FISHERIES TRAINING PROGRAMME

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Final Project 2004

CO-MANAGEMENT AND VALUE CHAINS: THE ROLE OF NILE PERCH EXPORTS IN POVERTY ERADICATION IN LAKE VICTORIA FISHING COMMUNITIES

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ABSTRACT

The Nile perch, an introduced species into Lake Victoria, has led to commercialisation of the fishery and development of industrial export oriented trade. This paper examines the Nile perch export value chain, distribution of the benefits along the chain and its relevance in the fight against poverty among the fishing communities of Lake Victoria. The Nile perch export supply chain has six links: the fishermen → middlemen → agents → fish processing factories → fish exporters/importers → retailers. In 2004 there were 13 fish processing factories operating in Uganda with over 500 fish supply agents. Over 6,000 fishing boats were specialised in the Nile perch fishery in the offshore waters of the Ugandan part of Lake Victoria and supplying fish for export processing. Using revenues from fish exports, the profit margin of each level of the Nile perch supply chain within Uganda was calucluated. The fish processing factories received 63%, the factory agents 10%, the middlemen 10% and the fishing boat owners 17% of the total value added to the chain. Overall, the exports of Nile perch have had a positive impact on the macro economy and improved the income of the Lake Victoria fishing communities. The analysis of benefit distribution is linked to fisheries management. The level and development of fish stocks determines what the fishermen can catch, therefore influencing the operations along the value chain. Catches are stagnating despite increased fishing effort. This coupled with increased harvesting of immature Nile perch are threats to the sustainability of the lucrative value chain. This paper therefore, also gives a brief discussion on fisheries management in relation to the sustainability of the value chain.

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ACRYNOMS

ACP	Africa, Carribean, Pacific countries
ADB	African Development Bank
DFID	Department for International Development of UK
DFR	Department of Fisheries Resources, Uganda
DRC	Democratic Republic of Congo
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FIRRI	Fisheries Resources Research Institute
FOB	Free on Board
HACCP	Harzard Analysis Critical Control Points
IITA	International Institute of Tropical Agriculture
GoU	Government of Uganda
LVFO	Lake Victoria Fisheries Organisation
LVFRP	Lake Victoria Fisheries Research Project
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MCS	Monitoring, Control and Surveillance
MEY	Maximum Economic Yield
MFPED	Ministry of Finance, Planning and Economic Development
MSY	Maximum Sustainable Yield
NRI	Natural Resources Institute of UK
OECD	Organisation for Economic Cooperation and Development
PEAP	Poverty Eradication Action Plan
PMA	Plan for Modernisation of Agriculture
TL	Total Length
UAE	United Arab Emirates
UBOS	Uganda Bureau of Statistics
UFPEA	Uganda Fish Processors and Exporters Association
UPPAP	Uganda Participatory Poverty Assessment Process
UPPAP2	The second Uganda Participatory Poverty Assessment Process
USA	United States of America
Ush	Uganda Shillings

1 INTRODUCTION

Lake Victoria has "a regulated open-access" fishery[1]. Until the 1970s, the indigenous tilapine *Oreochromis esculentus* and haplochromine cichlids dominated the catches. Subsidiary fisheries included non-cichlid fishes, such as *Bagrus, Clarias*, *Synodontis, Schilbe, Protopterus* and *Labeo* (Ogutu-Ohwayo 1990, Okeyo-Owuor 1999). The catches are now dominated by two introduced species: Nile perch *Lates niloticus* and Nile tilapia *Oreochromis niloticus* plus one indeginous species, the small pelagic cyprinid *Rastrineobola argentea*. Other species, which still appear in the catches though in small numbers include: *Clarias mossambicus, Bagrus docmac, Barbus altinalis, Protopterus aethiopicus, Synodontis victoriae, Mormyrus Kannume, Labeo victorinus, Schilbe mystus* and *Haplochromis spp.*

The introduced Nile perch led to increased catches in all the three countries sharing Lake Victoria. In Tanzanian waters the annual catches rose from 146,000 tons in 1988 to 231,600 tons in 1990, in Kenya annual catches rose from 13,000 tons in 1965 to 190,000 tons in 1990 while in Uganda the annual catches rose from 10,000 tons in 1980 to 132,400 tons in 1989. Nile perch went from 0% of the total catch in 1975 to 68% in 1988 in Tanzanian waters, in Kenya it increased from 0% in 1968 to 58% in 1996 while in Uganda it went from 0.01% in 1965 to 72 % in 1991(Bokea and Ikiara 2000, LVFO 1999, Reynolds and Greboval 1995 ,)

Fishery for Nile perch in Uganda supplies an export market worth over US $ 100 million, providing a major source of foreign exchange earnings and revenue for fishers, processors and exporters. Nile perch has had a major impact and transformed fishing from a subsistence and social activity to a commercial enterprise.

Since Nile perch entered the global market, there has been an increase in the number of fish processing factories dealing in exports of fish fillets with increased demand for raw material. This has resulted in the rise of factory gate fish prices from an average of Uganda Shillings 800 per kg (US $ 0.64) in 1998 to the average of Uganda Shillings 2,100 (US $ 1.17) per kg in 2002. Earnings from fish exports have grown from US $ 1.4 million in 1990 to US $ 87 million in 2003 (DFR 2004).

Apart from contributing to foreign exchange, fish exports have the added the potential benefit of being pro-poor as export prices should be translated into higher prices of fish for fishermen and those involved in fish trade. The increase in fish exports is closely linked to increased household income and therefore poverty reduction. If the fishery is well managed, it will contribute to driving income poverty down.

Despite the relatively high prices of fish paid by factories to agents and fishermen and the expected high earnings by fishers, recent trends and developments in the fish trade and marketing have raised concerns over the welfare of the fishing communities. A number of socio-economic studies indicate that fishing communities around Lake Victoria remain poor (Bokea

[1]The fishery is regulated in the sense that there are gear restrictions and fish size limits for both Nile perch and Nile Tilapia. It is open- access in the sense that anybody who can afford a fishing licence is free to join the fishery. There is no limit on the number and size of fishing vessels or on the number of legal gears one can use.

and Ikiara 2000, Jansen 1997, LVFRP 2001, MFPED 2002). Income distribution is thought to be increasingly skewed in favour of fish processors against the fishers. It has been noted that the dispersion of benefits between user groups is not fully understood and that further analysis is required (Bwathondi *et al.* 2001).

The growth of Nile perch export has attracted many people to the fishery and a value chain has developed around this species. However, there is currently little literature on the number of people participating in the Nile perch value chains and the distribution of benefits. A large number of middlemen have joined in the fisheries marketing chain. Fishers around Lake Victoria claim that factory agents are cheating them either through low prices or through adjusting weighing scales (Heck *et al*. 2004). The presence or absence of cheating has not been verified due to lack of data on the fish marketing chain and this has hampered policy decisions.

There are those who hold the view that current fisheries management and export regimes from East African countries are resulting in reduced availability of fisheries products to local consumers, undermining local food security. Incurred costs to local economies and domestic natural resources have exceeded gains from export earnings (Abila 2003, Bokea and Ikiara 2000, Douglas 1993, Jansen *et al.* 1999). The picture potrayed is that all fish is going to the fish factories for exports, leaving no fish for domestic consumption. There is a need to look at what is being processed for export and what goes to the domestic markets of the estimated fish catches. This is important in policy decisions when balancing the objectives of foreign exchange earnings and food security. Links must be built between sustainable livelihoods at the community level and external trade that are beneficial to artisanal fishers and fishing communities

International fish trade is supposed to contribute to the economic growth of the country and improve the earnings of fishermen. This study analyses the value chain in the marketing of the Nile perch from Uganda by tracing the catches from the boat to the international market and analysing benefit distribution along the chain. It focuses on the value added at each segment of the chain and how the benefits accruing from the fish export are distributed among the different segments in the value chain. It thus examines the impacts of the fish export chain on poverty alleviation in light of government efforts to reduce poverty, especially among the rural population. The study also examines whether co-management arrangement will improve rent distribution, contribute to poverty alleviation and provide an incentive for proper fisheries management.

2 DATA USED AND METHODOLOGY

This study is based on primary data and secondary data available in the Department of Fisheries Resources (DFR), Uganda. Records of fish exports generally represent the true value and have been useful for planning. Monthly returns from the fish factories are analysed in this paper for quantity and value of fish procured, quantity and value of fish exported, average price per kg for both procurements and exports, price differences along the geographical location where fish is sourced and the number of agents supplying fish to the factories. Prices of fish paid at different levels of the chain were obtained from interviews with key informants in the industry, district fisheries officers and from DFR records.

Data on the number of fishermen, number of fishing boats and gears involved in the Nile perch fishery were obtained from the Lake Victoria frame survey results of 2000 and 2002. Percentage change between the 2000 and 2002 figures is used in deriving the fishing parameters for 2001 and 2003.

Based on the quantities of fish procured for export processing and the revenue from fish export, supply chain costs and benefits were calculated for each segment of the chain. Transaction cost data for fish transport boats (middlemen) and factories were obtained from a recent study carried out by the Natural Resource Institute (NRI) and the International Institute of Tropical Agriculture (IITA) (NRI and IITA 2002). Transaction costs for fishing boat owners and land-based transporters (factory agents) were calculated based on data obtained under the fish quality improvement component of the EU\ACP Globalisation Project (Marriot and Keizire 2004). The transaction costs of the various players in the chain were incorporated in the supply chain profit analysis. Supply chain costs and margin calculations were done in Excel. Profits were calculated as the difference between revenues and costs. Profits as percentage of revenue and as difference between sale price and cost price per kg were also calculated.

Economic benefit or resource rent from a fishery at agiven time can be expressed as:

$$\Pi_t = \left[P_t h_t - (VC_t + OCE_t + FC_t)\right]$$

where:
$P_t h_t$ = total value of landed fish at time t (P = price and h = quantity of landed fish).
VC_t = Variable cost at time t
OCE_t = Opportunity cost of effort at time t
FC_t = fixed cost at time t

This formula was used as a base for calculating profits along the value chain:

$$\prod = R - C \quad (1)$$
$$C = fc + vc + cc \quad (2)$$
$$R = y * p \quad (3)$$

Where $\prod$ is the profit.

C is the costs, *fc* is the fixed costs, *vc* are variable costs and *cc* are the capital costs.

R is the revenue, *y* is the quantity of fish and *p* is the price perkg.

The four levels of the value chain analysed were fishing, middlemen, agents and industrial processing. In fishing, there are two players, the boat owners and the fishers (crew). Middlemen are operators of fish transport boats who buy fish from the fishers especially from island and remote landing sites and transport it for marketing in the big mainland landing sites serviced by the fish traders. Factory agents are mainly land-based transporters who buy fish from the landing sites and sell to the fish processing plants. Industrial processing are the fish processing factories preparing mainly fish fillets for export to international markets.

3 FISHERIES IN UGANDA

3.1 Fisheries resource base

Uganda has a surface area of 241,000 km^2 out of which 44,000 km^2 is covered by water rich in fisheries resources. Uganda was ranked 9th among the top 20 inland countries in fish production by FAO (Vannuccini 2004). Uganda has good potential with a production per unit area of land approximately 0.9 tons/km^2 (FAO 2003).

The sector is comprised of both capture and aquaculture fisheries. Capture fisheries currently contribute most of the total production with aquaculture just starting to venture into the commercial stage. Capture fisheries are based on five major lakes (Figure 1) and a number of minor lakes. The five major lakes are: Lake Victoria (68,800 km^2)[2], Kyoga (2,047 km^2), Albert (5,335 km^2), Edward (2,300 km^2) and George (250 km^2).

The maximum sustainable yield (MSY) estimate for the capture fisheries sub-sector is 330,000 metric tons (MAAIF 2004a). However, according to records available at the Department of Fisheries Resources, Entebbe, the highest landed estimate was 245,200 tons in 1990 and the catches fluctuated between 217,100 and 229,510 tons from 1991 to 2002. It is not clear whether the MSY has not been reached or surpassed since data collection is not comprehensive due to the numerous and scattered nature of the fish landing points. In addition, data collection does not capture the fish smuggled on water from shared lakes to the neighbouring countries. The MSY of the various multispecies water bodies have not be calculated thus making it difficult to know whether the national MSY of 330,000 tons is still valid. Intensified monitoring, control and surveillance (MCS) on Lake Victoria in 2003 saw an increase in landed catch at 175,220 tons and a slight increase in the estimated catch for the whole country reaching 241,700 tons for that year.

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[2] Lake Victoria is shared between three countries Tanzania 51%, Uganda 43% and Kenya 6% (See Figure 1). Lakes Albert and Edward are shared between Uganda and the Democratic Republic of Congo with Uganda having 54% and 29% respectively.

Figure 1: Map of Uganda showing major fishing waters.

The Nile perch (*Lates niloticus*) which is found in lakes Victoria, Albert and Kyoga has dominated Ugandan fisheries over the past two decades acounting for 42% of the catches by volume. Other major species harvested include *Oreochromis niloticus* (35%) *Rastrineobola argentea* (8%) and the other species accounting for 15% (genera of *Bagrus, Clarias, Protopterus, Alestes, Barbus, Hydrocynus, Synodontis, Mormyrus*, and *Labeo*) (Balirwa and Kamanyi 2004, MAAIF 2004b).

Although Nile perch is found in other water bodies in Africa, it is only the Lake Victoria Nile perch that has featured in international fish trade. Nile perch is a demersal fish and grows to a recorded total length (TL) of 193 cm and weight of 200 kg (Fishbase 2004), is a predator and lives in the water column 10 – 60 m deep. It has white palatable flesh with very few bones and is rich in omega 3 fatty acids (700mg/100 grams), which studies suggest can help to reduce the risk of heart disease.

Although Nile perch was introduced in Lake Victoria in the 1950s, it only started appearing in the catches in Uganda in late 1960s and rose to prominence in 1980s (Figure 2).

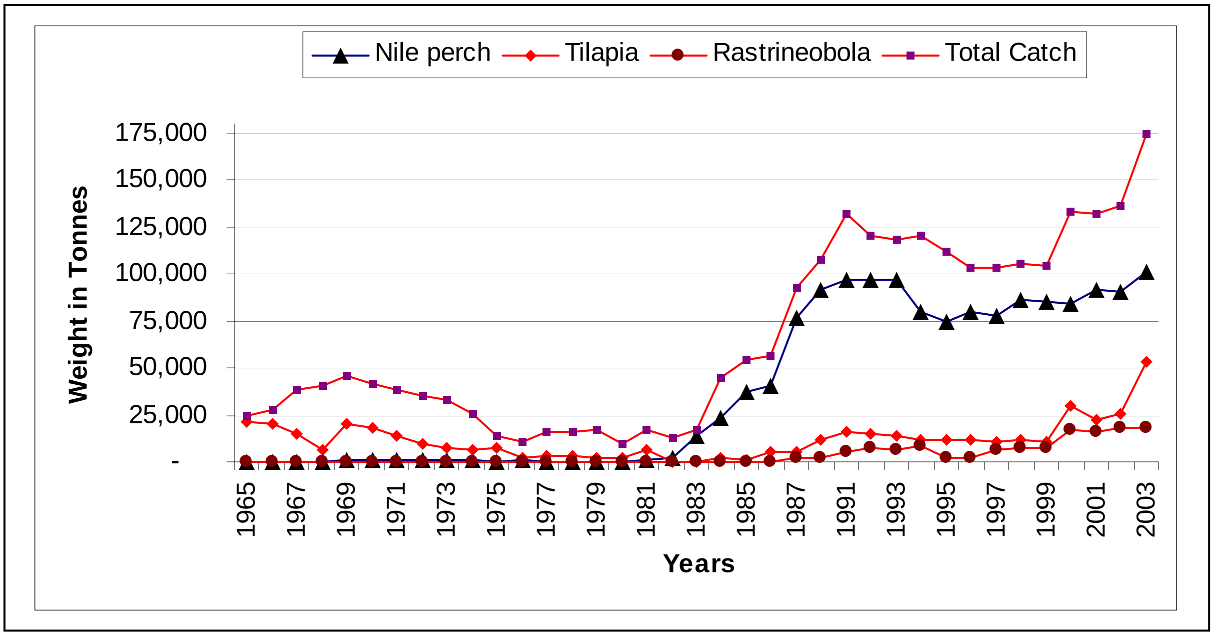

Figure 2: Evolution of the Lake Victoria fishery from 1965 to 2003 showing the rise of the Nile perch species in the 1980s.

3.2 Fish supply

The vast majority of Uganda's fish is caught on Lakes Victoria, Kyoga and Albert with little coming from other lakes (Table 1). While the reliability of the data is questionable because of poor data collection methods, it is clear that Lake Victoria contributes more than 50% of the total production and more than 60% of value.

Table 1 : Fisheries production estimates for Uganda 1999 – 2003.

(Weight in '000' tons and Value in '000,000' USh. (MAAIF 2004b))

Year	L. Victoria		L. Kyoga		L. Albert		Others		TOTALS	
	Wt.	Val.	Wt.	Val.	Wt.	Val.	Wt.	Val.	Wt.	Val.
1999	104.20	39.60	81.12	24.50	29.06	8.30	15.13	6.70	229.51	79.10
2000	133.40	49.02	55.89	15.19	19.38	4.60	10.83	4.81	219.50	72.46
2001	131.80	42.00	58.42	19.13	19.60	4.91	10.90	6.30	220.72	72.34
2002	136.11	49.61	55.58	15.19	19.38	4.60	10.82	4.87	221.89	73.05
2003	175.22	140.00	32.89	26.00	19.46	15.80	14.13	11.20	241.70	192.70

3.3 Fishing technology

Fishing technolgy is simple with fishermen using exclusively small plank constructed canoes from which they set their nets and longlines. There is an estimated total of 30,000 fishing boats in the country. During the Frame Survey 2002, of the 18,612 canoes found on Lake Victoria (U), 3,250 boats had outboard motor engines, 1,074 were using sails while the remaining 14,262 were paddled. Of all the boats, 80% were less than 10 meters in length. The main gears used are gillnets and longlines for Nile perch and tilapia and mosquito nets for *Rastrineobola argentea* (locally known as mukene or dagaa[3]). Although outlawed, beach seines and cast nets are also still in use.

