover, because this fish is also being filleted for the export market. This huge demand for table fish has created incentives for fishermen to use small meshed nets, with grave resource sustainability consequences.

In the case of *R. argentea*, fishermen have reasonable control over the price as this fish can be easily sun-dried and stored for sale when the prices are better. Despite this relative control, and like the case for Tilapia, real prices of *R. argentea* in the ex-vessel market have dropped significantly over the years, particularly in the 1980s and 1990s.

In 1988, the ex-vessel price of Nile perch ranged between Kshs/KG 2 and 4 depending on the quality compared to the retail price of Kshs/KG 8 in Kisumu, 18 in Nairobi and 25 in Mombasa [Ogunja 1988]. Smoked Nile perch was sold to wholesalers at an average price of Kshs/KG 8, retailing for 13 at Kisumu, 15 at Nairobi and 20 at Mombasa [Ogunja 1988]. The corresponding prices for fresh Nile perch fish, in May 1995 were: ex-vessel average price of Kshs/KG 21, and retail prices of 55 at Kisumu, 110 at Nairobi and 80 at Mombasa. For Tilapia the ex-vessel average price, over the same period, was Kshs/KG 34 while the retail prices were 50 at Kisumu, 110 at Nairobi and 100 at Mombasa.[40]

These price data reveal interesting insights. Fish quality, nature of processing, and location of the market in relation to Lake Victoria, are the main determinants of fish price in the domestic market. Moreover, retail markets differed in the preferred product form, with Nairobi and Mombasa preferring fresh to smoked fish and Kisumu preferring the latter. For Nile perch, where the control of price by fishermen has been substantially eroded, the price the fishermen get is only about 10-20% of the retail price in Nairobi and Mombasa and about 30-40% of the retail price in Kisumu, located at the lakeshore. Nevertheless, because of increasing competition between fish processing firms, the ex-vessel price of Nile perch is one of the few that saw improvement, in real terms, in the 1990s relative to the 1970s and 1980s. In the case of Tilapia, the pricing of which fishermen exercise some degree of influence, the margins to fishermen are better. Thus, ex-vessel prices in 1995 were almost 70% of retail prices in Kisumu and about 32% of those prevailing in Nairobi and Mombasa. The ex-vessel prices have, however, dropped over time in real terms owing to unprecedented growth in inflation and to the high price for this species relative to the other species in the 1970s. The high prices in Nairobi and Mombasa cannot be attributed entirely to transport costs since prices in Mombasa are marginally lower than in Nairobi yet the latter is closer to Kisumu, most probably because of competition with marine fish species in Mombasa. It is impressive that despite the relatively greater availability of substitutes in Mombasa relative to Nairobi (marine fish species), prices of Lake Victoria fish in Mombasa are only marginally lower than those in Nairobi. This demonstrates the popularity of fresh water fish.

Determination of ex-vessel Nile perch prices

It is instructive to pay closer attention to the determination of the price for Nile perch, at the ex-vessel market. In general, large fish-processing firms control the ex-vessel price for Nile perch although competition between these firms for the dwindling supplies has seen the real

[40] The ex-vessel prices are based on the author's survey data while the urban market prices are obtained from a survey reported in the Business and Finance section of *The East African Standard*, May 9, 1995.

prices rise marginally in the 1990s. We have developed a simple exploratory model to illustrate this control. In the model, the price of Nile perch at the ex-vessel market is hypothesized to be positively influenced by the *number of fish processing firms* that visit the beach on a given day, the *average daily catch of Nile perch per vessel at the beach*, the *monthly time effect*, and *beach effects*. On the other hand, the price is negatively influenced by the *previous day's price at the beach* (fishing firms encountering high prices on a particular day are unlikely to come back to the same beach the following day), and the *number of buyer categories*.