The fishing fleet has grown in line with the rise of the export processing factories. In 1990, at the begining of the export industry, just 8,674 fishing boats operated on Lake Victoria (U) while in 2002 the figure had more than doubled (Table 2). Most of the rich fishing grounds for Nile perch are found in deeper waters and around islands. This has attracted a large proportion of Lake Victoria fishers to live and operate from the islands that are far offshore. While a few are able to bring their fish to the mainland, most rely on transport boats specifically designed to bring fish from the islands. Most of these boats are operated by "middlemen". The middlemen buy fish from fishermen in the islands and remote landing sites and transport it to the big landing sites on the mainland where it is sold to factory agents. There were 758 fish transport boats operating on Lake Victoria (U) according to the 2002 frame survey .

Table 2: Number of fish landing sites and fishing boats on the Uganda part of Lake Victoria in selected years from 1970 to 2002 (DFR 2004).

Year	No. of fish landing sites	No. of fishing boats	Survey conducted by:
1970	620	2643	Wildlife Ltd
1971	197	3254	EAFRO/PAO
1972	-	3002	UFD
1988	291	3470	MAAIF
1990	715	8674	UFD
2000	597	15544	LVEMP
2002	552	18612	LVEMP

3.4 Fisheries and the economy

Uganda has a thriving fisheries sector playing a vital role in the economic growth of the country and contributing to food security and employment. Fisheries contribution to the national GDP is estimated at 2.4% by the Ministry of Finance (up to 12%[4]) (Bahiigwa and Keizire 2003). There is a link between increased fish export earnings and economic growth in the country. Fish has continued to record an unprecented increase in earnings coming second to coffee in foreign exchange earnings in 2002. Its share of total exports increased to 7.7, 17.3 and 18.8 percent in 2000, 2001 and 2002 respectively (UBOS 2003). Fish is therefore, the largest foreign exchange earner of the non-traditional export commodities in Uganda. Not only do fish exports contribute to foreign exchange earnings, they also contibute to improved incomes as the distribution of the benefits along the value chain benefit many people.

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[3] Dagaa is the common name for *Rastrineobola argentea* adopted by the Lake Victoria Fisheries Organisation. The same species is locally known in Uganda as Mukene.

[4] A number of independent studies (Banks 2003, Yaron and Moyini, 2003) have found that fisheries contribution to the GDP is higher than what is officially reported. FAO (1996) reports that in most countries, the methodology used for estimating fisheries contribution to the GDP takes into account only primary production value, excluding the value added further along the production chains.

The fisheries exports have created multiplier effects in the industry with increased horizontal linkages to others sectors of the economy. Expansion of the size of landing sites and resident population has attracted a significant amount of commercial and service activities with most of the larger beaches now dotted with cafes, bars, small hotels and lodges among other business premises. Some landing sites now exhibit a town-like atmosphere. Within the sector, there are backward linkages to boat building, gears and equipment supplies and repairs and forward linkages to post harvest handling, processing and marketing. The total investment by private investors in the industrial fish processing in Uganda is around US$ 100 million (Balagadde 2003). Processing and trade based on Nile perch by-products are important spin-off activities that have emerged from the modern fish processing industry with an example of one big open facility at Seguku smoking six tons of by-products per day and employing over 50 people.

The Poverty Eradication Action Plan (PEAP) is the national framework policy through which the government of Uganda aims to reduce the proportion of the population living in absolute poverty from 44% in 1997 to below 10% by 2017. Sectors develop their own policies and plans within the PEAP framework. PEAP has four goals: (1) to build a strong economy that continues to grow, (2) to make sure government accounts to the people and protects them, (3) to help poor people raise their incomes and (4) to make life better for the poor (GoU- MFPED 2001). Fisheries has a role to play towards achieving this overall policy. The government has emphasized that, through PEAP, boosting economic growth will be a major challenge to drive income poverty down. In line with PEAP, the agricultural sector has put in place a broad framework known as the Plan for Modernisation of Agriculture (PMA) (MAAIF/MFPED 2000). The main objective of the PMA is to improve rural producer incomes and fisheries, as part of the agricultural sector, have to work out plans for raising producer prices. The fisheries play a very important role in nutrition, employment and alleviation of poverty among the rural population and is therefore, contributing towards goals 1, 3 and 4 of the PEAP.

3.5 Fisheries and employment

An estimated 300,000 people are directly employed in the fisheries industry while an additional 1.2 million earn their income in both downstream and upstream activities. Bahiigwa and Keizire (2003) carried out a survey where they found out that there were 218,661 people directly involed in the Lake Victoria fishery (Appendix 1). In most areas around water bodies, there are limited opportunities for alternative employment leaving fisheries as the main employer in those rural communities. Since Nile perch entered the international export market, the number of fishermen on Lake Victoria has increased and this is attributed to the boom of Nile perch in the 1990s as compared to the pre-Nile perch period. In addition to direct employment in the fishing activities and artisanal processing, about 10,000 people earn a living as fish retailers in domestic markets while the fish processing factories employed 2,580 people and fisheries related institutions employed 3,232 people as of 2003 (Bahiigwa and Keizire 2003).

3.6 Fish processing and export trade

The marketing of Lake Victoira's fish was localised within the riparian states during the pre-Nile perch era. The increase in Nile perch catches led to the establishment of fish filleting factories and the expansion of the marketing of Nile perch to both regional and international markets. Industrial fish processing in Uganda started in 1989 when Greenfields Uganda Ltd developed the first fish processing plant in the outskirts of Entebbe Town. Nile perch consititutes the main raw material for the factories' operations and a few have started processing Nile tilapia for export. Nile perch is sourced from Lake Victoria with little coming in from Lake Kyoga and Lake Albert. The sustainability of the filleting industries will depend on sustainable resource management since there are already signs of Nile perch decline in Lake Victoria (Bwathondi *et al.* 2000).

The installed capacity of the fish processing factories in Uganda is > 500 tons per day which translates to over 180,000 tons of raw material per annum. However, the official policy of Uganda is to allow only 60,000 tons of fish as raw material per annum for export processing (MAAIF 2004a). This is to ensure that adequate fish is available for local consumption. Fish processors are being encouraged to start fish farming to supplement their requirements for raw material.

Revenues from fish exports have increased from US $ 4.75 million in 1991 to US $ 87 million in 2003 (Figure 3). However, the country experienced two episodes of fish bans to the European markets in 1997 and 1999 due to fish safety concerns. After the European Union (EU) lifted the ban on fish exports from East Africa in 2000, the quantities and price of fish have continued to rise leading to good earnings for those engaged in the fishery. There has been an overall upward trend in fish and fishery product exports, where exports reached 18.8% of the total value of goods exported in 2002. The official export figures quoted are for only fish fillets and fish maws from the established industrial fish processors. Estimates by Yaron and Moyini (2003) suggest that unrecorded exports and smuggling to neighbouring countries (principally the DRC, Kenya and Tanzania) may be as high as US $ 80 million per year. With access to fish from numerous water bodies, domestic and regional fish trade was established long before the rise of the new, capital intensive export industry. This trade remains important today although its relative size is difficult to establish due to lack of reliable statistics. Domestic markets concentrate on supplying fresh fish to areas close to the water bodies and artisanally processed fish to areas far off.

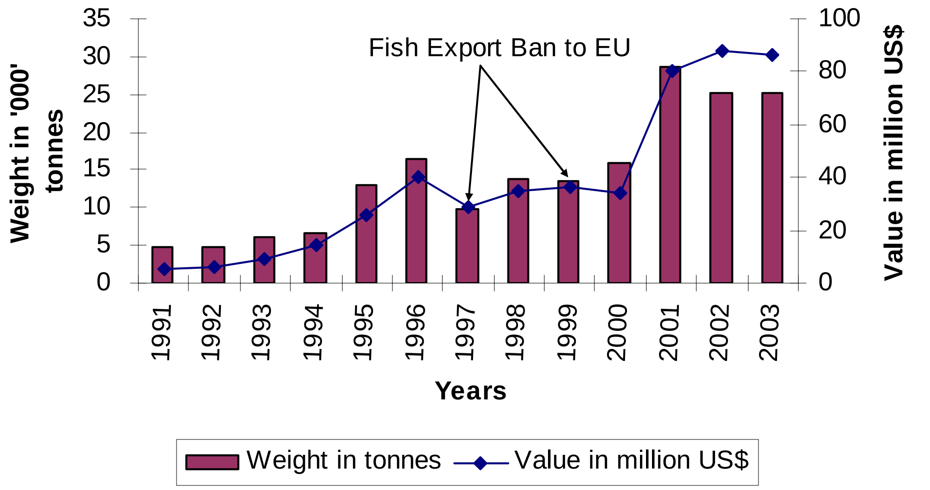

Figure 3: Fish exports from industrial processors 1991-2003 (DFR, records).

3.7 Fisheries and food security

Fish provides protein nourishment to about 69% of the population in Uganda. LVFRP (1999) indicates that people living within a 25 km radius of Lake Victoria consume an average of 45 kg of fish per person per year. The widespread belief that fish is practically unavailable for local consumers since most of the Nile perch goes to the processing factories and export markets is not true.

Table 2 shows there has been a stable total fish production in the country. However, with population growth in Uganda estimated at 3.4% per annum and increased demand for fish for export, there is need to increase fish production. With static supply from capture fisheries, there is a big drive to increase fish production from aquaculture both for export and food security. In 2000/2003- 2003/2004 fiscal years, the government implemented a strategic intervention programme to boost production in seven commodities and fisheries was one of them. Under this programme, minor lakes, dams and farmers' ponds were stocked with fish. In addition, there have been DFID- supported and FAO-supported small scale fish farming projects and under the ADB funded Fisheries Development Project, aquaculture research and development are currently addressed. Efforts are being made to support the development of emergent commercial fish farmers estimated at about 5000. With all these developments, the future of fish farming in Uganda looks bright and already many top government officials have shown interest by investing in it.

3.8 Fisheries management

Fisheries management is the pursuit of certain objectives through the direct or indirect control of effective fishing effort or some of its components. Fish stocks are a common property resource and subject to overexploitation if not properly managed. According to Arnason (2001), methods of fisheries management can be divided into two main systems, namely biological and economic fisheries management. Economic fisheries management is concerned with maximisation of the resource rent.

Biological fisheries management systems aim at maximising sustainable yield. Measures applicable are the total allowable catch, area restrictions, closed seasons, gear restrictions and fish size restrictions. Biological fisheries management is reliant on research for information on the status of stocks coupled with monitoring, control and surveillance, both of which are very costly (OECD 2000, Schrank *et al.* 2003). Biological management systems require reliable data on catches and performance of gears for effective monitoring and adjustments. However, in a fishery like Lake Victoria with over 1000 landing sites scaterred over the shorelines and islands, monitoring of catch at the landing points becomes difficult .

On Lake Victoria, management is more oriented to the biological management system which has relied on mesh size and fish size at capture to control the fishing mortality. The fish size at capture is applicable only to Nile perch which has an allowed slot size of 50 – 85 cm TL and Nile tilapia which has a minimum size of 28 cm TL. This has been supported by monitoring, control and surveillance. However, the system has not yielded much success because of the open-access nature of the fishery where there is no control on effort. The fishery has been characterised by declining catches due to increased fishing effort, increased use of illegal gears, catching juvenile Nile perch coupled with environment degradation.

The responsibility for managing the fisheries resources in Uganda is vested in the Department of Fisheries Resources. The Fisheries Act passed in 1964 provides for matters related to fisheries. Before decentralisation, fisheries in Uganda were run on a classic centralised model, with teams of out-posted regional and local officers policing the use of the resource and offering advice and support to fishing communties. Uganda adopted a decentralised system of governance in 1992 and the Local Government Act was passed in 1997. The Act devolved some responsibilities such as extension to the districts. The DFR under the Ministry of Agriculture, Animal Industry and Fisheries is now mandated to promote, guide and support the sector, but also retains responsibility for setting and enforcing the regulations and standards for practices pertaining to the fisheries. The Department is responsible for drafting policies, making national plans, coordinating the fishery development programmes and monitoring, control and surveillance activities. Fisheries Resources Research Institute, Jinja (FIRRI) is responsible for the provision of scientific information for formulation of management plans. Local governments and fishing communities provide additional support in fisheries management.

The current linkages between DFR and FIRRI are shown in Figure 4. The Department of Fisheries Resources is responsible for policy and planning, fisheries management and fisheries development. Within the Department, the activities are implemented under two divisions: the division of fisheries regulation and quality control and the division of fisheries production and development. FIRRI is responsible for conducting research, both for capture and aquaculture fisheries. However, the Department contributes in setting the research priorities while FIRRI also participates in the discussion of draft policies, legislations and plans prepared by the Department. Arrows indicate the direction of information flow.

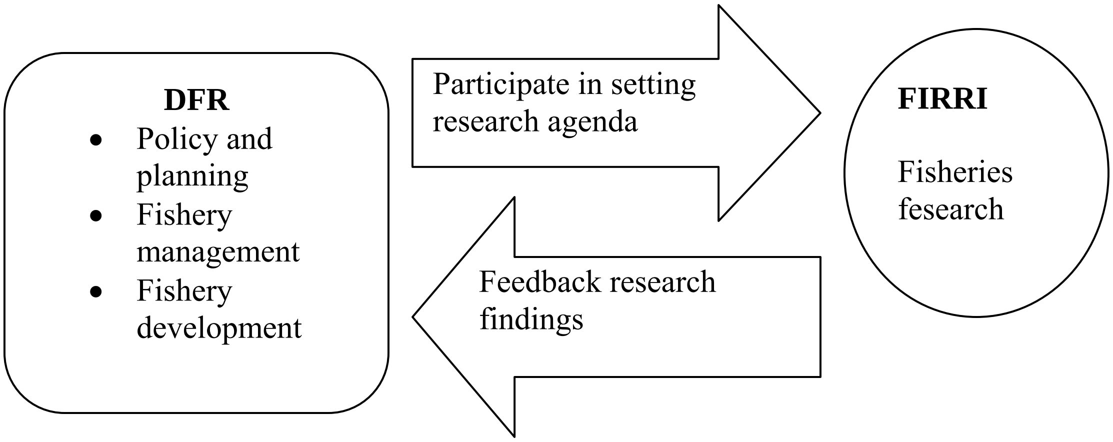

Figure 4: Fisheries management roles.

Policy makers and fisheries administrators are increasingly recognising the need for sustainable development and utilisation of fisheries resources and in the recent past a number of donor-funded projects have been implemented in Lake Victoria with the implementation of the Fisheries Management Plan now on-going. These projects have addressed areas of fisheries research, fisheries management, water quality monitoring and environment protection.

The current fisheries policy in Uganda is to promote socially and economically sustainable use of the fisheries resources and the protection of the aquatic ecosystems. This is in line with the FAO guidelines on management, which state that "fisheries exist to provide social and economic benefits to society and management should ensure that these benefits are obtained in an appropriate and sustainable manner" (FAO 2002a p117). According to the Uganda National Fisheries Policy (MAAIF 2004a p6) the vision of Uganda's fisheries sector is "an ensured sustainable exploitation and culture of the fisheries resources at the highest possible levels, thereby maintaining fish availablity both for the present and future generations without degrading the environment".

In order to improve fisheries management and address some of the existing issues in the fisheries sector, the Department of Fisheries Resources has adopted a co-management approach where the stakeholders will share management responsibilities with the government. Beach management units (BMUs) have been set up as a foundation for fisheries co-management and to enable all fisheries stakeholder groups at the fishing community level to influence decision making. The BMUs have been legalised under the Fish (Beach Management) Rules No. 35[5] of 2003 (GoU 2003). The fisher folk will be the main players in the co-management arrangement in collaboration with other stakeholders. All the fisher folk[6] must register with a BMU to legally operate. The roles of the vaious stakeholders in fisheries management have been outlined in the National Fisheries Policy, the Fish (Beach Management) Rules No. 35 of 2003 and the BMU

[5] Fish (Beach Management) Rules No. 35 of 2003 is a statutory instrument made under the Principal Fisheries Act of 1964 to legalise the establishment of Beach Management Units for fisheries management purposes under the co-management arrangement.
[6] Fisher folk refer to all boat owners, fishermen, artisanal fish processors, fishmongers and all those who derive their livelihood from fisheries activities.

Guidelines (GoU 2003). Participatory fisheries management institutions are built on community and stakeholder structures which will lead to the generation of adequate incomes to alleviate and prevent poverty.

4 VALUE CHAIN ANALYSIS AND FISHERIES MANAGEMENT

Data from FAO show that there is increased global trade in fisheries with the developing countries contributing 55% of the traded fishery products in 2002 (Vannuccini 2004). This has provided the opportunity for substantial income growth. However, most countries are still faced with a challenge of how to participate in the global process in a way that provides for sustainable income growth for the poor people and for poor countries. Value chain analysis can be used to determine those factors, which drive the distribution of gain from globalisation, gauge the extent to which the local people and the country are gaining from economic integration into global market products and make it easier to identify policies that can be implemented for individual producers and countries to increase their share of these gains (Kaplinsky 2000). A value chain is a high-level model of how businesses receive raw materials as input, add value to the raw materials through primary and support processes and sell finished products to customers. Value chain analysis focuses on the dynamic inter-linkages in any industry and describes the full range of activities required to bring products from inception of ideas to manufacture upto delivery to final consumers (Kaplinsky 2000, Jacinto 2004).