Estimation results, summarised in equation 3.1, indicate that a beach with one extra fish processing firm visiting on a particular day relative to another has, *ceteris paribus*, Nile perch price on that day that is 14% higher. This indicates that competition among fish processing firms is a major determinant of the ex-vessel Nile perch price. The negative and significant coefficient for the number of buyer categories (*BUYERS*) reinforces this finding. Many categories of fish buyers at a beach imply that fish processing firms, which generally offer higher prices, take only a fraction of the Nile perch landed at the beach; the balance being taken, at invariably lower price, by small scale traders and consumers. This evidence of competition between fish processing firms so that none of them has absolute control over prices refutes the claim by Abila and Jansen (1997) that through collusion, fish buying agents postpone buying of fish to force desperate fishermen to sell their catch at low prices. While this may happen in isolated remote landing beaches and during extremely wet periods of the year, it is not true for the general fishery as our estimation results indicate. In fact, fish processing firms complain of high fish prices at the beaches that make their business unprofitable.[41]

Variables in the equation are defined as follows: subscript t refers to time, specifically the day; P to the average ex-vessel Nile perch price at the beach; QM to the average per vessel catch of mature Nile perch at the beach; QJ to the average per vessel catch of juvenile Nile perch at the beach; *FISHPROC* to the number of fish processing firms visiting the beach; *BUYERS* to the number of buyer categories (such as processors, hotels, agents, small scale traders, and consumers) that were available at the beach; *AUG* and *NOV* dummy variables for August and November, with *May* being the reference category; and *BEACH1* and *BEACH2* dummy variables for beaches. The third beach, like May, is the reference category. Only three beaches, each for 92 days, were used in the implementation of this simple model.

$$Ln\ P_t = 3.51 + 0.00004QM_t - 6.45QJ_t - 0.005P_{t-1} + 0.14FISHPROC_t - 0.18BUYERS_t + 0.12AUG + 0.59NOV + 0.074BEACH1 + 0.004BEACH2.\ N = 276;\ Adj.\ R^2 = 0.93;\ Std.\ Error = 0.083;\ DW = 2.06 \quad \ldots 3.1$$

All the explanatory variables except one of the beach dummy variables and QJ_t are significant at the 5% level of significance. These two variables are not significant even at the 10% level.

[41] In 1996, for instance, one source in the fish processing industry indicated that the beach price for Nile perch averaged about Kshs 55-60 per kilogram while he estimated that the maximum price should have been Kshs 47 for fish processing to be profitable. This is in sharp contrast with the finding by Abila and Jansen (1997) of very high margins for owners of these firms.

As hypothesized, the estimation results indicate that fish processing firms or their agents, move from beach to beach depending on prices. Thus, a beach with a relatively high price of Nile perch today is likely to have a slightly lower price the following day as some of the fish processing firms or agents will move to other beaches, thereby reducing competition and, therefore, upward pressure on price.

The results presented in equation 3.1 are credible since the autoregressive model yielding them is stable. There is stability if the absolute value of the coefficient for the lagged variable is less than 1 [Stewart 1991]. An autoregressive model can be estimated by standard OLS procedures so long as the sample size is reasonably large, stability conditions are satisfied, and there is no serial correlation [Stewart 1991]. Our model meets these conditions.

Some of the large firms that export Nile perch fillets enter into contracts with their buyers in Europe and elsewhere for, say one year, to supply the fillet at a set dollar rate[42] per kilogram of quality fish. Swings in the exchange rate, therefore, affect the prices these export firms are willing to pay for the fish at the ex-vessel market. The firms indicate that overseas demand for the fillet is very high but fluctuates, being high during winter compared to summer. The export price, moreover, varies substantially depending on the quality of fish, the external market and the relationship between the exporting firm and the customer abroad. The sensitivity of the ex-vessel market for Nile perch to the external market is evident from the impact the EU ban of fresh fish imports from East Africa had on prices. As noted already, the ban saw the ex-vessel price of Nile perch in Kenya fall by almost 60% in only 3-4 months. This was, in addition, demonstrated in 1994 when media reports of dead human bodies being sighted in the lake led to a similar downward pressure on ex-vessel fish prices.