Analysis of a particular commodity chain, links analysis to issues concerning the social and economic characteristics of chains. In marginal economies, and for commodity like fisheries, analysis is also concerned with the resource sustainability and economic growth based on unregulated natural resource extraction. Existence of an urban market and/or export market for fish is a precondition for the possibility of maximisation of the resource rent through capital investments. However, the sustainablity of the resource and predictability of the profits guide the decisions made by the investors while investing in the fisheries. Value chain analysis can be used as a tool for investigating the situation of fishing communities vis-à-vis other economic players at the local, national and global level. This should help policy makers gain a better understanding of how to utilise fish exports as a tool to benefit national socio-economic development.

While looking at the benefits of the fish exports, it is important to bear in mind the possible impact of exports on resource sustainability. In the context of fisheries, increased trade on one hand poses a significant risk of increasing pressure on the stocks, but on the other has great potential as a source of desparately needed income for local fishing communities. Trade can enhance employment and income generation, both directly, and through multiplier effects, in developing countries but of equal importance is the need to consider distributional impacts of trade rather than mere increase in macroeconomic indicators (Bokea and Ikiara 2000).

Income by fishermen is determined by the quantity of fish and the price paid for it. Trondsen *et al.* (2003) pointed out the fact that fishermen's propensity to fish and economic performance will depend upon the market value obtained for their effort. They contend that past efforts at fisheries management and research have all sought to improve profitability whilst dealing with the core issue of declining catches failing to maintain demands and aspirations within the industry. “Not withstanding the importance of these phenomena, it may be argued that this focus has tended to neglect the central role of price in resource management and the fundamental importance of price as a key determinant of fishers’ income and economic development” (Trondsen 2003 p 918). There are different methods used around the world to determine the price of fish catch ranging from contracts to auction methods. With increased demand for fish against stagnating catches from capture fisheries, it is important to understand the role of the fish exchange method in influencing the price and value added. Prices are of course dependent on demand and supply coupled with quality issues.

Although international trade provides opportunity for increased income, Hannesson (1999) points out that in fisheries there are no direct long-term relationships between international trade and economic development since increasing trade of fish might increase demand for scarce fish resources causing further overexploitation of fish stocks, which over time tend to decrease catches and bring about a decline in economic gain from international trade. “What is special about trade in fish is that the distribution, and indeed generation, of benefits depends on whether the country exporting fish has overcome the problems associated with open access. If a fish exporting country does not manage its fisheries properly, its gains from fish markets opening up in other countries will be smaller than otherwise. In fact, it will be quite likely to lose instead of gaining from trade” (Hannesson1999). Economic development from the international trade of fish products is therefore, conditioned by a fisheries management system, which tries to balance the total catch to a sustainable fish stock level. Sustaining the profits from the value chain is linked to fisheries management policies to secure sustainable harvesting and economic policy to secure distribution of economic gains from trade. Gaining economic development from fish trade is also dependent on the local fish resources having an economic value in the international fish market, customers’ perceptions of the rarity of the product and marketing services compared to competing offers. All these have implications on the operations of the Nile perch value chain and sustainability of benefits from international trade.

5 CURRENT FISHERIES MARKETING CHAINS IN UGANDA

5.1 International fish export

5.1.1 Fish supply chain

During the last 5 years, a marketing chain for Nile perch has developed on Lake Victoria where fishers sell their fish to middlemen who in turn sell it to agents and eventually to fish processing factories. Although the main flow of fish is from fishers to factories via middlemen and agents, there are still some fishers that may sell their fish directly to the agents or to the factories (Figure 5). Transport boats operated by middlemen buy their fish from fishers in remote landing sites and islands and sell it at the mainland landing sites or direct to the factories where factories have their own landing sites adjacent to the factory premises. Most of the factories have their own approved landing sites on the shores of Lake Victoria. At the landing sites, prime quality fish is sold to the land based transporters (factory agents) for factory processing while what is rejected is sold to the fish mongers. Fish rejection is mainly due to heavy bruising or where there are signs of spoilage. Transport boats take three to four days per trip collecting five to seven tons of fish.

Prior to 2000, the factories purchased fish directly from the fishers but now have adopted the use of agents to reduce the logistics problem involved in collecting fish from scattered fishers and the opportunity of cheating by the water-borne factory staff. The number of agents has risen rapidly and are now over 500 in number. The agents come under two categories: those that cover their own expenses and those that are tied to specific factories who supply trucks, fuel, drivers and ice. In both cases, agents are expected to provide their own working capital. Factories provide the ice for icing fish at the landing site and some to be given to the transport boats. The transport boats provide the important link between the majority of fishers on Lake Victoria and the traders/factories. In many cases, factories value the strong relationships they establish with the agents and middlemen, who they see as having in-depth knowledge of their supply and quality requirements. Factories supply ice to middlemen as a way of cementing trading relationships (NRI and IITA 2002). There is only limited use of ice by fishing boats and fish is often iced after it has been placed in the transport boats. The factory agents take two to four days at a landing site, depending on the catches, to fill their vehicles. As many as five vehicles may be waiting for fish at some landing sites. There are 14 gazetted fish landing sites to handle fish destined for the export market but agents also procure fish from approved landing sites[7].

Currently, there are 13 operating fish processing factories with an installed capacity of over 500 tons per day. Competition between factories exists and prices paid by factories to their agents vary as revealed from the data submitted from the Factories to the Deparment of Fisheries Resources. After processing fish into fillets and packaging, it is sold to fish exporters free on board (FOB) Entebbe (FOT/FOR[8] Kampala for frozen fillets) or the processors may arrange

[7] Gazetted landing sites are those published in the National Government Gazette while approved are those that have been permitted by the local government authority and have a trained local fish inspector stationed at the landing site.
[8] FOT is free on truck, FOR is free on rail while c.i.f. is charge in freight.

freight for themselves and sell c.i.f. to overseas importers. The exporters that are based in Kampala are basically branches of European fish importing companies. There is an assumption that the European importers operate in Uganda so as to capture a greater part of the total fish exports. This in itself is an indication of the value that the European buyers attach to Nile perch (NRI and IITA 2002). Currently, there are 7 fish exporting/importing companies operating in Uganda: ANOVA, Phonix IFG, VSV, WS fish (Holland), Icemark (Belgium), Caladero (Spain) and Fiorital (Italy). By-products from factories are sold to local fish mongers who may sell it to artisanal processors or sell it fresh to consumers. There is a two-way trade between fishmongers and artisanal processors with artisanally processed fish being sold to the local fish mongers for supply to the domestic market.

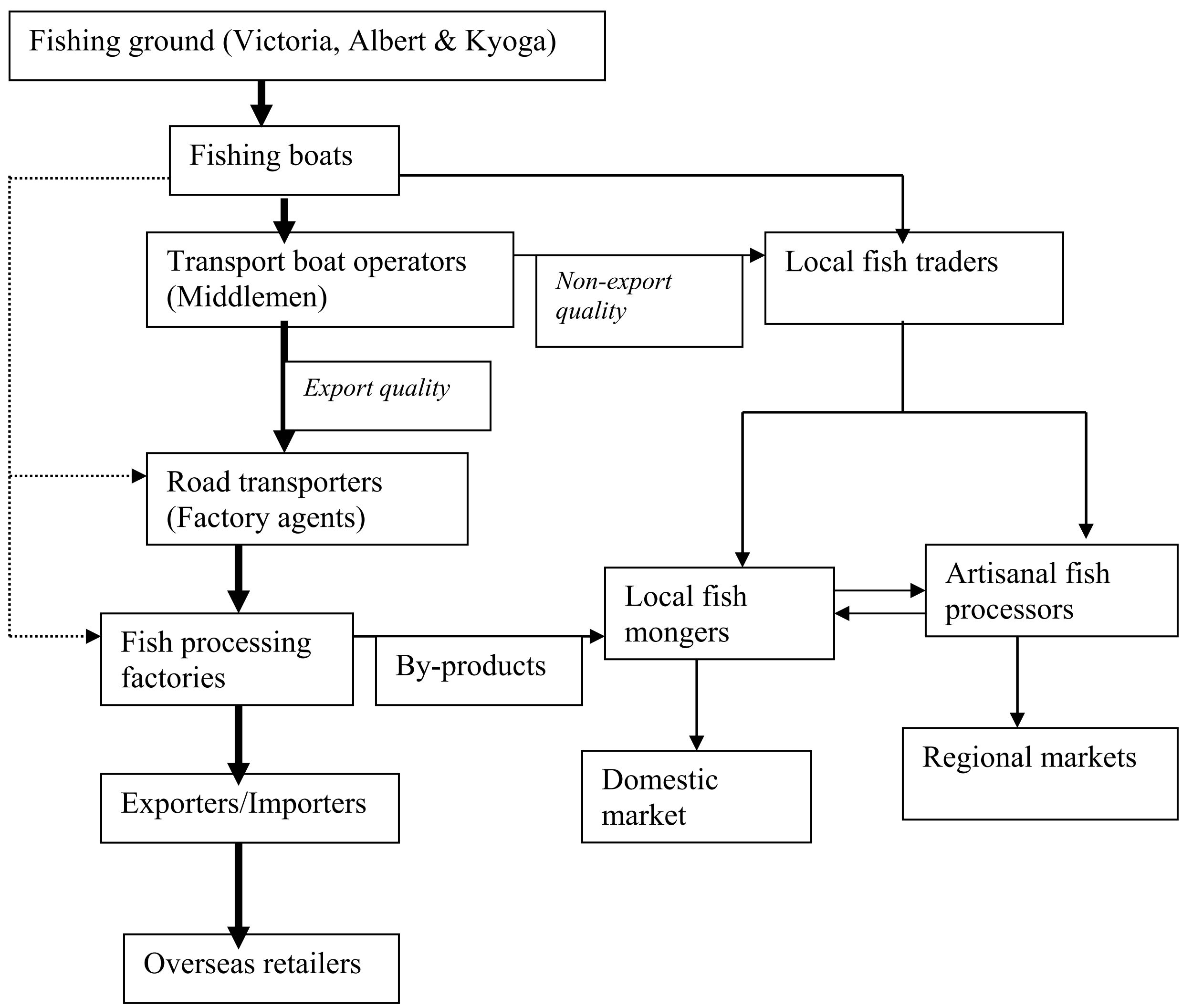

Figure 5: Fish marketing chain in Uganda (modified from NRI and IITA 2002).

(The bold lines indicate the flow of fresh fish destined for the processing factories. Thin lines indicate the flow of fish sold to domestic and regional markets, while the dashed line indicates direct supply by fishers to either agents or fish factories).

5.1.2 Vertical Integration[9]

There are reports of some fishing and fish transport boats being vertically integrated with the fish processing factories. One of the factories reports on its website owning a large fleet of fishing and transport boats for collecting raw material (UFPEA 2004). This company registers and trains all sub-agents and fishermen to ensure complete control over the supply chain and product traceability. Some boat owners have both fishing and fish transport boats, which allows them to capture profits at both levels. Where there is no vertical integration, transactions between fishers and middlemen are either cash payment on the spot or in some cases on the basis of credit extended to fishers by middlemen. Credit is provided to fishers in the form of fishing nets and fishers are obliged to sell their fish to the credit provider who recovers his money through paying lower prices to the fisherman. Where fish is taken on credit there are reported cases of cheating where the middlemen over-declare the quantity of fish rejected by the factory. This is especially the case where transport boats purchase fish from the islands. During field visits in February, 2004 by this author to Lolwe Island in Bugiri district, fishers complained of fish transport operators linked to factories taking their fish on credit and on return they declare large quantities rejected as spoilt. In such cases, some fishers had opted to sell their fish to Kenya where they were paid cash at the beach. Middlemen pay on average Ush.1,200 per kg to the fishers on Lake Victoria and Ush 800-1,000 to fishers in Lake Kyoga and Lake Albert.

Fishers operate in an individualistic manner with each local fisher accounting for an insignificant portion of the total fish supply and is therefore a price taker. This gives leeway for the middlemen to take advantage because if one fisher tries to reject a price the next fisher will accept the same price leaving the first fisher no option but to sell at the price set by the middleman. A study conducted by the IUCN/LVFO project on the socio-economics of the Lake Victoria fishery, found that fishers around the lake have a weak bargaining position when dealing with fish transporters. Some of the reasons for this was lack of marketing organisations and no means of prolonging the shelf-life of their fish. They are therefore obliged to sell to the first buyer that comes along (Heck *et al*. 2004). Entry of agents and traders controlling fish landing sites has taken on a "free-for-all" atmosphere thus leaving no incentive for fishers to adopt a responsible fishing behaviour (Owino 1999). In many cases, fish transport boats (middlemen) have an arrangement to supply a particular agent.

According to the study by the Natural Resources Institute of the UK and the International Institute of Tropical Agriculture, the fish traders' margin between their buying and selling prices was approximately Ushs. 300/kg, yet on average their operational costs were less than Ushs 100/kg. A considerable amount of money gets to fish traders or agents through the purchase of raw material fish by exporting firms (NRI and IITA 2002).

[9] Vertical integration is used here to refer to cases where an individual or firm in upstream position is engaged in long-term cooperation with downstream individuals.

5.1.3 Products exported

Results of analysis of factory returns show that in 2003 Uganda exported chilled fish fillets 49%, frozen fillets 47%, whole fish plus headed and gutted fish 3% and fish maws[10] 1% (Figure 6). The contribution of each product category to the total value is given in Figure 7. The European Union (EU) is the most important market for the Ugandan fish exports for both chilled and frozen products accounting for 60% of total exports in 2003 (Figure 8). Frozen products have a wider distribution than the chilled products with both the Middle East and Australia have increased their market share in 2003 compared to 2002 (Appendix 2). Fish fillets are exported to some 25 countries in all the continents with the main countries being Belgium, the Netherlands, Luxembourg and the USA for chilled fillets, while Australia, Israel, the UAE, the Netherlands, Japan and Greece are the main destinations for the frozen products. The main market for fish maws is Hong Kong which accounts for 81%. Figure 8 shows the proportion of fish exports to various continents.

All the by-products of the Nile perch processing, apart from fish maws, are sold in the local market and provide added revenue to the factories.

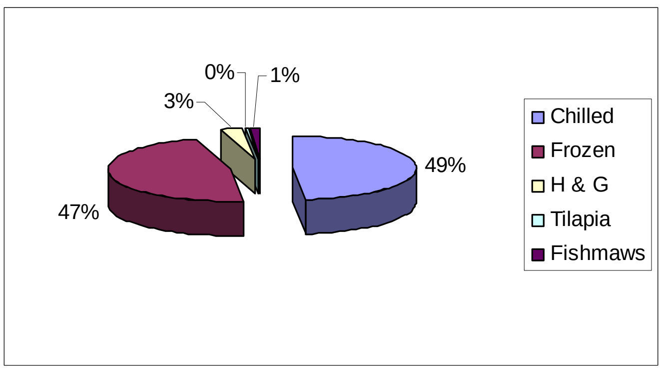

Figure 6: Percentage contribution of each product to total export volume.

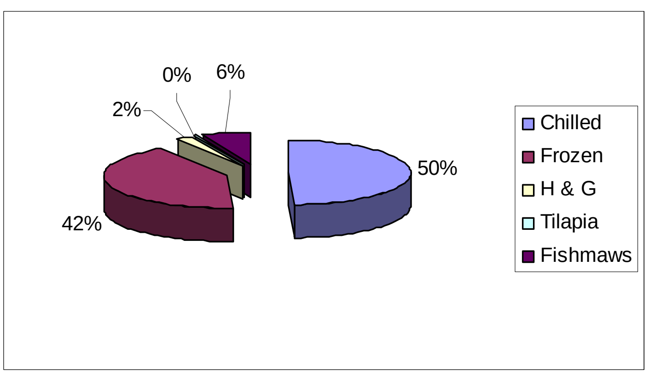

Figure 7: Percentage contribution of each product to total export value.

[10] Fish maws are swim bladders of Nile perch. These are mainly exported sundried to Hong Kong and frozen to the UK and Singapore. Sundried fish maws fetch more than four times the price of fillets per kilogram going as high as US $ 25.87/kg.

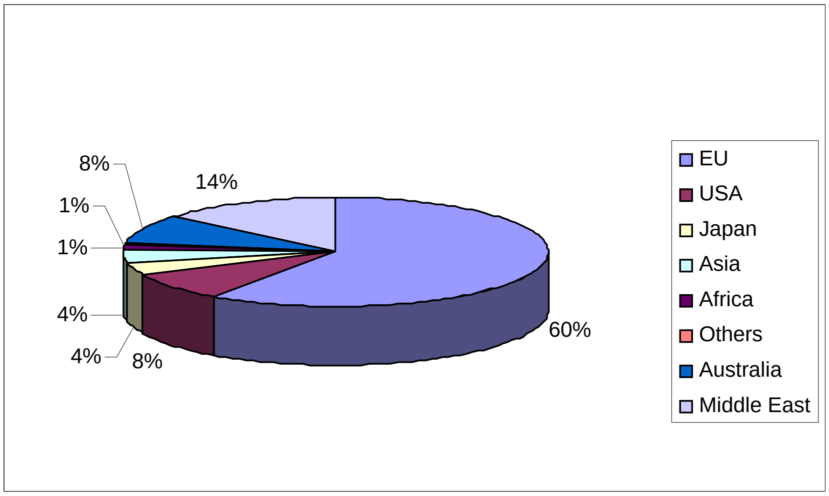

Figure 8: Quantity of fish exported to each region as a percentage of total exports.

Factories are currently receiving an average of US$ 3.54 per kg of chilled Nile perch and US $ 3.08 for frozen FOB Entebbe. Industry observers often query why export prices should be so low when retail prices in Europe are as high as US $ 9.00. According to Goulding (1997), Nile perch retail prices in Europe compare favourably with other white fish fillets, such as Cod and Haddock, which is the main reason for its appeal. In 1997 retail prices in Belgium for fresh Nile perch fillets were US $ 9.30 per kg compared with US $ 9.90 for Cod and US $ 11.30 for whitting fillets. Auchan supermaket chain in France paid 11 US $ per kg in 2002, while in Rome fish was going for 10 Euros per kg in 2004. Data from EUROSTAT (Eurofish 2004) show that fish importers in the EU paid 3.91 Euros (US $4.43) per kg of Nile perch in 2003 down from 4.97 Euros (US $ 4.70) per kg in 2002 (Table 3). The fall in price of Nile perch fillets was attributed to competition from cheap catfish (basa) from Viet Nam on the European market.

Converting prices from EUROs to US $ and comparing with FOB Entebbe prices, gives a difference ranging from 0.7 – 1.9 per kg. This is presumably what goes to cover the freight charges (Figure 9). Looking at the average price for 1997 in Table 3 and Figure 7 and taking into consideration Goulding's price for Nile perch, it appears there is a big profit margin within the European segment of the Nile perch marketing chain. The importers and retailers shared a revenue of more than US $ 5 per kg compared to US $ 2.9 that was shared within the national level of the chain. There is need for market intelligence to get a clear picture of Nile perch prices in international markets to judge whether Ugandan fish gets appropriate pricing and work out appropriate strategies.

Table 3: Fish imports into Europe from East Africa.

(Weight in tons, value in thousands of Euros (Eurofish 2004)).

Origin		1997	1998	1999	2000	2001	2002	2003
Kenya	Wt.	7,488	2,447	1,121	30	2,747	3,972	5,086
	Val.	26,109	6,589	4,539	125	13,062	19,375	19,134
Tanzania	Wt.	9,015	12,506	4,581	26,857	23,063	23,119	26,965
	Val.	29,491	42,899	15,699	110,667	99,170	114,235	99,701
Uganda	Wt.	8,621	8,894	2,731	3,451	14,776	12,213	13,062
	Val.	31,892	32,544	11,305	14,649	62,930	60,679	51,049
Total	Wt.	25,124	23,846	8,433	30,338	40,586	39,303	45,113
	Val.	87,491	82,032	31,543	125,440	175,163	194,289	169,884
	Average price/kg	3.48	3.44	3.74	4.13	4.32	4.94	3.77

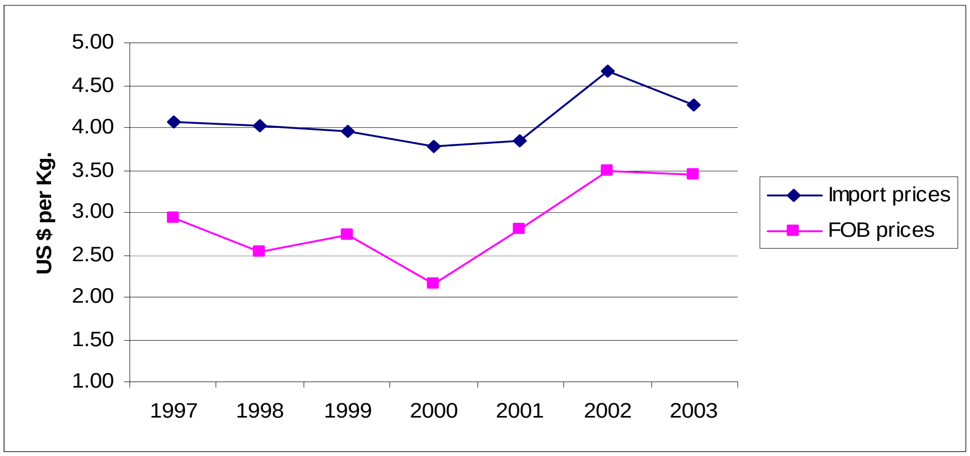

Figure 9: Comparison of FOB Entebbe prices and EU import price per kg of fillets (Eurofish 2004 & DFR records).

5.2 Regional fish trade

While factory processing of fillets started in Uganda in 1989, exports of fish to the regional markets was long established with about four species constituting the bulk of exports. The main species were tilapia, *Alestes, Hydrocynus and Bagrus*. Nile perch and *Rastrineobola* now form the bulk of fish exported. The exports to regional markets is mainly of artisanaly processed fish with very little exported fresh. The main processing method was smoking, however, with increased quantities of immature fish, the main processing method for Nile perch is now salting for sale mainly to the Democratic Republic of Congo. Exported Nile perch comes mainly from Lake Victoria apart from some passing through Panyimur and some originating from Ntoroko which comes from Lake Albert. Tilapia comes form Lake Kyoga, Mukene comes from Lakes Victoria and Kyoga while *Alestes* and other species come from Lake Albert. The regional trade data is presented in Table 4. It should be noted that the data presented in Table 4 is only for fish passing through the official channels. It is likely that, like catch data, regional trade may also be under-estimated due to illegal, unregulated and unreported (IUU) transactions within the region. There is a lot of undeclared trading accross the borders using unofficial routes. This means that the figures in Table 4 are underestimates of the true volumes sold to the neighbouring countries. Secondly, the survey was conducted at a time when most traders were not operating due to intensified law-enforcement activities against those dealing in immature Nile perch. During operations mounted by the law enforcement staff of DFR in 2003, many trucks were arrested every week loaded with bales of immature Nile perch with some specimen as small as 5" in total length against the minimum legal size of 20"TL. A lorry would have as many as 50 bales with each bale containing as many as 1000 heads of Nile perch. In a week about 10 lorries with an average of 10 tons of fish each transported immature Nile perch to the DRC. This translates to over 5,000 tons of immature fish going to the DRC per annum.

Table 4: Annual estimates of fish going to neighbouring countries in tons dry weight (FIRRI 2003).

Region	Border post	Species	Quantity (tons)	Value (Million UShs)
West Nile	Panyimur	Alestes and others Nile perch	229.26 163.2	573.15 489.60
South Western	Kasensero/Mutukula	*No exports at time of study*	0	0
	Katuna	Tilapia *	189.6	242.69
		Mukene	408	101.97
	Bunagana	Mukene	1,349.69	447.00
	Mpondwe	Nile perch salted N.p. immature Smoked other species	289.8 208.0 392.2	1,217 923.52 1,741.37
		Nile perch by-products	244.8	361.62
Eastern	Malaba	Tilapia	522	522.
	Busia	Tilapia / Mukene	985.8	1,300
Estimated total quantity of fresh fish			**14,940.86**	**7,919.92**

(Tilapia to Rwanda through Katuna is fresh. The conversion rates of raw material to processed fish used were 65% for salted fish and 30% for smoked).

6 VALUE CHAIN ANALYSIS RESULTS

6.1 Procurements

Analysed monthly returns from the factories as summarised in Table 5, revealed that their procurements are still within the export quota of 60,000 tons of raw material per annum permitted under the national fisheries policy. Details of fish procurements by factories is provided in Appendix 3. Almost all the fish processed for export comes from Lake Victoria with less than 0.3 % (2002) and 0.009% (2003) coming from lakes Albert and Kyoga. Nile perch is the principle species for processing, although a few factories exported whole tilapia in 2003. By August 2004, the quantity of tilapia exported was 1.56 % of the total export volume.

From the available data, 54% of the estimated catches for Nile perch goes to the fish processing factories. However, this is less than 40% of the estimated total catches for all species in Lake Victoria. About 32% of the country's total production from capture fisheries is exported both to international and regional markets leaving a balance of about 68% of annual total production for the domestic market. This does not include what comes from aquaculture.

Table 5: Total quantities of fish procured by factories during the period 2000 – 2003 ('000 tons) value in billion Ushs (Data Analysis)

	2000	2001	2002	2003
Quantity	33.97	50.83	49.00	55.53
Value	31.12	83.61	105.85	110.67
Average price/kg.	939	1,645	2,160	1,992
% of L. Victoria total production (all species)	25.46%	38.57%	36.00%	31.69%
% of National Production	15.48%	23.03%	22.08%	22.97%

The low volume in 2000 was due to the closure of some factories and reduced processing activity in others as a result of the fish export ban to the EU market. This also affected the price per kg of fish paid by the factories. When Uganda, in 2001, was transfered to the list of countires exporting to the EU, the prices increased along the chain.

Monthly procurements by factories were found to fluctuate more in line with the seasonal fluctuations in the catches (Figure 10). Usually the catches are low during the dry season especially from June to August when there are strong winds on the lake. There was a sharp decline in November and December 2002 because three factories did not operate during that period. On the other hand the sharp rise in October to December 2003 was due to increased supplies of fish following the intensified MCS activities by the DFR staff to curb fish smuggling across the lake to neighbouring countries.

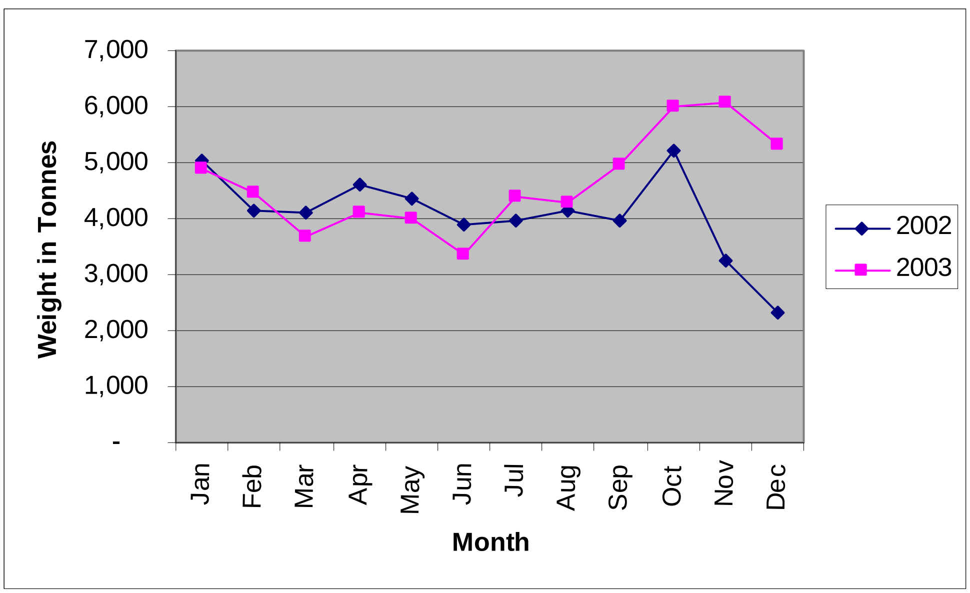

Figure 10: Comparison of procurements between 2002 and 2003.

Procurements had the same pattern of fluctuation in the two years (Data Analysis).

6.2 Fish agents

Examination of the monthly reports revealed that a total of 434 people supplied fish to the factories in 2002 rising to 592 in 2003. Some were land-based tranporters while others were boat-based transporters delivering fish directly to the factory landing sites. Most people supplied fish to only one factory with only 60 supplying to two, 11 supplying to three and one supplying to four factories. Most agents appear to be linked to particular factories.

6.3 Nile perch prices

Analysed procurement data revealed that the price paid by the factories for fish depends on supply and demand of fish for exports and prices received by the factories from the export markets. Between1997 and 2000, when the country experienced episodes of fish ban, the price of fish fell to USh 939 per kg corresponding to the FOB price of US $ 2.16 down from US $ 2.93 in 1997. However, the factories continued operating at low capacity processing frozen fish for export to non-EU markets. Immediately when the EU market was re-opened, the fish price paid by the factories rose to USh 1,645 per kg corresponding to an increased average FOB of US $ 3.01 per kg in 2001. Export of chilled products has gradually increased due to improved processing facilities and increased demand for chilled products in the European market. Chilled fillets fetch a better price than frozen as revealed by the analysed data for 2002 – 2003 where chilled fillets price ranged from US $ 2.49 to 8.00 while the price of frozen fillets was US $ 1.28 – 3.70 FOB.

In 2003 there was a price decrease following increased supplies of fish (Figure 11). The factories procured more fish from October to December at a much lower price leading to low income for fishers.

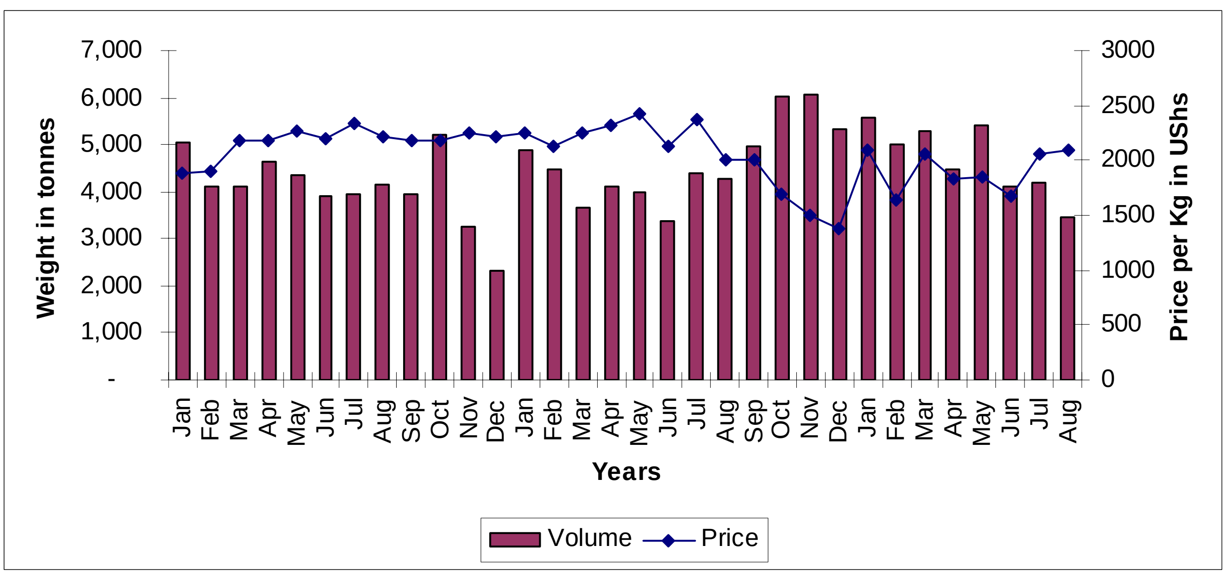

Figure 11: Average monthly prices paid by factories for fish between 2002 and 2004 with the corresponding quantity bought.

Apart from the monthly variations of prices paid to agents, there is also price variation between factories and even within the same factory as the price paid to agents from different beaches varies. The price variation between factories could be due to competition for fish while the reason for internal variations within the factories is not clear. It could be attributed to the quality of fish at the time of delivery to the factory. Prime quality fish gets a higher price as compared to fish with some bruises. Figure 11 shows a comparison on price fluctuation between 2002 and 2004. A complete list of landing sites from where fish was procured together with the average annual fish prices paid to agents coming from those landing sites is shown in Appendix 4.

6.4 Supply chain costs and margins

In order to calculate the profits, live weight values were used throughout the chain. All export values were converted to Uganda shillings for comparability using the average inter-bank exchange rates prevailing in Uganda in the year in question. Since cost data were for the year 2002, the average underlying inflation rates for the years under review were used to estimate the costs of inputs in the years 2000, 2001 and 2003. The costs of inputs are divided into two categories, the variable costs for those inputs whose cost is directly influenced by quantity of fish traded and fixed costs for those inputs whose costs are met irrespective of the quantity of fish traded. The assumption here is that the items categorised under fixed costs do not change much from year to year.

Fish procurement is categorised under variable because the cost depends on the quantity of fish that is purchased and the prevailing market price.

Five segments of the chain within Uganda were looked at individually to obtain their profits. However, due to inadequate information on the costs and revenues of exporters/importers , calculation of profits at that level of the chain was not completed.

The six segments of the chain are shown below of which the first four are analysed:

Chain Segments	**Responsibility**
Boat owners/fishers	Production and managment of the resource
⇩	
Middlemen	Collection of fish from fishing boats and transporting it to marketing points on the mainland landing sites
⇩	
Factory agents	Purchasing fish from transport boats and delivering it to the factories
⇩	
Processing Factories	Filleting, freezing, quality assurance of fish products
⇩	
Exporters/Importer	Shipping of fish products to international markets and distribution to retail outlets.
⇩	
Retail markets	Sale to consumers

The number of players in each chain link is summaried in Table 6, while the effort used in Nile perch fishery is given in Table 7. The number of operating factories and agents was obtained from the factory returns while the number of fishers and boat owners was obtained from Lake Victoria frame survey results of 2000 and 2002. The assumption was that each fishing boat had one boat owner. Of all the 13 factories currently operating in the country, only two are fully owned by Ugandans while another two have Ugandan share holders. The rest are owned and managed mainly by Asian businessmen.

Table 6: Number of people that participated at each segment of the value chain.

	2000	2001	2002	2003
Fishing boat owners	4,621	5,360	6,066	7,052
Fishing crew	10,351	12,006	13,588	15,796
Middlemen	182	239	197	217
Factory agents	100	219	434	592
Operating factories	7	7	10	11

Table 7: Estimated number of fishing effort used in the Nile perch fishery.

	2000	2001	2002	2003
Fishing boats	4,621	5,360	6,066	7,052
Out board engines	2,031	2,640	3,250	4,225
Nets 6”>	175,434	218,067	260,896	324,394
Longlines	254,453	590,331	926,959	1,263,587

For fishing boats, only those that were identified in the frame survey as targeting Nile perch were included in the analysis. It is important to note that in Lake Victoria, there is a possible grouping of boats by fishery into Nile perch, tilapia and mukene using the type of boat and gear together with fishing grounds. Nile perch fishers operate in offshore deep waters, tilapia and mukene fishers operate in the nearshore waters up to 10 meters in depth. Both the Nile perch and tilapia fishers do take bycatch of the other species. Immature Nile perch are harvested by the illegal beach seines and the gillnets below 6” operating in nearshore waters and it is supplied to artisanal processors where it is prepared for the domestic market and regional markets.