Goulding (1997) provides the following export market prices: in 1995, fresh Nile perch fillets went for an average wholesale price of US$ 4.21 per KG while frozen fillets sold at an average price of US$ 2.82 per KG. The ex-vessel price of Nile perch in 1995 was, therefore, less than 10% of the wholesale export price. Like farmers engaged in liberalised agricultural sectors of Sub-Saharan Africa, the proportion of export prices received by fishermen exploiting these Kenyan fisheries has not increased from liberal fish export because of an imperfect and under-developed ex-vessel fish market. In 1997, frozen fillets were reported to be under pressure on account of static demand. The FOB price for frozen fillet of 35% yield was US$ 2.5/KG in that year. On the other hand, fresh fillet was retailing at US$ 9.30/KG in Belgium relative to US$ 9.90 for Cod and US$ 11.30 for Whiting, which are substitutes. It is not surprising, therefore, why the demand for Nile perch fillet is very high in the external market. These prices are broadly comparable with those reported by Abila and Jansen (1997) for 1996 and those given to us by contacts in the fish processing industry for 1994 and 1995.

Competition between firms is also lowering the price in the external market. Thus, according to an industry source, the export prices in 1996 were lower than in the previous two years, because of underpricing by some competitors. There are, moreover, other species of fish that serve as close substitutes of Nile perch and compete with it in the external market.

Obstacles facing fish marketing

Impediments to improved fish marketing on the Kenyan side of Lake Victoria include:

i) Poor roads that render some beaches inaccessible especially during the rainy seasons. This

[42] The contracts are, however, reviewed monthly or otherwise depending on demand.

leads to enormous post-harvest losses, depresses fishing activities, and increases the market vulnerability of fishermen to agents and fish processing firms. This, additionally, raises the vehicle maintenance costs enormously for fish processing firms, affecting profitability. At one time, a source in the processing industry said, the problem was so bad that the firms contemplated closing down or sending a delegation to the Government. Lake-transport helps quite a bit in the rainy season but this, too, is affected because the lake is quite rough then.

ii) Lack of cold storage facilities at the beaches, again leading to post-harvest losses especially in the rainy season and denying fishermen say in price determination.

iii) Failure of fishermen cooperative societies to play an important role in marketing leading to the current situation where fishermen have no say on fish price. Fish processing firms have also suffered from this failure in that they have been forced to rely on fish buying agents. The firms have complained of rip-offs from their agents at the beaches who cheat on the price they offered at the beaches.

iv) For the export market, the most important challenge is to meet and maintain the stringent quality standards being set for fish by the EC and other external markets.

v) High cost of electricity and frequent blackouts were cited as serious constraints by fish-processing firms. This has been a serious obstacle not only for fish processing firms but literally all power-consuming production units in Kenya.

vi) Fish processing firms also complained of lack of freight space and fraud in the external market. The Fresh Produce Exporters Association of Kenya (FPEAK) recently announced that it was exploring ways in which its members could export joint consignments through charter flights which are relatively cheaper. The association is also making arrangements that will enable members to negotiate for cargo space and freight rates, with the airlines, as a strong unified body. These are opportunities from which fish exporting firms can benefit substantially, either by joining FPEAK or forming a similar association of their own.

Besides these obstacles, negative resource sustainability and socio-economic impacts associated with expanding fish markets are, themselves, obstacles to the marketing process. Given their importance, these are discussed, separately, in the next section.

3.3.5 Socio-econo-environmental implications of expanding fish marketing

The commercialization that has taken place in Lake Victoria fisheries since mid-1980s has had some positive impact on the socio-economic wellbeing of many people. Thus, the lucrative Nile perch export business has enabled fishermen to obtain higher real prices in spite of rapid increase in inflation, owing to increased competition among the exporting firms. Employment opportunities have also been created in the filleting factories, transportation, fish purchase agencies, Nile perch frame processing outfits, and other spin-off activities. At the national level, the country has benefitted substantially from foreign exchange earnings and corporate tax receipts. Investors in the fish-processing sector, both local and foreign, have earned billions of shillings from fish marketing. These have been the largest beneficiaries of commercialization.