6.4.1 Cost and margins of fish exporters

In calculating the profits for exporters, freight charges were adjusted downwards by 0.2 US$ per kg. bearing in mind that not all the fish are air freighted and costs for FOT/FOR are less than those for air freight. NRI and IITA (2002) reported high freight charges at Entebbe at a rate of US $ 1.5 per kg in 2002. Inquiries made to some of the factories by this author revealed that the freight charges have been increasing since 2000 ($ 0.9 – 1.0), 2001 ($ 1.3 – 1.4), 2002 ($ 1.4 – 1.55) and 2003 ($ 1.5 – 1.8). The current freight charges at Entebbe are too high compared to those at Nairobi airport where rates range from US $ 1.00 to 1.10.

The equation used in the calculation was:

$$C = y * \$ * x + y*b*x \quad (1)$$
$$R = y*E*w*x \quad (2)$$
$$P = R - C \quad (3)$$
$$z = R/v \quad (4)$$

Where C is costs, R is revenue, P is profit, E is import price perkg in Euros, y is export volume, $ is FOB price per kg in dollars, x is the exchange rate of US $ to Uganda Shillings, b is air freight charges at Entebbe, w is exchange rate Euros to US $, z is price per kg of live weight, and v is volume of fish procured by factory for processing.

An attempt at analysing exporters costs and margins using the figures obtained from Eurofish as the revenue for Uganda-based exporters gave results according to which it appeared that exporters made losses in all the years as in Appendix 6(i). NRI and IITA (2002) in their report pointed out that the exporters in Kampala are in-country branches of European fish importing companies. It is likely that the difference between the Eurofish price per kg and FOB price per kg is the costs of air freight and other charges and not the revenue for exporters. Since the sale price to the retailers is not available, it is not possible to tell what the profit margin of these companies is.

6.4.2 Costs and margins of fish processors

$$C = (v*p) + vc + (fc*n)$$
$$R = y*\$*x$$

Where *v* is the volume of raw fish procured; *p* is the price per kg of live weight; *vc* is variable costs, *fc* is fixed costs of one factory, *n* is the number of operating factories, *y* is export volume, *$* is FOB price per kg in dollars, *x* is the exchange rate of US $ to Uganda Shillings.

The base cost data for factories was that collected by the NRI as shown in Appendix 5. This data was compiled from data given by several fish processing factories and is therefore believed to give a reasonably accurate financial picture of an average processing factory in an average year.

The costs for factories have been divided into variable and fixed costs. The variable costs include those items whose cost is influenced by the quantity of fish procured and this group includes the packaging materials, energy and fuel. The fixed costs are those that have to be met by the factory independent of the quantities of fish procured for processing and these include management costs, lab expenses, administration, fixed assets maintainance and depreciation of assets.

Analysis results show that factories are making fairly good profits, around 26% of their revenue (Appendix 6ii). Their profits are relatively stable over the 4-year period analysed despite the fluctuations in prices of fish exports. The possible explanation is that the burden of cost is passed down the value chain while the factories are able to keep their profit margin. The relatively wide market for frozen Nile perch enables the factories to continue operating even when there are fluctuations in export supply and demand. The main costs are the raw material and packaging material as shown in Table 9.

6.4.3 Costs and margins of factory agents

$$C = (v * p_1) + (vc * k) + (fx * k) + (cc * k)$$
$$R = v * p$$

Where *C* is total cost, *v* is the volume of fish procured, p_1 is price paid to middlemen perkg, *vc* is the average variable costs, *fx* is fixed costs and cc opportunity cost of capital of one agent, *k* is the number of agents, *R* is the total revenue and *p* is the price paid by factories per kg of fish.

The factory agents are making profits which are on average 5% of their revenue. While most people have been assuming that factory agents are making huge profits, the results of this study indicate the contrary. In the past, factories procured fish themselves from the landing sites. However, the case has now changed with factories dealing with agents. The rapid increase in the number of agents (Table 6) has meant competition for fish, long waiting times and increased costs thus lowering the profit margins of the agents. The profits of agents depend on the price of fish paid by the factories and the quality of fish delivered to the factory. Prime quality fish gets a good price while the rejected fish is sold by the factory to the fish mongers on behalf of the agent at a lower price. Details of the analysis results are given in Appendix 6iii. The main cost item for agents is also fish procurement, which contributes 88% of their operating costs and fuel contributing 4% of the operating costs (Table 9).

6.4.4 Costs and margins of middlemen

$$C = (v * p_2) + (r * p_2) + (fx * n) + (cc * n)$$
$$R = (v * p_1) + (r * p_3)$$

Where *v* is the volume of fish procured by factories, *r* is the fish rejected by factory agents, p_2 is the price paid to fishermen, *fx* is the fixed costs and *cc* is the opportunity cost of capital and n is the number of middlemen, p_1 is the price paid by factory agents and p_3 is the price at which rejected fish is sold to the local market.

This analysis did not include all the transport boats identified during the frame surveys because some of those boats are involved in the transportation of fresh tilapia, smoked fish and sundried *Rastrineobola argentea* from the islands to the mainland landing site markets. Using the average of 3,800 tons per trip, a total number of middlemen likely to have participated in the Nile perch chain was calculated as shown in Table 6. Like the factory agents, the middlemen do not make big profits, averaging around 8% of their revenue (Appendix 6iv). Their main cost is towards procurement of fish, fuel and direct labour for sorting and loading fish (Table 9).

6.4.5 Costs and margins of boat owners

$$C = vc + fx + cc$$
$$R = (v_1 * z_2) + (r_1 * p_3)$$

Where *vc* consists of labour cost of crew and fuel; *fx* consists of cost of gears, licences and taxes; *cc* is capital cost of boats and engines; v_1 is volume of fish sold to transport boats, p_2 is price paid by middlemen, r_1 is fish rejected by middlemen and p_3 price at which fish is sold to the local market.

From the analysis results, fishers are getting quite good profits at an average of 19% of their revenue compared to both the factory agents and the middlemen. However, fishing boats' profits have wide fluctuations according to price fluctutations. When the prices are low the fishers profits are below 15% of their revenue (Appendix 6v). The main cost for the fishing boat owner is the payment for the crew and fuel for those with outboard engines (Table 9).

This finding is supported by findings in a recent study conducted by the socio-economic group of Fisheries Resources Research Institute (FIRRI), Jinja which, found out that fishermen of all categories are getting good returns on their investments. The reasons for good returns was because investment costs are generally low except for the outboard engines, which are expensive, and gillnets with a short life-span. According to the FIRRI findings, investments in fishing were profitable both in the short-run and the long-run and all types of fishing enterprises realized net profits that were sufficiently high to cover their investment costs within a period of one year (Wegoye and Kaidhiwa 2004).

The fishers (crew) are also making a reasonably good income. With their payment being a percentage of the catch, their income is dependant on the catches. Table 8 below shows the average income per boat owner and per crew member in the 4 years under review on the assumption that all the boats that participated in the value chain were captured in this study.

Table 8: Annual average income per boat owner and per crew member.

	2000		**2001**		**2002**		**2003**	
	USh. million	US $	USh. Million	US $	USh. million	US $	USh. million	US $
Boat owner	1.41	772.95	4.66	2,652.28	4.45	2,476.77	2.17	1,106.51
Crew	1.66	907.50	2.97	1,690.39	3.41	1,895.83	3.02	1,536.07

In all the four segments of the value chain, the variable costs contribute over 90% of the total costs except for the fishing segment where it was found on average to be 84% of the total costs. In the fishing segment, the labour cost of the crew and fuel for the outboard engines are the biggest cost items followed by the gears. Comparision of the cost items in the four segments is given in Table 9.

Table 9: Distribution of costs as percentage of total costs.

Operating costs – variable	Factories	Agents	Middlemen	Boat owners
Raw material	80.15	88.36	89.19	
Packaging material	4.35			
Energy	3.09			
Fuel	0.38	3.53	3.79	36.32
Direct labour	2.90	2.82	2.95	47.89
Sub-total	**90.87**	**94.71**	**95.94**	**84.22**
Operating costs- fixed				
Management	2.05			
Lab expenses	1.03			
Administration	1.32			
Fixed assets maintenance	0.50	0.19	0.15	
Depreciation	4.08			
Miscellaneous	0.16			
Wages		2.36	2.41	
Landing taxes and licences		0.34	0.15	1.73
Capital costs		2.40	1.36	6.62
Gear				7.43
Sub-total	**9.13**	**5.29**	**4.06**	**15.78**
Total costs	**100.00**	**100.00**	**100.00**	**100.00**

6.5 Profit distribution along the chain

Profits at each level of the chain were calculated as shown in Table 10. These were looked at both as difference between revenue and costs and as a percentage of revenue. These profits were plotted in Excel to give a percentage distribution. Figure 12 shows the percentage of revenue distribution if one merely uses the prices of fish while Figure 13 shows the actual profit distribution along the chain. Profits are surplus revenue after deducting costs. Figure 14 compares the profit distribution over a period of four years.

Table 10:Comparison of prices and profit per kg along the marketing chain (live weight equivalent).

	2000			**2001**			**2002**			**2003**		
	Price	Profit	Profit % of rev.	Price	Profit	% of rev.	Price	Profit	% of rev.	Price	Profit	% of rev.
Exporters	3,627			3,924			4,347			4,096		
Factories	1,985	554	28	2,871	813	28	3,439	749	23	3,319	835	25
Agents	939	41	4	1,645	114	7	2,160	118	5	1,993	183	4
Middlemen	823	33	4	1,387	168	12	1,785	121	7	1,600	133	8
Boat owners	650	89	14	1,038	272	27	1,500	298	23	1,300	151	13
Value added		***717***			***1,367***			***1,286***			***1,302***	

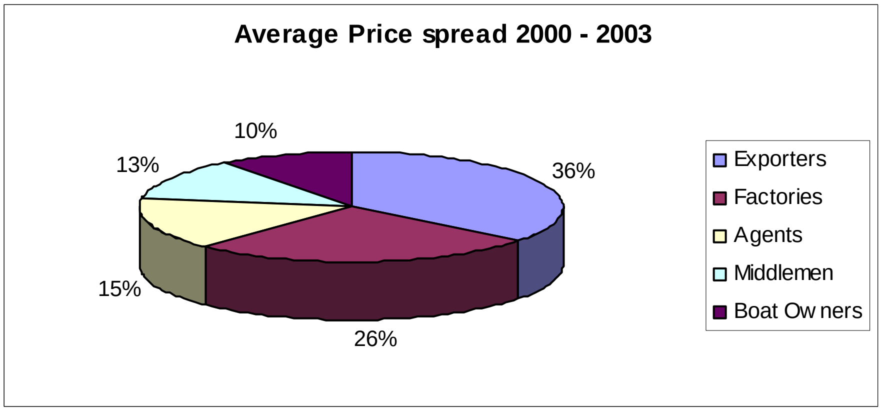

Figure 12: Distribution of the four-year average price at different value chain segments.

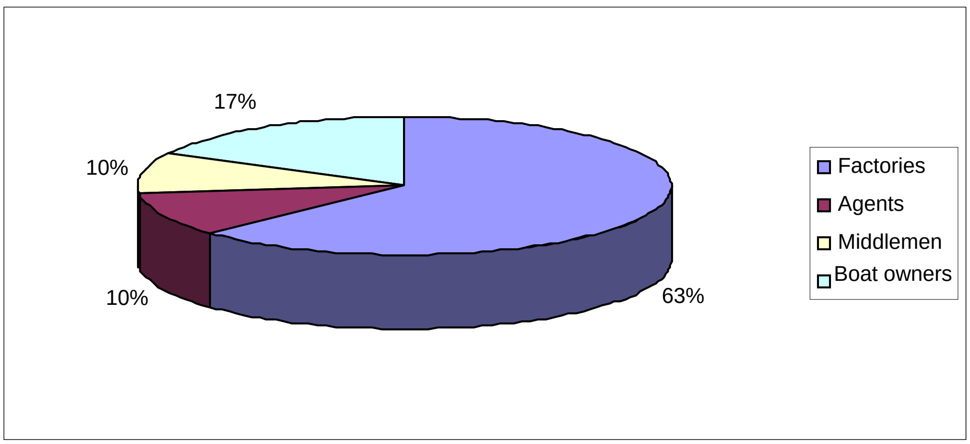

Figure 13: Distribution of the four-year average profit for the period 2000 -2003.

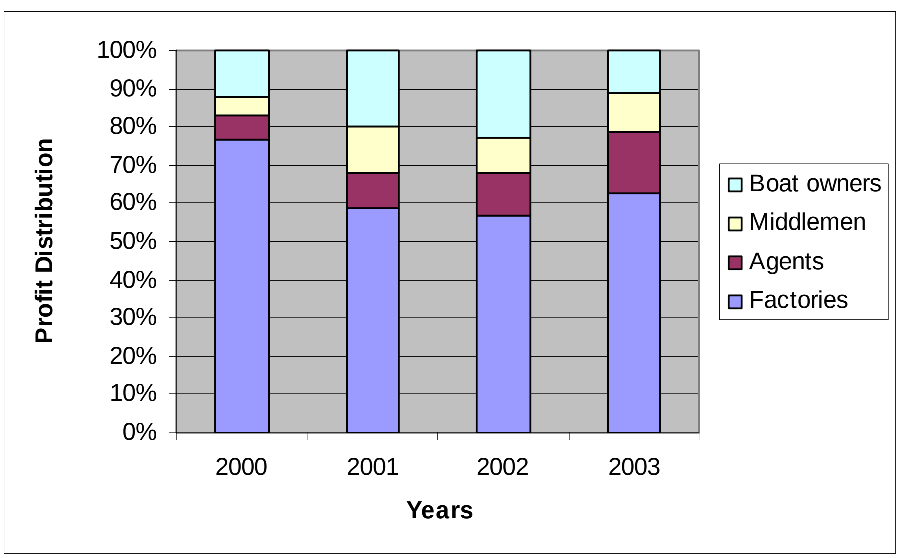

Figure 14: Comparison of profit distribution along the chain 2000- 2003.

6.6 Model sensitivity analysis

The model used in the value chain analysis was derived using the current data and based on the situation pertaining in the fishery. It is assumed that operating costs do not change much due to the relatively stable economic environment prevailing in the country. In order to see how this model depends on the framing assumptions, the profits of the various segments of the value chain were subjected to sensitivity analysis[11]. Assuming the market prices of the key cost items are to change due to inflation, or the price of fish is to change due to changes in the international price or changes in the quantity of fish caught, the sensitivity analysis will show what will happen to the profits and which items in the model are more sensitive to changes.

The net present value (NPV) of the profits for each segment was calculated for the four years under review keeping the discount rate constant at 15%. Input values for each item were subjected to a range of percentage changes independent of the other inputs and the amount of change in the NPV was recorded. The recorded NPVs were then plotted in Excel to give the charts shown in Figure 15.

The results indicate that revenues are very sensitive to changes while the fixed costs and variable costs are less sensitive. For the processors, the revenue could be sensitive to their selling price which would be dependant on world market prices for fish. However, the revenues remain positive even if there is a 20% reduction (-20%). The profits of the fishing boats also remain positive up to -20%. Agents and middlemen have their profits sensitive to price reductions by the processors. Any deviation from the current price of more than 10% reduction will turn their NPV negative. Sensitivity charts for all the four segments in the chain showed that the cost of fish along the chain was very sensitive to changes in export market prices thus affecting the profitability of the value chain. Procurement of fish as avariable cost is also sensitive. All other inputs were not very sensitive.

Changes in the supply and demand balance means fluctuations in the prices and opportunities for windfall profit or big losses. Fisheries are by this characteristic, perceived as a high-risk industry. FAO (2003) reports a decline in value of both capture and aquaculture fisheries in 2002 compared to 2001. Increased consumer demand for cod and cod-like species and streamlining of effort and catches to better manage the stocks in the EU have created a void which can be partially filled by Nile perch. However, with increased production from aquaculture in the Asian region, coupled with a decline in unit value of landings for human consumption, there is a possibility of prices of fish going down due to increased supply in the market. This will mean reduced profits from fish exports from developing countries.

[11] Sensitivity analysis is a technique for determining the outcome of a decision if a key prediction turns out to be wrong. Sensitivity analysis determines which values in a spreadsheet model have the greatest impact on the results.