The negative implications have, however, been as much, if not more than, the positive ones. Nutritionally, high fish prices have meant that cheap protein is no longer available to poor Kenyans who had hitherto relied upon it. For many, Nile perch and Tilapia became

luxuries a long time ago when only *R. argentea* and Nile perch frames were affordable. Demand in the fishmeal industry has, however, made these too increasingly unavailable. The prices of Nile perch and Tilapia in the retail markets are so high that only high-income earners can afford them. Because of high ex-vessel prices, due to the influence of the export market, even fishermen and consumers living near the lake cannot afford these fish. They can only consume the juveniles and fish rejected by the fish-processing factory on account of low quality. It was estimated that between 1984 and 1986, only 3% of the fish landed from these fisheries was consumed by the fishermen and their families with the rest being marketed [Ogutu, G.E.M. 1988]. Abila and Jansen (1997) estimate that if none of the Nile perch were exported and none of the *R. argentea* and Nile perch frames were used for fishmeal production in 1996, per capita fish consumption in Kenya would have been double, that is 6 KGs instead of 3 KGs. The small-scale traders and processors, mainly women, who derived their livelihood from the fishing industry, have additionally, been edged out and their means of sustenance is threatened.

Since fish is very important in the food and nutrition security of many developing countries, it is worthwhile to assess the significance of fish in Kenya's food policy.

Food policy and fish in Kenya

Kenya's food policy, agricultural policy, and development policy are almost synonymous with each other. They have the same objectives. These are food self-sufficiency, food security, employment creation, income-generation, foreign exchange earnings, rural-urban balance, and overall growth [Republic of Kenya 1994b]. Food production and food security, the main elements of food policy, are also agricultural policy's overriding priorities. The policies and strategies drawn to achieve the objectives of the national food policy are, therefore, largely those aimed at boosting agricultural production, improving the distribution and marketing of the agricultural products, and earning of more foreign exchange with which food could be imported during periods of scarcity. These include price incentives to encourage farmers; an enabling socio-economic and political environment for enhanced private sector production; a favourable agricultural inputs policy; provision of research and extension services; importation of the necessary foodstuffs during periods of deficit; improved food processing and marketing including increased public investment in roads and other infrastructure; an agricultural trade policy that controls export of all food crops, regulates food imports to protect domestic farmers, and supports the export of such crops as tea and coffee that generates foreign exchange required to import foodstuffs when these are in shortage; a nutritional policy that targets increased production of more nutritious foods (beans, peas, and groundnuts for proteins), improved distribution of purchasing power, market intervention and other programmes to protect the vulnerable groups, information gathering on nutritional status, safeguarding of nutritious quality of diets for small-holder producers who switch from food to cash crop production; a resource development policy that addresses sustainability issues; an employment policy that aims at providing incomes to the majority of Kenyans; and measures to mitigate the adverse impact of the Structural Adjustment Programmes (SAPs) on the food security of the vulnerable groups [Republic of Kenya 1981, 1994b]. These strategies are complemented by a macroeconomic policy that aims at enhancing household food security through its impact on job creation, income growth, education, and health.

In 1980, Kenya faced a severe food shortage due to poor policies that forced farmers to

reduce production and due to unfavourable growing conditions [Republic of Kenya 1981]. The country was, therefore, forced to import maize (her staple foodstuff), wheat and milk. By that time, moreover, per capita nutritional intake had fallen to levels below the recommended ones, mainly because of a population that was growing at the rapid annual rate of 4% and a largely fixed amount of arable land. These are the factors that prompted the Kenyan Government to publish *Sessional Paper No. 4 of 1981 on National Food Policy*, the country's first. In spite of the comprehensive measures contained in the food policy, the rapidly expanding population, shortage of high potential arable land, but more so because of poor implementation of the measures, have meant that national supply of food has persistently failed to meet demand since the early 1980s. The nutritional status of Kenyans has also worsened, to the extent that even calorific intake has become inadequate. In 1989, a year that was relatively good compared to the 1990s, for instance, calorie supply per capita was only 2163 compared to the recommended minimum of 2300. According to the UNDP, the daily per capita supply of calories in Kenya has fallen from 2,180 in 1970 to only 1,980 by 1995 despite the decline in annual population growth rate from about 4% in the 1980-81 period to about 2.2% in 1995. As early as 1976 when the calorific requirements were being met in the country, protein intake was inadequate. In that year, the average Kenyan consumed only 56 grams of protein per day, 3.5 grams short of the required level [Republic of Kenya 1981]. About 46% of the Kenyan population is, furthermore, estimated to be living below the poverty line at the moment.

Nutritional status statistics, based on national averages, in fact conceal the fact that the low-income groups are extremely malnourished largely due to inequitable income distribution. The vulnerable groups in Kenya, that is those with low or zero food security, are the very poor, the near landless, the disadvantaged groups of young children, pregnant and lactating women. As an example of how vulnerable these groups are, at least one-third of the Kenyan children are estimated to be anaemic, mainly because of low dietary availability of iron and folic acid [Republic of Kenya 1994a].

It is for these reasons that food production and food security have remained the priority targets of the agricultural sector and the second policy paper, *Sessional Paper No. 2 of 1994 on National Food Policy*, was published. The only new elements of the new policy paper are strategies (social dimensions programme) to protect the food security of the country's vulnerable groups in light of the liberalization of the money and foreign exchange markets, and food prices. Kenya's Development Plan (1994-1996), in addition, targets economic growth and improved income distribution as the main strategy for reducing chronic food insecurity, and substantial growth in employment in agricultural and other sectors as the strategy for a sustained reduction in chronic food insecurity [Republic of Kenya 1994a].

It is obvious, therefore, that Kenya's food policy is comprehensive and correctly identifies the areas that need intervention. Compared to OECD's definition of "Food Policy" [Tracy 1993], for instance, the only components that are not well addressed in the Kenyan food policy are those dealing with informative food labelling and consumer participation in policy decisions. Kenya's problem is not policy formulation; her policies in most sectors compare well with the best in the world. Kenya's problem is a very poor record of policy implementation.

In the national food policy, fish is regarded as being relatively unimportant in the overall national diet [Republic of Kenya 1981]. Kenya's food policy dwells mainly on staple

foodstuffs, which fish isn't. In 1981 fish was viewed as an important source of protein and, therefore nutrition, but only for regional areas. In the 1994 sessional paper, however, fish is recognized as one of the 9 major foods. It is estimated that by the year 2000, 5490 calories of energy per person per day and 1.05 grams of protein per person per day will be required from fish. This is the excess that will not be met unless measures are taken to improve the supply situation. The role the fishing sector is expected to play in the economy has also increased substantially. Thus, the Government's main objective for the sector is increased fish production to increase the supply of protein, increase incomes, and expand contribution to the GDP [Republic of Kenya 1994a, 1994b]. Fishing being labour-intensive, the sector is also expected to be a significant source of employment. The sector is, moreover, regarded as having untapped export earnings potential. The official position is that fish production can still be expanded from inland lakes, dams, the marine subsector, and fish farming [Republic of Kenya 1994a]. In 1992, for example, the 198,000 tonnes of fish harvested from all sources in Kenya represented only 33% of the estimated harvest potential for that year. Following this belief, the Government projected fish production to grow at an annual rate of 4.3% between 1992 and 1996 [Republic of Kenya 1994a]. In reality, however, fish production has been declining since the beginning of the 1990s in spite of increasing fishing effort. Like the agricultural sector, the strategy set for the fish sector is increased production, improved marketing, and reduction of post-harvest losses.