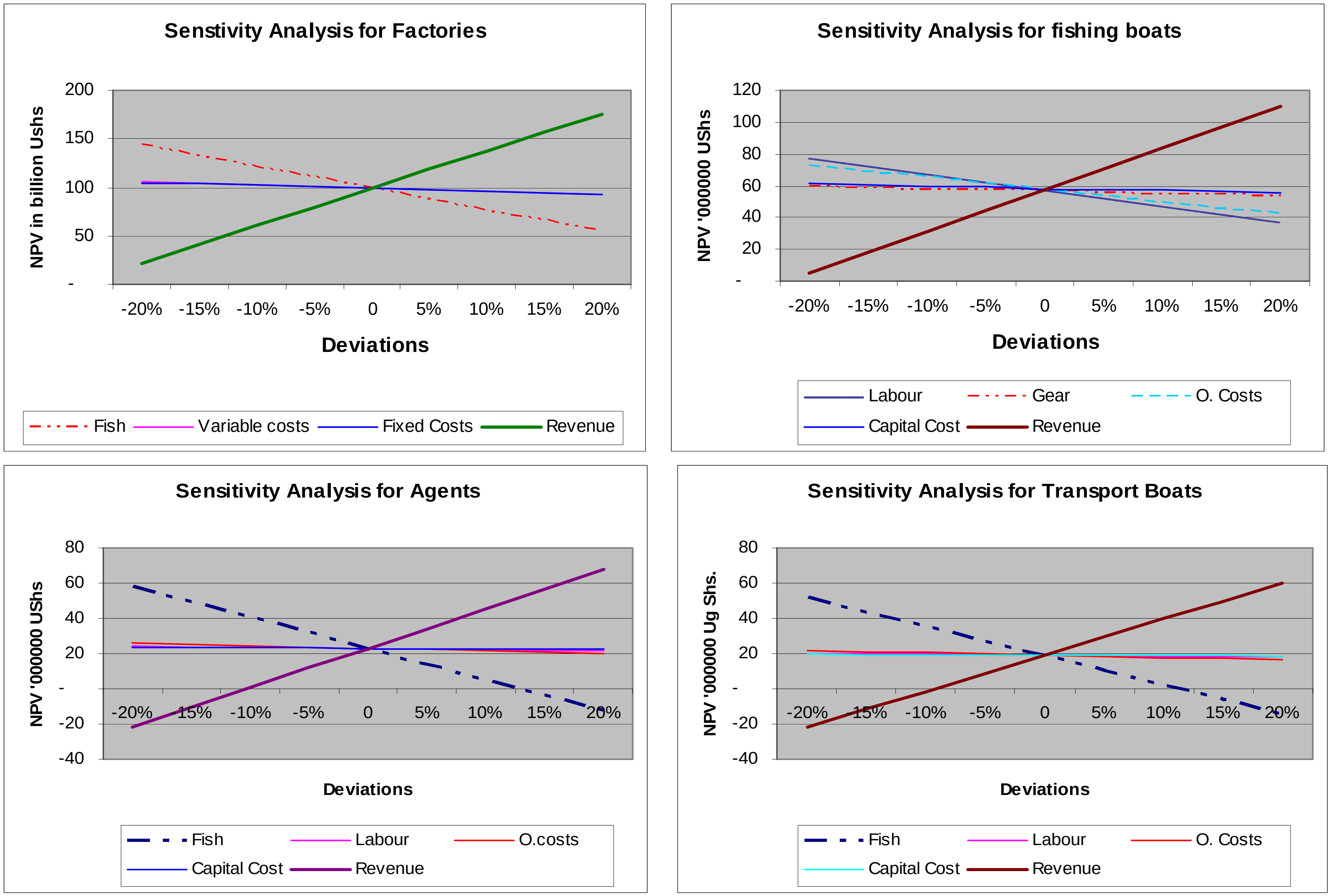

Figure 15: Sensitivity analysis charts for the value chain.

7 DISCUSSION

7.1 Supply chain costs and margins

Analysis of supply chain costs and margins reveals that both factory owners and fishing boat owners are making comfortable profits. Costs in both fishing and processing are low and this coupled with the high revenues due to high market prices for fish have made the fisheries business very lucrative. The fixed costs for all categories are quite small with the major part of their costs being the variable costs, which are dependant on the quantities of fish handled. The profitability of the fishery might give an explanation as to why there are still more people applying for licences to open fish processing factories. As common in business, any profitable venture will attract people to enter into the same business.

There have been claims that fishers, although the main users and custodians of the resources, do not earn enough from their production to give them incentive to utilize and manage these resources sustainably. There is need to differentiate between the boat owners and the crew (hired labour). This study has revealed that boat owners actually do earn enough money from fishing at least for those engaged in the Nile perch value chain. Their profits are at least more than 20% of their revenue. The high price of Nile perch has a direct influence on the prices of other species thus enabling all the fishers in different categories to make good returns on their investment. On the other hand, the crew are also making good income in the Nile perch chain (average of US $1,400 per annum) compared to the general rural population, e.g. a coffee farmer earned between US $ 120 – 240 in 2002. The wages in civil services for the group employees are about US $ 500 per annum while a starting salary for a graduate is about US $ 1,600 per annum. One can conclude that the fishermen are making a relatively good income. Both the boat owners and fishers have benefited from the fishery and should see the need to sustainably utilise the resources.

7.2 Distribution of benefits

The distribution of profits along the supply chain is indeed skewed towards the fish processing companies as suspected by most people. This is clearly shown in Table 10 and Figure 14. Looking at Table 10 under the column for profits, one can see that the factories are getting a larger share of profits as a proportion of the value added to the fishery. However, fishermen are still getting better profits than both factory agents and middlemen. The profits made by the fishing boats compared to that by the middlemen and agents would seem to dispel the fear that agents and middlemen have been making big profits at the expense of fishers. In fact most people have been looking at revenue from fish sales without taking into consideration the operating costs. Looking at Figure 12 in section 6.5, both the agents and middlemen seem to make big margins while the fishermen get the least. This is because just revenues and not actual profits are reflected in Figure 12. Profits are what is reflected in Figures 13 and 14. The big disparity in profits between factory operators and the other three segments of the chain lies in the fact that, while the processors have formed a strong association to protect the interests of members, the other three segments do not have functional associations and therefore have no forum for bargaining prices with factory processors. Any fall in export prices is passed down to the middlemen and fishers while processors are able to keep their profit margins as seen from Figure 14.

Currently, fishermen do not seem to perceive the fishery as an interest of the whole group and prefer to operate individually. In other words, many fishers seem to be reluctant to take joint responsibility for addressing common difficulties. This not only weakens their socio-economic position, but also affects the perfomance of the fisheries as an economic sector.

7.3 Fish exports and poverty

Many papers on Lake Victoria fisheries have pointed out that fish exports are the driving force behind the overexploitation of the fishery (Bokea and Ikiara 2000, Bwathondi *et al.* 2001, Kudoja 2003, LVFRP 2001). Although fish exports have been accused of driving the fishing effort up, the question here should not be whether we should participate in fish exports or not but how to sustainably exploit the natural resource of Lake Victoria and use it to alleviate poverty within the rural community. Whereas the fishery for tilapia species and dagaa (*Rastrineobola argentea*) contributes significantly to income generation amongst the rural poor and to food security around the Lake Victoria region, it is the Nile perch which is the financial driving force of the lake economy and needs to be sustainably utilised.

The value of fish exports is one of the more useful indicators for appreciating the economic importance of fisheries in the region. Importance of fish exports in the macroeconomy and within the fishing communities can be seen from the fish price fluctuations which were associated with the fish ban in 1997 – 2000. The ban of fish exports to European markets due to contamination and non-compliance to official standards cost the country loss in revenue, loss in employment and a drop in domestic prices for fish. Loss to fishermen on account of reduced prices and less fishing activity was estimated at US $ 1 million per month. It is estimated that 60-70% of the directly employed people were laid off due to factory closures. Around 35,000 people involved in various fishing activites including fishermen, fishmongers and fish transporters became jobless. The remaining indirectly employed people earned less than one third of their normal earnings. Other related industries like packaging, transport and the economy in general were directly affected because of the fish ban (Balagadde 2003).

Even at times when there are no fish bans, there are some landings that are not easily accessible by road and therefore depend on water transport to deliver their fish to big landings where it is sold to factory agents. During some of the field visits by this author to such landings in Bugiri, fishermen targeting Nile perch had not gone fishing because they were waiting for a fish storage container to be brought back by the transport boat. Asked why they could not fish and sell to the local market, their response was that the local people could not afford to buy all their fish and prefered only tilapia. Such fishers depend on a container with ice in it being placed at their landing site so that when they return from fishing, fish can be stored in ice until enough has been collected for transportation to the marketing point.

High price of Nile perch, due to export demand, helps to raise the average prices of other species thus benefiting those engaged in exploiting species other than Nile perch. Looking at the history of the fish export, one can see that without fish exports, the financial value of the Nile perch will go down and so will the income of the fishing community.

Reynolds and Greboval (1995) estimated that between 1975 and 1989, the Nile perch fishery alone generated net economic benefits of US$ 280 million per year. LVFO now estimates the economic benefits from Lake Victoria at a tune of US $ 600 million. While much of this sum has accumulated and been concentrated in the hands of relatively few industrial processing firms, one cannot deny the fact that fishing communities themselves have benefited. The concern here is how the money received by the fishers and boat owners is being utilised and what impact that utilisation has on the sustainability of fishery resources.

The high incomes for both boat owners and crew members revealed in this study should have translated to poverty reduction among the fishing communities. However, earning money from the fishery is one thing, making good use of that money towards poverty alleviation is another. What seems to be happening in Lake Victoria is that the Nile perch boat owners are not the indeginous fishermen but rather the wealthier section of the community which was attracted into the fishery by the Nile perch boom. Most of these fishers have set up businesses at the landing sites or in nearby towns where they own assets like commercial buildings. Other members of the community who act as service providers have also benefited from the Nile perch export industry. While the boat owners have invested their income in other income generating activities, the crew in most cases spend its income as it comes.

The crew and most fisherfolk in general lack a saving culture and therefore squander their earnings with a belief that tomorrow they will still go to the lake and make a living.
It is not uncommon to find fishers busy drinking alcohol in the morning hours. In fact, this has been encouraged by the mushrooming of bars in the landing sites. It is also not uncommon to find a fisherman with more than one wife in different fish landing sites. These are all drains on the hard earnings of the fishermen. During a field study conducted by this author in 1999 – 2000, many fishermen believed that fish in Lake Victoria were in-exhaustible and as such they would still make more money. Some believe that their job is a risky life and therefore they live one day at a time. The same scenario was found during the second Uganda participatory poverty assessment program - UPPAP2 (MFPED 2002).

> There appears to be little upward mobility in the communities, with few fishermen becoming boat owners. Fishermen ascribed this to lack of capital, and this was commonly attributed to the absence of a saving culture. Fishing offers immediate profits for a while, and these profits are also immediately consumed, often in alcohol. In Busabala, fishermen admitted that to them saving for tomorrow is a dream and that they have a higher propensity to consume than to save. One young fisherman was quoted as saying; we have a problem on how to prioritise our spending because of our extravagance. We spend whatever we earn daily on our families and concubines. UPPAP2, pg 67 (MFPED 2002).

Another problem encountered in fishing communities of Lake Victoria is the high mobility of fishers. Many are immigrants from other parts of the country and live in temporary shelters which do not encourage accumulation of property. These communities are characterised by an apparent contradiction between high levels of cash-flow but little in the way of assets and development. Coupled with this is the fact that most of the crew are below 25 years of age and many have been in fishery for less than 10 years (Ikwaput-Nyeko 1999). They may therefore not be aware of the situation which was prevailing in the fishery sector before the Nile perch boom. All these may be contributing to continued poverty among the fishing communities. A lot of awareness creation is needed among the communities to make them fully aware of the status of the fishing stocks and their role in sustainable use of these resources.

A savings culture coupled with a sound fisheries management that would guarantee sustainability of resource use and equitable benefit sharing is called for if poverty levels among the fishing communities are to be reduced. Fishermen need capacity building in book keeping and accounts to enable them to keep track of their operations and make informed decisions on their spending. There is also need for information dissemination on market prices for fish for the benefit of all those who are in the value chain and managers of the industry.

7.4 Determining real fish prices

Fish prices have been characterised by numerous fluctuations due to a variety of factors especially variability of supply and demand for export processing. The processing industry has influenced market prices at various landing sites. Fish destined for export processing has generally attracted higher prices than fish sent directly to domestic and regional markets. Kaelin and Cowx (2002) noted that the current fish trade on Lake Victoria is a major constraint to greater benefits accruing to fishing communities. Under current arrangements the fish buyers not only determine the price but also use the perishable nature of fish as a negotiating tactic to keep the price low. With lack of cooling facilities, prolonged negotiations lead to higher quantities of fish getting rejected and attracting low prices. This has forced fishermen to catch as much as possible to ensure that at least a proportion of what they catch is sold at the highest possible price.

According to Trondsen *et al.* (2003) fishers fish to earn income rather than just catch a specified or maximum quantity of fish. One means of achieving sustainable levels of fishing efforts would be to give incentive to fishers through concentrating on ways in which the unit price of the resource might be increased. Ex-vessel prices can be improved through the auction method. Studies in other parts of the world have shown that fisheries, where fish is sold on contract, fetch lower prices than where there is an auction system (Trondsen *et al.* 2003). Competitive auction with a number of buyers gives the seller higher expected revenue than would be achieved through negotiation with a single buyer where a monopolistic situation tends to develop. An argument may also be put accross in support of contract sales as they reduce risk of marketing for the producer and supply for the trader. However, much as this may be true, in a situation where there is demand for the product, the contract system will benefit the trader as he is assured of supply at a fixed price while it disadvantages the producer because he is not able to take advantage of better prices that the competitive auction system tends to avail.

Auction has traditionally favoured regions where both boats and buyers can meet to exchange product. For fishers in Lake Victoria to be able to benefit from an auction system, they would have to bulk their catches and deliver them to gazetted landing sites where they could meet with a large number of buyers. Fishermen would also need to form a fishermens' organisation that would negotiatate with the processors' association a minimum price which would benefit both the fishers and the processors and let the daily price be set according to demand and supply but not falling below the minimum price. Provision of market infrastructure at gazetted landing sites would encourage the development of the auction method.

Trondsen (1997) suggested an alternative way in which fishermen could comand higher prices than the costs to supply the market as being through control of limited supply of the demanded product. This could be achieved through reduction of fishing effort which would also benefit the fish stocks.

Price of fish in the domestic segments of the value chain is also determined by the price of fish in the export market due to global supply and demand of similar and substituting species. Export markets are senstive to assured supply and quality. Experiences from the past fish export bans are still clear as mentioned in section 7.3. International trade in fish products has faced the following major issues (FAO 2002b):

1. The change in quality control measures in the main importing countries toward a preventive HACCP-based strategy.
2. The concept of risk assessment.
3. General public concern regarding overexplotaition of the resource.
4. Environmental concerns regarding aquaculture.
5. The discussion of traceability and labelling.

The EU and USA have made HACCP plans mandatory for the plants producing fish products for their markets. While the USA enforces these measures through importers in the USA, the EU controls the competent authorities in the exporting countries. With the coming into effect of a new EU regulation on 15 January 2005, there will be a requirement to trace the fish products from the lake to the last consumer. This should address the source of catch by whom traces along the supply chain to the factory. This calls for proper fish handling along the chain to reduce chances of contamination. Factory operators and agents should help in building the competencies of fishers in fish safety and quality issues. The value chain is pulled by quality-conscious consumers, supermarket chains and distributors, which are dependent on suppliers who can offer fresh quality products for their customers. As fish moves up the marketing chain it can not gain freshness but it can, however, lose it. It is important that the processors are able to rely on being supplied fresh products consistently. Quality and safety must be maintained throughout the value chain if the country is not to experience more fish export bans.

The relative importance of Nile perch depends on sustainable marketing which is dependent on sustainable production. Sutainable production can only be achieved if there is effective fisheries management. In addition, increased industrial growth of value-adding is dependent on a governmental policy, which includes marketing as an integrated part of the fisheries management, together with fish stocks management and management of the resource rent distribution (Trondsen 1997).

7.5 Implications of fisheries management on value chains

As mentioned in sub-section 2.7, fisheries management in Uganda has been more oriented towards a biological system of management, without success. Although a biological fisheries management system is applied widely and has been effective in avoiding total stock collapse in many fisheries around the world, it does not solve the problem of open access often associated with the tragedy of the commons (Arnason 2001).

There has been increased fishing effort as revealed by the frame surveys (Table 2) accompanied by almost stagnating fish catches as seen in Figure 2. The impact of increased fishing effort on the stocks can be illustrated with the help of a bio-economic model. This model has implications for the sustainability of the Nile perch value chain discussed in section 6. Sustainable resources are needed if the fishery is to contribute to continued economic growth and improved livelihoods of the rural poor.

Using the Frame Survey Results of 1990, 2000 and 2002 the effort on Lake Victoria was calculated and plotted against the time series estimated catch between 1990 and 2002 (Figure 16).

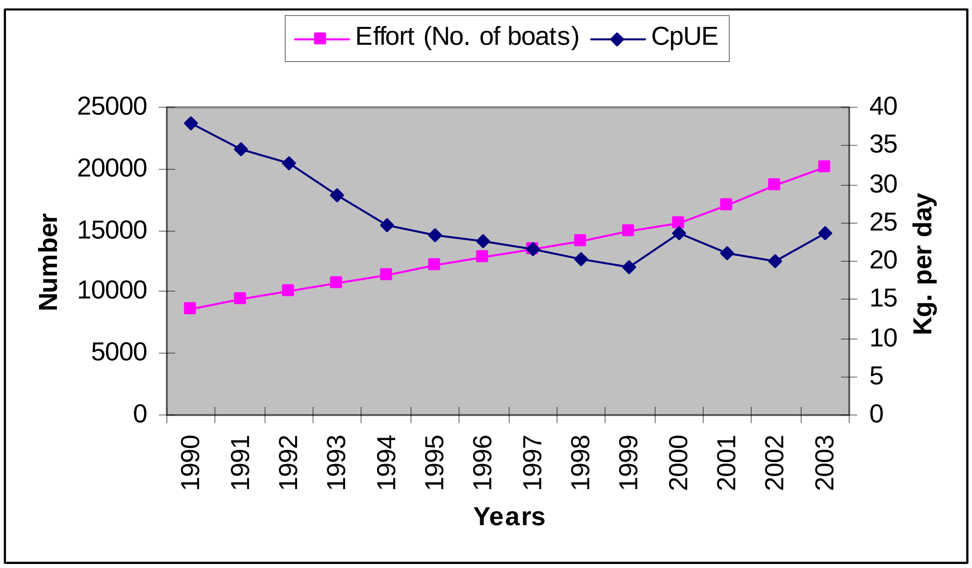

Figure 16: Average catch per boat (for all species) on Lake Victoria. Based on records at DFR (MAAIF 2004b).