Kenya has potential to become and remain self-sufficient in the production of maize, sugar, wheat, sorghum, finger millet, rice, pulses, tubers, oilseeds, fruits and vegetables, meat and meat products, dairy products, poultry and eggs, fish and honey [Republic of Kenya 1994a]. With regard to fruits and vegetables, the official policy is to increase production for both the export and domestic markets. Increased production of coffee, tea, pyrethrum, sisal, and cut-flowers is targeted for the export market. Indeed, fast growth of export crops is part of a strategy for food security. Thus, there is a reluctance to shift some of the land under export crops to food production on account of foreign exchange earnings. The objective is to generate foreign exchange with which to import the staple foodstuffs in periods of acute deficits. This appears to be the implicit policy with regard to fish and horticultural products. The goal of foreign exchange earnings appears to override that of food self-sufficiency, at least for these commodities. Thus, unlike the staple foodstuffs, there is no strategy of controlling fish or horticultural exports to safeguard domestic supplies yet these are crucial in the attainment of the nutritional goal of the national food policy. There is, instead, export encouragement for these commodities. The objectives of the fish processing policy, for instance, are the encouragement of fish imports from the neighbouring countries to ensure ample raw material supply to the processing plants; encouragement of fish filleting for export through export and tariff incentives, and rationalisation of the tariff structure on imports of fish processing machinery and inputs; support for programmes that provide boats and gear to artisanal fishermen; assistance to local fishermen in acquiring good equipment; encouragement of financial institutions to provide loans for development of fish handling and storage infrastructure at the beaches; and strengthening of local cooperative societies through finance, training, and research [Republic of Kenya 1994a].

The failure to place a ceiling on the amount of fish exported per period, obviously in pursuance of the myopic objective of maximising foreign exchange earnings, is erroneous in that it denies Kenyans a cheap source of protein and increases pressure on the resource base.

The failure of the Government to rationalize the use of fish and fish products in the animal feeds industry is another manifestation of a food policy that is poorly focused. Even though fishmeal is used for the production of other sources of animal proteins (poultry, dairy products, and beef), these are generally unavailable to the poor. The use of fish for feeds production rather than for consumption by poor Kenyans could, therefore, be regarded as re-distribution of nutrients or welfare from the `have-nots' to the `haves'. The government appears to be ignorant of the fact that fish is an important source of animal protein to the poor, as it is cheaper relative to meat, poultry and dairy products; that fish adds flavour to the staple diet; that fish is rich in essential fatty acids, vitamins and minerals; and that fish is easier to process compared to the alternative sources of animal protein. The sector, moreover, provides food security at the household level by providing households with a safety net during harvest failures and during times when less labour is required for their principal occupation. Controlled fish exports would, ultimately, reduce demand in the overseas market because of rising prices and thus reduce the exploitative pressure on the resource system. Simultaneously, local and domestic consumption of fish would increase with positive impact on the nutritional status of Kenyans. The same would be the case if the use of fish for fishmeal production is controlled.

Fish consumption in Kenya has increased over the years from a national annual average of 2.2 KGs per capita at independence (1963) to about 8 KGs in 1992 [Kenya Fisheries Department]. This is still inadequate given that the poor cannot afford supplementary sources of animal protein. Furthermore, this figure falls short of the estimated fish consumption requirements. Okemwa and Getabu (1996) suggest that each Kenyan needs 9.3 KGs of fish every year. The figures given by the Fisheries Department are, in fact, very inaccurate as they do not consider the amount of fish exported, imported, and that used in fishmeal production. Taking these factors into consideration, Abila and Jansen (1997) provide more realistic per capita fish consumption figures that show a much worse situation. Their figures indicate a fall from 4.5-5.0 KGs in 1990 to 3.1-3.7 KGs in 1996. The consumption is highest in areas adjacent to the water bodies from which fish is harvested and in urban areas [Nyagambi 1988]. There is still unacceptance of fish as a food, however, in some parts of the country due to cultural and social norms, religion, food beliefs, and personal factors [Nyagambi 1988]. It is worthwhile to note that the highest levels of malnutrition in the country are found in districts inhabited by the fisherfolk, because they consume very little of the fish they produce and, yet, have no access to supplementary sources of protein. Kwale and South Nyanza, for instance, have not only maintained some of the highest levels of stunting among children in Kenya, but also an increase in prevalence from 1982 to 1987 with levels of stunting being 43.4% and 30.9%, respectively, in 1987 [Republic of Kenya 1994a]. Additionally, the highest per centage of people suffering from food deficiency and from absolute poverty in Kenya's urban centres are found in Kisumu, the centre of the fishing industry [Republic of Kenya 1997]. Many surveys have, furthermore, shown a high incidence of protein deficiency among the people living around the lake, especially children [Republic of Kenya 1997]. Control of amount of fish exported (like Uganda does) will not guarantee that the fisherfolk receive higher prices for their catch but the reduced demand for fish will force them to consume more fish. In any case the fisherfolk hardly benefit, from the lucrative fish export market, the real beneficiaries being participants in the processing and marketing sectors.