It is clear from Figure 16 that the catch per boat over the last 12 years has declined while effort has increased. Because of the open access nature of the fishery, the effort will continue rising with negative impacts on the fish stocks. The relationship between effort and stocks can be demonstrated with the help of a simple bio-economic model based on the work of Gordon (1954) and Schaefer (1957)

According to Cochrane (FAO 2002a), a standard assumption in stock assessment is that $y = e * q * x$ where y is the catch, e is the fishing effort[12] and q is the catchability coefficient of effort[13], while x is abundance of the stock. If catchability remains constant each year, the fishing mortality rate (catch as a fraction of abundance) is directly related to effort: the higher the effort the higher the fishing mortality rate (FAO 2002a). With the help of bio-economic model based on the Gordon-Schaefer model (Clark 1990), which combines a surplus production curve for the stock in question with the relationship between the cost of fishing and fishing effort, a simple bio-economic model for Nile perch can be derived.

The logistic biomass growth function as adapted from Hannesson (1993) is given as:

$$\dot{x} = G(x) - y \qquad (1)$$

Next year's biomass $$x_{t+1} = x_t + \alpha * x_t - \beta * x_t^2 - y_t \qquad (2)$$

Where x_t is biomass at time t and α and β are biological parameters.

Since the parameters α and β in Equation (1) are not known, by assuming $\frac{\alpha}{\beta}$ is equal to the virgin stock, and virgin stock as being equal to 2MSY, since MSY is known, both the α and β could be calculated. Using the MSY for Nile perch, which is estimated as 75,500 tons for Ugandan waters of Lake Victoria (Kudoja 2003), and assuming that MSY occurs at biomass which is 50% of the virgin biomass, then the virgin stock would be 151,000 tons. Muhoozi (2002) calculated harvest for Nile perch in 2000 as 82,000 tons using Virtual Population Analysis. Frame survey 2000 found 15,544 boats, but not all these boats were engaged in Nile perch fishery. Assuming 80% caught Nile perch, the number of boats for Nile perch would be around 12,435. Using the equations below, both the alpha, beta and catchability coefficient were calculated.

$$\beta = \frac{y}{(x_{vig} * x_{msy}) - x_{msy}} \qquad (3)$$

$$\alpha = \beta * x_{vig} \qquad (4)$$

$$y = q * e * x_{msy} \qquad (5)$$

$$q = \frac{y}{e * x_{msy}} \qquad (6)$$

---

[12] Fishing effort is measured in units appropriate for the fishery in question. In some cases the unit of measurement is simply the total number of vessel-days per unit of time, in other cases more detailed information regarding the number of nets, lines or traps hauled is available (Clark 1990).
[13] The value of q depends on whether effort is defined in terms of boats, vessel-ton-days, fishing hours, etc. q provides some indication of the technical efficiency of the fishing fleet.

Where y is the harvest, x_{msy} is the biomass at which maximum sustainable yield occurs, x_{vig} is virgin biomass and e is the effort (which in this case is represented by the number of boats).

Apha (α), which is the intrinsic growth rate of biomass, was calculated as 2.172.
Beta (β), which is the environmental variability, was calculated at 0.0000144.
While q, which is the catchability coefficient, was calculated as 0.000135762.

Adding fishing cost and revenue to the biomass curve, the Gordon-Schaefer model can also be used to estimate the theoretical bio-economic equilibrium in an open access fishery, at which point costs and revenues are equal so that there is no incentive for new entrants to join the fishery.

$$C(e) = F + n * e^2 \qquad (7)$$

$$R = y * p \qquad (8)$$

Where *C(e)* is total cost, *F* is fixed cost, *n* is variable cost, *R* is revenue, *p* is price per kg of fish.

Due to limited data, it was not possible to run regression analysis to calculate both *F* and *n*. *F* therefore, is based on current fixed costs in the fishery while *n* is estimated. A simple graph was obtained as given in Figure 17[14]. The supporting data for Figure 17 are given in Appendix 7.

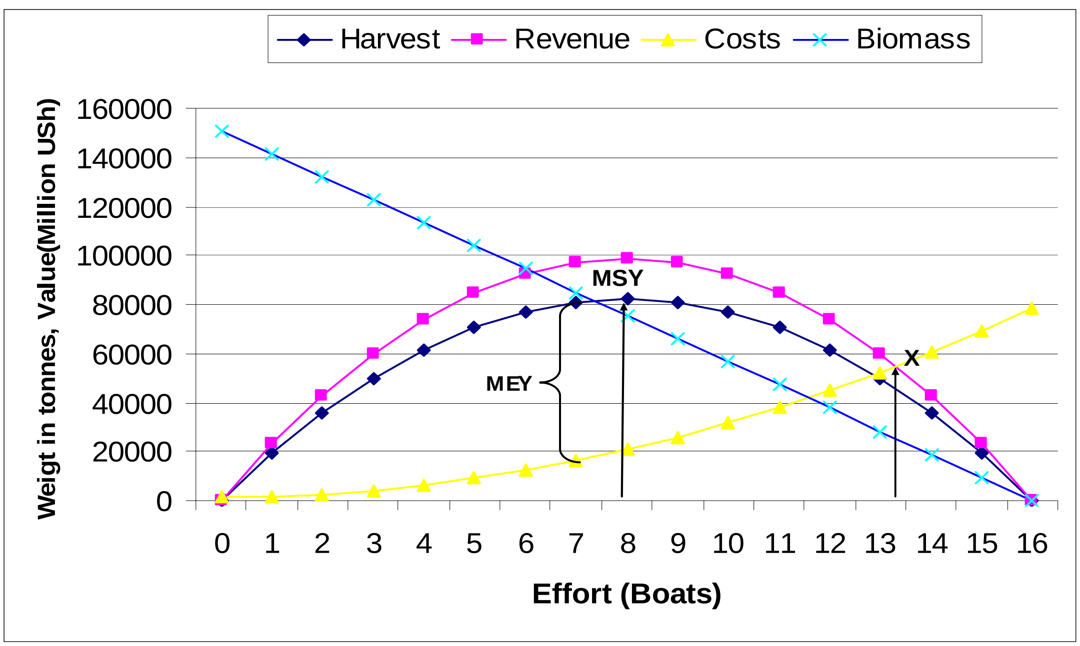

Figure 17: Bio-economic model for Nile Perch (based on existing data).

The biomass curve shows the stock-effort relationship, while the harvest curve represents both the growth-effort and catch-effort relationships. The larger the fishing effort, the higher the

[14] This graph is not conclusive due to the uncertainty in the reliability of the data.

fishing mortality and the lower the size of the stock. That is, there is an inverse or negative relationship between fishing effort and the size of the standing stocks: as effort expands the fish stock shrinks. The total revenue and costs curves assume a constant price per yield and constant cost per unit of effort. Every point along the harvest and biomass curves is assumed sustainable so long as effort at that level remains the same.

The number of fishing boats according to the frame survey of 2002 was 18,612. However, not all those boats were engaged in the Nile perch fishery. Assuming that 60% of the 18,612 boats were engaged in the Nile perch fishery, this would translate to about 11,200 boats. From Figure 17 it appears that the current fishing effort is above that required to achieve both MSY and MEY. However, it would appear the fishery is still profitable enough to attract more people into the Nile perch fishery so long as the export prices remain high. In an open fishery with no barriers to entry, existing profits will attract more fishers. The fishing effort is going to shift towards a bio-economic equilibrium at ***x*** driving the fishery's profits to zero where there will be no surplus profits to attract new entrants. However, by the time equilibrium is achieved, the biomass will be very low. Effort should be reduced in line with the FAO Code of Conduct for Responsible Fisheries, Article 7.2.2. (FAO 1995).

An increase in the number of boats means an increase in employment opportunities. However, in terms of income, an increase in the number of boats means a reduction in stock and harvest resulting in reduction of the aggregate fishing income, average income per boat and average income per crew member. The fishing effort for Nile perch would have to be reduced to around 7000 boats if the MEY is to be persued as the objective of management. MEY is a more appropriate goal for fisheries management, since it results in maximisation of a society's net benefit from the fishery, in addition to keeping stocks from collapsing in light of our limited knowledge of ecological interrelationships in the lake (Panayotou 1982).

However, Lake Victoria being a multi-species and multi-gear fishery, mainly artisanal with a few sections of the fishing community appearing to be targeting specific species, substantial reduction of fishing effort would be impractical from the socio-economic and political point of view. If both economic and social objectives are to be persued as provided for in the national fisheries policy, the current number of boats could still be retained on condition that destructive fishing methods are eradicated and effort in terms of fishing gear is reduced. The existing restrictions on gear should be upheld and the newly adopted co-management approach established and strengthened. This can be combined with the input controls and restricted access through licensing and rights-based regime using the BMUs as the right holders. At the same time research should address the issue of reliability of data for scientific management and work towards TAC for the present three commercial species, which can be allocated to the fishing communities as community quotas.

Muhoozi (2002) found that 90% of the Nile perch landed by paddled boats using passive gillnets below 6" mesh size is below the recommended minimum size of 50 cm TL, while motorized boats using mainly gillnets above 6" operated as driftnets landed about 35% of fish below minimum size and beach seines landed 98.6% below 50cm TL. Considering that most of the paddled boats (parachutes and dugout) and beach seines operate in the nearshore waters, they are posing a threat to the sustainability of the fishery. With the high fecundity of Nile perch, if all the immature fish which are currently harvested are allowed to reach the minimum allowed size of 50cm TL, the harvests of Nile perch would be sustainable at the current number of boats. Effort should be intensified to prevent the harvesting of juvenile Nile perch.

One way to control further effort increase would be through the use of licensing as a limited-entry management tool. Licensing in the past has been used more as a means of generating revenue rather than a management measure. Since it is difficult to identify the fishers with a long history who could be given fishing rights, the option is to give licences to all those currently participating in the fishery so as to achieve equity in allocation. This should be accompanied with a licensing moratorium of at least five years. Effort reduction would then occur through natural attrition. Future licensing would then be limited to only members of the BMU. Although boats have been used in this document to represent fishing effort, fishing gears must also be taken into consideration. Fishing effort should look at both gears and boats because gears determine the fishing mortality while boats determine the capacity to carry gears. To make licensing effective, minimum and maximum size of boats should be set together with the maximum number of nets, longlines and hooks per boats. The minimum size of boats should aim at eliminating the dugouts and parachutes, which are currently fishing in the littoral areas mainly breeding and nursery grounds of tilapia and young Nile perch. The catching of immature fish damages the potential of the stock to renew itself thus reducing the fishery yield and profit.

7.6 Fisheries co-management

In value chain analysis it was indicated that the boat-owners/fishers have a role to play in fisheries management. Under co-management, they are the primary players in partnership with government. Co-management is seen by economists as a possible approach to increasing the cost effectiveness of fisheries management through lowering the ‘ex-post’ transaction costs, i.e. the costs involved in implementation and enforcement. If the purpose of fisheries management is to increase the flow of net benefits from the fishing activity, the costs of the fisheries management itself have to be subtracted from the revenues to arrive at net benefits of fishing. Since fishers are going to participate directly in fisheries management, their current profits will be lowered by the management costs they have been assigned to undertake. According to Arnason (2003), existence of management costs discourages management effort and consequently leads to lower optimal biomass levels and higher optimal fishing effort than would otherwise be the case. Sustainable co-management therefore requires a situation in which the fishing communities can capture a large enough share of the benefits to support at least some management costs. Captured benefits should be conceptualised as an essential aspect of complete co-management, alongside adequate control of fishing effort. Through the BMU system and retention of 25% of proceeds of the fish movement permit[15], some beach management units will be able to generate funds to meet the cost of their participation in management. However, due to the fact that some landing sites are disadvantaged by road

[15] A fish movement permit was introduced in Uganda in 2003 as a means of traceability of fish. Anybody carrying fish of more than 10 kg and destined for commercial purposes is required to have a permit which shows the origin of the fish, the species, the amount, the form (fresh or processed) and where the fish is being taken. Currently, a fee of Ush 10 per kg is charged for the permit.

accessibility, they may not be able to benefit much from the fish movement permit fee. This calls for urgent establishment of the fish levy fund into which the middlemen, factory agents, fish processing factory owners and Uganda-based exporters would be asked to contribute a small levy towards fisheries management costs. These funds can then be used to support those disadvantaged communities in meeting their management obligations.

8 CONCLUSION AND RECOMMENDATIONS

Currently, the available economic data is inadequate for making sound management policy. If the purpose of fisheries management is to increase the economic return from the fishery and if proper decisions are to be made on the management and development of the fishery, then a thorough understanding of the economics of the fishing activity and proper socio-economic data must be made available. Data needed for proper economic monitoring of the fishery includes employment in the harvesting, processing and marketing sub-sectors, fish price changes, net income to the harvesting sector, average income per fishing boat per year, costs per fishing unit per year and fish marketing data. Also, costs of management and enforcement need to be recorded. Gender disagregated data on people employed in shore-based activities, and dependence of the fishers and shore-based workers on the fishery for their livelihoods are all needed. Cost and earning studies should become a regular feature of the fishery statistical systems. They can form the basis for assessing the economic, financial and social health of the fish economy. Planning and policy advice are greatly enhanced when the data and information are of high quality.

Another realm is to have a good understanding of the value chain from harvesting to the stage of export. This would permit a better understanding of the commodity flows and the value and price spreads. This will allow monitoring and assessment of impact of international fish trade on the local population in the areas of income and food security. Timely information on prices of fish for export can contribute to enhancing the bargaining capability of the players down the value chain.

In this study, the costs and margins along the Nile perch value chain were analysed. Results show that the fishery has benefited many people in the chain and that boat owners and fishers are making a good income. The fishery has the potential to drive down income poverty and to sustain the current margins along the chain if properly managed. However, because of low investment costs and high returns, the fishing effort on Lake Victoria will continue to rise if the open-access policy continues, and will lead to rent reduction..

Despite the paucity of data, the simple bio-economic model indicates that increased effort is leading to declining biomass and revenue while the costs are rising very fast. As a result, profits are declining. If the value chain is to remain sustainable, there is need to control the fishing effort especially in terms of fishing gears. This should be coupled with intensified law enforcement to curb the catching of immature fish which is undermining the capacity of the stocks to renew themselves.

Limited access through licensing should be strengthened. Fishing communities should receive capacity building for effective management of the fishery resources and effective utilisation of income from the fishery towards improved livelihoods.

Under the co-management arrangement, fishers will play a direct role in fisheries management and will require financial resources to support their management activities. A Fish Levy Trust should be established and all the players in the Nile perch value chain should contribute to it. Funds from the Levy Trust can be used to support fisheries management on Lake Victoria. Formation of beach management units (BMUs) is going on around Lake Victoria. Development of fish marketing associations should be encouraged within these BMUs in order to improve the benefits to the fishermen in participating in value chains and improve data collection. It is important for fishermen to organise into marketing groups to increase their bargaining power by bulking their catches and concentrating on product quality. Not only will they improve their bargaining power, but they can also improve their access to finance and technical services.

With high demand for Nile perch both in international, regional and domestic markets, there is a need to focus on value added products. Value addition in a species like *Rastrineobola argentea* can be achieved through improved handling. Value-added fishery products should give considerable scope for improving the incomes of small-scale fisher folk. *Rastrineobola argentea* is one species which has increased in catches over the last years and is becoming an important component in the diet of the rural poor. Post harvest handling of mukene needs to be addressed so as to improve the income from that fishery and increase the ratio available for human consumption. Proper processing of mukene for human consumption will earn more money than using it for animal feed. Export quota for tilapia should be set in line with the total production from both capture and aquaculture fisheries to avoid contributing to food insecurity.

Since fishermen make their investment decisions quite independently from each other and since the economic life of a fishing vessel is quite long, over-investment is likely to occur. Moreover, once built, a fishing vessel is, to a large degree, a “sunk” cost and would keep operating whether it covers its fixed cost or not, as long as it covers its variable costs. To avoid a situation of over-investment, there is a need for capacity building among fishermen in book keeping and to encourage record keeping for their own planning.

In conclusion, fish exports have led to increased incomes although currently, fish processors take a bigger share of total value added. For international trade to contribute to poverty reduction, it must be sustainable with equitable distribution of benefits from exports. The starting point for the sustainability of the value chain is the need for protection of the integrity of the resource base and careful consideration of the manner in which it is achieved. This should be followed by a clear recognition of the due economic and social rights of the men and women who labour to manage the resource. Although it may not be possible to have a policy prescription on how benefits should be distributed, setting up of a levy trust for fisheries management may be a starting point for redistributing the benefits.

ACKNOWLEDGEMENTS

I am indebted to the United Nations University and the Ministry of Foreign Affairs in Iceland for financial assistance to undertake this programme. My gratitude goes to the director of the UNU-FTP programme Dr. Tumi Tommasson and his deputy Mr. Thor Asgeirsson for giving me the opportunity to participate in this programme and for all the valuable comments towards this final project. The comments of my supervisor Dr. Vilhjalmur H.Wiium are greatly acknowledged. Thanks go to Ms. Sigridur Kr. Ingvarsdottir for all the administrative support and to the Marine Research Institute, Iceland for hosting the programme and all the hospitality accorded to the UNU-FTP fellows.

Many contributed to my success in completing this project. Some whom I don't know in person nor do they know me, willingly shared with me information via e-mail. To all of them I say thank you.

I am grateful for all the assistence extended to me by the Commissioner for Fisheries and his staff in the Department of Fisheries Resources, Uganda, especially the secretaries who sent me all the data for this study.

To all the fellows of 2004-2005, especially Fatma, I say thank you for all the moral support and good times shared in Iceland.

Last but not least, I am indebted to my husband Dick Nyeko and my children Emma, Jackie, Luke, Patience and little Mathew for their understanding and allowing me to be away from home on many occassions to improve on my knowledge. May God bless you always.

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APPENDICES

Appendix 1: Number of People Employed in the Capture Fisheries Sector as of October 2003.

Water Body	**Number of people Directly employed in fishing**	**No. of pple directly Dependant on fisheries**
Victoria	218,661	914,627
Kyoga	38,227	196,171
Albert	15,334	76,348
George	1,729	9,495
Edward	1,255	5,959
Kazinga Channel	463	2,317
Minor Lakes &Rivers	3,157	14,838
TOTAL	278,826	1,219,724

Source: Survey Data by Bahiigwa and Keizire, 2003.