Environmental (resource sustainability) implications

While not underplaying the magnitude of these socio-economic impacts, it is the impacts on the environment, or more specifically resource sustainability, of expanding fish trade and export that are perhaps most worrisome given that these, ultimately, have repercussions on fishermen livelihoods. Exploitation pressure emanating from high demand for fish in the domestic and external markets is rapidly depleting stocks, thereby increasing the threat to sustainable use of these lake fisheries. Excessive capacity has been attracted into the harvesting and processing sectors. Desperate to increase or maintain capacity utilisation in the face of declining resource productivity, fish processing firms have, through credit arrangements and other strategies, aided fishermen in not only expanding effort but also switching to the use of inappropriate fishing technology such as Beach seines, Mosquito seine nets, illegal trawling, and the use of chemicals. This kind of technology recruits young fish into the fishery before they have had a chance to reproduce and/or destroys fish habitats. This behaviour is aggravated by the increasing commercialisation of small sized fish, including juveniles. Thus, the high prices offered for table fish are also strong forces in the switch of technology. Juvenile fish, too, are increasingly finding a market as small-scale operators displaced from *R. argentea* and Nile perch frames sectors turn to dealing in juveniles for survival. Further, faced with dwindling raw material supplies, excessive idle capacity, and export orders that must be met, fish processing firms are now using Nile perch of less than 1 KG in weight for processing. Previously, they could only use Nile perch that was at least 2-3 KG in individual size [Abila and Jansen 1997]. The government's explicit policy of encouraging and aiding, through reduced tariffs on imported fishing and fish processing equipment and through other tax measures, has also aggravated the tendency towards intensive fishing and use of destructive technology. This is a clear manifestation of policy failure.

Declining real prices, particularly for Tilapia and *R. argentea*, may have also increased exploitation pressure. Faced with these falling prices, fishermen may be expected to increase their fishing effort in a bid to sustain their real income levels. Under current poverty levels, therefore, sustainable use of these fishery resources cannot be guaranteed whether real prices are rising or falling. Even with rising real prices, fishermen are unlikely to sacrifice more fishing time for leisure, as their poverty levels are still very high. Worse, with falling prices fishermen will do all it takes, including the use of destructive technology, to maintain their income levels.

3.4 Summary and Conclusions

In terms of relative contribution to GDP, Kenya's fishing industry is not big. Nevertheless, the industry is a source of livelihood, employment, and animal protein for many Kenyans. The industry is an important source of foreign currency, too. Even though Kenya's share of Lake Victoria is very small, her fishing industry is dominated by the lake fisheries. Loss of biodiversity, general decline in the fisheries, and the resultant threat to resource sustainability and, therefore, to livelihoods is extremely worrisome as far as these fisheries are concerned.

The factors responsible for this increasing threat are, broadly and from an economic perspective, inadequate property rights and high time discount rates. These are symptoms of policy and market failures.

Overfishing, a result of both market and policy failures, is one of the main causes of biodiversity loss and general decline in these Kenyan fisheries. The fisheries are under all forms of overfishing, including quantitative, qualitative, biological, and "Malthusian". Delving into specifics, the factors responsible for the expansion of fishing effort that has led to this overfishing have been identified as rapid population growth, poverty, limited employment opportunities outside the fishery sector as a result of this population growth and low agricultural potential in the lake region, specialization of the Luo to fishing, expanding fish marketing opportunities and increasing commercialization of the lake fisheries, the lucrative and liquid nature of the fishing enterprise, ease of entry into the fishing industry as a result of the breakdown of traditional management structures and poor enforcement of the public regulations imposed to replace these structures, low production costs since the social and environmental costs of fishing are ignored, and the emergence of non-selective fisheries in response to declining CPUE.

Besides overfishing, ecosystem destruction and interference (or pertubation) is identified as the other major avenue through which biodiversity loss and decline in Kenya's Lake Victoria fisheries occur. This pertubation has arisen from overfishing; the introduction of non-indigenous fish species into the lake ecosystem that has led to the disruption of food webs and to predation; pollution from industrial, municipal, and agricultural wastes, including soil erosion caused by unsustainable agriculture and tree felling for woodfuel production; wetland mismanagement and destruction for agricultural and other developmental purposes; invasion of the ecosystem by the water hyacinth as a result of heavy eutrophication caused by pollution and sediment deposition; and occasional but massive fish deaths caused by fish pathogens, asphyxia, and toxins.

On account of their importance and since they are not analysed in subsequent chapters, two of the sources of threat to resource sustainability are discussed in greater detail in this chapter. The first is the management and regulation of the fisheries. The collapse of the traditional management structures left a regulatory vacuum, which the government has persistently failed to fill since the colonial period. The Fisheries Department, the institution mandated to manage, regulate, and monitor the fishing industry in Kenya, is poorly funded and politically marginalised. Consequently, the enforcement of regulations is lethargic and limited by financial bottlenecks, lack of an adequate logistical infrastructure, inadequate staffing, weak political will, corruption, unrealistic regulations that are out of touch with the socio-economic realities of the fisherfolk, lack of incentives for fishermen compliance such as secure and well defined property rights, lack of an adequate and accurate data base, reliance on administrative regulatory bans that are not supported by law, institutional weakness, and inconsistent fishery policy. Regulation of only qualitative aspects of effort cannot be effective as the experience with mesh size, closed areas and seasons, trawling, registration of vessels and fish trade in these Kenyan fisheries has shown. There is need, therefore, to regulate the quantitative dimensions of effort, too.

The second is fish marketing, commercialization, and pricing dynamics. Expanding fish marketing opportunities and the ensuing commercialization of the lake fisheries have had, and continue to have, enormous implications on resource sustainability and, thus, the livelihoods

of the fisherfolk. Excessive demand for fish in domestic and external markets, governmental support and aiding of the fish export sector, the consequent development of excess capacity in the fish processing sector, credit arrangements between the processing and harvesting sectors, growth of the fishmeal industry, substitutability of small and medium sized Nile perch and Tilapia as "table" fish, increasing commercialization of juvenile fish, and declining real fish prices continue to pose threat to resource sustainability by increasing fishing effort and the use of destructive technology. These, additionally, have adverse effects on fisherfolk livelihoods not only indirectly, through the threat on resource sustainability, but also directly, through loss of control over the means of production and over fish marketing.

The factors responsible for overfishing and ecosystem interference in Lake Victoria (Kenyan sector) have to be addressed if the integrity of these important fisheries is to be restored. This has to be done because the fisheries are important and because the alternatives, marine fisheries and aquaculture, are beset with serious problems. The inshore marine fisheries are overexploited while the offshore fisheries are inaccessible to Kenyans due to technological constraints and are heavily poached to the point of almost full exploitation. The officially estimated potential in the marine sector is, therefore, largely illusory. Like the rest of Africa and Latin America, fish farming in Kenya is still in infancy owing to a number of constraints. These include lack of capital; illiteracy and, therefore, low management skills; poor species selection; otter predation; unfamiliarity with fish in some areas of the country; lack of a strong institutional set-up to support and advise fish farmers; and the existence of open access capture fisheries that provide `softer options' for producing fish to people living in proximate locations. Kenya, in fact needs to address the obstacles hindering growth in all fisheries sub-sectors as fish is a nutritious food commodity. Given the fact that about 50% of Kenyans live below the poverty line and that about one-third of her children are anaemic on account of nutritional deficiency, Kenya ought to change her policy for the fish industry from one with an export bias in favour of one with a nutrition security bias. The amount of fish used in the animal feeds industry, moreover, ought to be rationalised with food security as the utmost objective.