Appendix 2: Comparison of fish exports to various regions 2002 – 2003 (%)

	Chilled fillets		Frozen fillets		H & G		Fish maws	
	2002	***2003***	***2002***	***2003***	***2002***	***2003***	***2002***	***2003***
EU	98	90	26	34	98	91	30	10
USA	0	6	1	3	0	0	0	0
Japan	0	0	18	8	0	0	0	0
Asia	0	0	14	6	0	0	70	90
Middle East	2	3	14	27	2	8	0	0
Australia	0	1	16	18	0	0	0	0
Africa	0	0	6	3	0	1	0	0
Others	0	0	5	1	0	0	0	0
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Product contribution to total volume	45	49	46	47	7	3	2	1

Appendix 3: Fish Procurement by Factories

Factory	2000		2001		2002		2003	
	WT.	VAL	WT.	VAL	WT.	VAL	WT.	VAL
A	1,624,844	1,758,023,250	3,703,005	5,773,770,500	3,319,705	6,898,245,817	3,190,603	6,164,734,523
B	5,782,566	5,774,295,111	12,815,593	21,319,572,849	8,055,831	17,673,255,402	6,941,522	13,729,827,090
C	-	-	-	-	4,985,483	11,103,575,428	6,844,439	14,015,869,494
D	4,316,651	3,844,370,830	5,345,552	8,457,378,874	4,639,541	9,196,659,214	4,690,332	8,365,310,298
E	5,914,591	5,668,279,127	1,714,132	2,742,282,400	4,643,766	9,907,330,023	5,564,682	11,092,139,210
F	6,291,368	5,844,625,395	11,451,319	19,665,852,013	9,241,501	20,240,322,585	8,474,579	17,655,060,248
G	915,859	861,700,600	-	-	2,193,110	4,955,385,479	3,087,435	6,495,940,425
H	-	-	779,886	1,360,043,184	1,234,572	2,713,464,033	3,416,647	6,434,754,576
I	8,289,300	7,365,852,928	15,022,647	24,287,329,965	10,690,889	23,165,681,696	11,167,809	22,610,856,954
J	-	-	-	-	-	-	2,155,922	4,104,765,910
TOTAL	33,135,179	31,117,147,241	50,832,134	83,606,229,785	49,004,398	105,853,919,677	55,533,970	110,669,258,728
Average Price		939		1,645		2,160		1,993

Appendix 4

PRICE VARIATION ALONG BEACHES			
	2002	**2003**	**2004**
DDIMO	2112	2008	1902
GGOLO	2153	2143	2001
GOMBA	2152	2174	1870
GREENFIELDS	1975	1863	1664
KASENSERO	2183	2069	1982
KASENYI	2233	2175	2039
KATOSI	2203	2164	1898
KIYINDI	2208	2180	1933
LAMBU	2159	2149	1863
MFP	2290	2194	1896
SSENYI	2207	2187	1920
UFP	2109	2140	2144
KIGUNGU	2290	2174	1945
BUSIRO	2264	2293	1651
BUGOTO	2205		
BUKAGABO	2056	1852	1377
BWONDHA	2188	2211	1841
KIREWE	2027	2005	1826
LUBYA	2242	2036	1917
MALINDI	2038		
MARUBA	2203		
MASESE	2214	2090	1793
WAKAWAKA	2137	1969	1653
MAJANI	2136		1714
PORTBEL	2280	2092	1876
KYAGALANYI		1855	1816
NAKATIBA		1980	2114
MWENA			2231
DOLWE			1875
KALANGALA			
LINGIRA			1894
MARINE			2059
MASOLIYA			1856
IGLOO			1651
FWFEL			1800
KYOGA	2083		1854
MASINDI	2025		
Mean	2162	2087	1870
Standard Deviation	*86*	*122*	*165*

Appendix 5 a : Transport boat opertors costs and margins (NRI and IITA 2002)

	Ushs per year	**Ushs per Kg of fish**	**US $ per kg of fish**	**% of costs**
Operating costs-variable:				
Raw material	448,695,000	1,500	0.87	94%
Sub-total variable costs	448,695,000	1,500	0.87	94%
Operting cost – fixed:				
Labour	8,190,000	27	0.02	2%
Fuel and Oil	12,909,000	43	0.02	3%
Repair and maintainance	500,000	2	0.00	0%
Licence	500,000	2	0.00	0%
Sub-total fixed costs	22,099,000	74	0.04	5%
Capital costs	3,124,805	10	0.01	1%
Total costs	473,918,805	1584	0.92	100%
Revenue	533,962,007	1785	1.03	
Profit (loss)	60,043,202	201	0.12	

Appendix 5b: Fish Processing Factory Costs and Margins (NRI& IITA)

	Ushs per annum	**Ush per kg of fillet**	**US $ per annum**	**US $ per kg of fillet**	**% of total costs.**
Operating costs – variable:					
Raw material	8,810,100,000	4500	5107304	2.61	76
Packaging	506,580,750	259	293670	0.15	4
Energy	360,000,000	184	208696	0.11	3
Direct Labour	2,893,146,000	148	167719	0.09	2
Fuel	44,201,028	23	25624	0.01	0
Sub-total variable costs	10010196378	5113	5803012	2.96	86
Operating costs – fixed:					
Management	276000000	141	160000	0.08	2
Lab Expenses	139200000	71	80696	0.04	1
Admin expenses	177600000	91	102957	0.05	2
Fixed asset maintenance	67200000	34	38957	0.02	1
Capital costs (interest and depreciation)	549600000	281	318609	0.16	5
Sub-total fixed costs	1232400000	629	714435	0.36	11
Sub-total operating costs	11242596378	5742	6517447	3.33	97
Miscellaneous	416290873	212	240865	0.12	3
Total operating costs	11636087251	5943	6745558	3.45	100
Annual revenue *	12783147447	6529*	7410520	3.79*	
Profit (loss befor tax	1147060196	586	664962	0.34	
* Includes revenue fillets and fish parts. The weighted export value of fillets is assumed to be US $ 3.48					

The key assumptions are that the facory is working at at 70% of full capacity , has average landing site buying price of Ushs 1,800/kg (US $1.04) of fish, has a fillet yield of 40% and receives a weighted a verage price of fillets (chilled:frozen) of US $ 3.48/kg (Ush 6,020).

Appendix 6(i) : Costs and Margins of Fish Exporters (Amount in Million US $)

	2000		2001		2002		2003	
	Amount	Price/kg	Amount	Price/kg.	Amount	Price/kg.	Amount	Price/kg
Operating costs - variable:								
Raw material	34.36	1.01	80.40	1.58	87.59	1.79	87.00	1.57
Sub-total	**34.36**	**1.01**	**80.40**	**1.58**	**87.59**	**1.79**	**87.00**	**1.57**
Operating costs- fixed								
Air freight US $ 1.5/Kg.)	15.88	0.47	34.67	0.68	32.72	0.67	37.94	0.68
Sub-total fixed costs	**15.88**	**0.47**	**34.67**	**0.68**	**32.72**	**0.67**	**37.94**	**0.68**
Total Costs	**50.24**	**1.48**	**115.07**	**2.26**	**120.31**	**2.46**	**124.94**	**2.25**
Revenue								
Fish Exports	62.34	1.84	101.90	2.00	118.29	2.41	111.89	2.01
Total Revenue	**62.34**	**1.84**	**101.90**	**2.00**	**118.29**	**2.41**	**111.89**	**2.01**
Profit	12.10	0.36	-13.18	-0.26	-2.02	-0.04	-13.05	-0.24
Profit as % of revenue.	**19.41%**		**-12.93%**		**-1.71%**		**-11.67%**	

Appendix 6(ii) Export Factory Costs and Margins (whole segment). (Amount in Million US $)

	2000 Amount	Price/Kg	2001 Amount	Price/Kg	2002 Amount	Price/Kg	2003 Amount	Price/Kg
Operating costs -								
Raw material	17.43	0.51	47.62	0.94	58.91	1.20	56.36	1.01
Packaging material	1.87	0.06	3.00	0.06	2.82	0.06	2.93	0.05
Energy	1.33	0.04	2.13	0.04	2.01	0.04	2.08	0.04
Fuel	0.16	0.00	0.26	0.01	0.25	0.01	0.26	0.00
Direct Labour	1.07	0.03	1.71	0.03	1.61	0.03	1.67	0.03
Sub-total	21.87	0.64	54.72	1.08	65.59	1.34	63.29	1.14
Operating costs- fixed								
Management	1.06	0.03	1.10	0.02	1.54	0.03	1.55	0.03
Lab Expenses	0.53	0.02	0.56	0.01	0.77	0.02	0.78	0.01
Administration	0.68	0.02	0.71	0.01	0.99	0.02	0.99	0.02
Fixed asses maintenance	0.26	0.01	0.27	0.01	0.37	0.01	0.38	0.01
Depreciation	2.10	0.06	2.19	0.04	3.06	0.06	3.08	0.06
Miscellaneous	0.06	0.00	0.05	0.00	0.12	0.00	0.16	0.00
Sub-total	**4.68**	**0.14**	**4.88**	**0.10**	**6.85**	**0.14**	**6.93**	**0.12**
Total Costs	**26.55**	**0.78**	**59.60**	**1.17**	**72.44**	**1.48**	**70.22**	**1.26**
Revenue								
Fish Exports	34.36	1.01	80.40	1.58	89.75	1.83	88.26	1.59
By-products	2.48	0.07	2.73	0.05	4.05	0.08	5.59	0.10
Total Revenue	**36.84**	**1.08**	**83.13**	**1.64**	**93.79**	**1.91**	**93.85**	**1.69**
Profit	10.29	0.30	23.53	0.46	21.35	0.44	23.63	0.43
Profit as Percentage of	**27.93%**		**28.31%**		**22.77%**		**25.17%**	

Table 6(iii) Costs and Margins of the Factory Agents (whole sector). (Amount in Million US $)

	2000		2001		2002		2003	
	Amount	Price/Kg.			Amount	Price/Kg.	Amount	Price/Kg.
Operating Costs - variable:								
Raw Material	15.28	0.45	40.16	0.79	48.68	0.99	45.25	0.81
Direct labour	0.50	0.01	1.38	0.03	1.36	0.03	1.46	0.03
Fuel and Oil	0.37	0.01	1.10	0.02	2.25	0.05	2.91	0.05
Total Variable Costs	**16.15**	**0.47**	**42.64**	**0.84**	**52.29**	**1.07**	**49.62**	**0.89**
Operating Costs- fixed								
Wages	0.25	0.01	0.74	0.01	1.51	0.03	1.95	0.04
Repair and Maintenance	0.02	0.00	0.06	0.00	0.12	0.00	0.16	0.00
Landing Taxes	0.00	0.00	0.06	0.00	0.13	0.00	0.16	0.00
Licence	0.01	0.00	0.06	0.00	0.12	0.00	0.16	0.00
Subtotal fixed costs	**0.28**	**0.01**	**0.92**	**0.01**	**1.88**	**0.03**	**2.43**	**0.04**
Capital costs	0.25	0.01	0.75	0.01	1.53	0.03	1.98	0.04
Total Costs	**16.67**	**0.49**	**44.31**	**0.87**	**55.70**	**1.14**	**54.02**	**0.92**
Revenue								
Fish sold to factory	17.43	0.51	47.62	0.94	58.91	1.20	0.00	0.00
Revenue	**17.43**	**0.51**	**47.62**	**0.94**	**58.91**	**1.20**	**56.36**	**1.01**
Profit	0.76	0.02	3.31	0.07	3.21	0.07	2.34	0.09
Profit as % of Revenue	**4.38%**		**6.96%**		**5.45%**		**4.15%**	

Appendix 6(iv) Costs and Margins of the Transport boats (whole sector). (Amount in Million US $)

	2000		2001		2002		2003	
	Amount	Price/Kg	Amount	Price	Amount	Price	Amount	Price
Operating Costs - variable:								
Fish to agents	12.06	0.36	30.05	0.59	40.91	0.83	36.76	0.66
rejects 5.78%	12.06		1.84		2.51		2.26	
Grading fish	0.50	0.01	1.38	0.03	1.36	0.03	1.46	0.02
Fuel and Oil	1.16	0.02	1.67	0.03	1.42	0.03	1.48	0.03
Total Variable cost	**25.79**	**0.39**	**34.95**	**0.65**	**46.19**	**0.89**	**41.96**	**0.71**
Operating Costs- fixed								
Labour	0.73	0.01	1.06	0.02	0.90	0.02	0.94	0.02
Repair and Maintenance	0.04	0.00	0.06	0.00	0.05	0.00	0.06	0.00
Licence	0.04	0.00	0.06	0.00	0.05	0.00	0.06	0.00
Subtotal fixed costs	**0.81**	**0.01**	**1.18**	**0.02**	**1.00**	**0.02**	**1.06**	**0.02**
Capital costs	0.44	0.01	0.61	0.01	0.49	0.01	0.49	0.01
Total Costs	**27.05**	**0.40**	**36.74**	**0.68**	**47.69**	**0.92**	**43.50**	**0.74**
Revenue								
Fish Sold to Agents	15.28	0.45	40.16	0.79	48.68	0.99	45.25	0.81
Rejects	12.99	0.38	1.73	0.55	2.51	0.83	2.26	0.66
Total Revenue	**28.27**	**0.42**	**41.89**	**0.78**	**51.19**	**0.98**	**47.50**	**0.81**
Profit	1.22	0.02	5.15	0.10	3.50	0.07	4.00	0.07
Profit as % of Revenue	**4.30%**		**12.30%**		**6.83%**		**8.42%**	

Appendix 6(v) Costs and Margins of the fishing boats (whole sector). (Amount in Million US $)

	2000		2001		2002		2003	
	Amount	Price	Amount	Price	Amount	Price	Amount	Price
Operating Costs - variable:								
Raw Material								
Labour (40% of catch)	9.39	0.13	20.29	0.22	25.76	0.28	24.26	0.24
Running Cost engine boats	9.10	0.12	13.01	0.14	16.47	0.18	20.28	0.20
Total Variable costs	**19.03**	**0.25**	**33.30**	**0.36**	**42.23**	**0.46**	**44.54**	**0.44**
Operating Costs- fixed								
Gear	1.73	0.02	2.83	0.03	3.48	0.04	4.10	0.04
Fishing Licences	0.05	0.00	0.06	0.00	0.07	0.00	0.07	0.00
Income tax (average)	0.45	0.01	0.58	0.01	0.68	0.01	0.74	0.01
Subtotal fixed costs	**2.23**	**0.03**	**3.47**	**0.04**	**4.23**	**0.05**	**4.91**	**0.05**
Capital costs								
Engine boats	1.21	0.02	1.74	0.02	2.20	0.02	2.71	0.03
Non-engine boats	0.59	0.01	0.68	0.01	0.72	0.01	0.69	0.01
Sub-total Capital costs	**1.80**	**0.02**	**2.42**	**0.03**	**2.92**	**0.03**	**3.39**	**0.03**
Total Costs	**22.52**	**0.31**	**39.19**	**0.43**	**49.38**	**0.54**	**52.86**	**0.52**
Revenue								
Fish Sold Transporters	24.13	0.36	31.90	0.59	42.87	0.83	39.02	0.66
Fish sold to local market	1.96	0.36	21.51	0.57	21.53	0.56	21.64	0.51
Total Revenue	**26.09**	**0.36**	**53.41**	**0.58**	**64.40**	**0.71**	**60.66**	**0.60**
Profit	3.57	0.05	14.22	0.16	15.02	0.17	7.80	0.08
Profit as % of revenue	**13.69%**		**26.62%**		**23.33%**		**12.86%**	

Appendix 7: Lake Victoria Nile perch Biomass-effort relation.

Alpha	2.1721854
beta	1.439E-05
qq	0.0001358
fk	1500000
cc	0.3
price	1.2

Biomass Growth	Effort	corr effort	B(t)	Harvest	B(t+1)	Revenue ('000)	Costs ('000)	Profits	Corr B(t+1)	Corr Harv
-	0	0	151000.4	0.0	151000.4	-	1,500		151000	0
19,219	1,000	1	141562.8	19218.8	141562.8	23,063	1,800	21,263	141563	19219
35,875	2,000	2	132125.3	35875.2	132125.3	43,050	2,700	40,350	132125	35875
49,969	3,000	3	122687.7	49969.0	122687.7	59,963	4,200	55,763	122688	49969
61,500	4,000	4	113250.2	61500.3	113250.2	73,800	6,300	67,500	113250	61500
70,469	5,000	5	103812.6	70469.0	103812.6	84,563	9,000	75,563	103813	70469
76,875	6,000	6	94375.1	76875.3	94375.1	92,250	12,300	79,950	94375	76875
80,719	7,000	7	84937.5	80719.0	84937.5	96,863	16,200	80,663	84938	80719
82,000	8,000	8	75499.9	82000.2	75499.9	98,400	20,700	77,700	75500	82000
80,719	9,000	9	66062.4	80718.9	66062.4	96,863	25,800	71,063	66062	80719
76,875	10,000	10	56624.8	76875.0	56624.8	92,250	31,500	60,750	56625	76875
70,469	11,000	11	47187.3	70468.7	47187.3	84,562	37,800	46,762	47187	70469
61,500	12,000	12	37749.7	61499.8	37749.7	73,800	44,700	29,100	37750	61500
49,968	13,000	13	28312.2	49968.4	28312.2	59,962	52,200	7,762	28312	49968
35,874	14,000	14	18874.6	35874.4	18874.6	43,049	60,300	-17,251	18875	35874
19,218	15,000	15	9437.1	19218.0	9437.1	23,062	69,000	-45,938	9437	19218
- 1	16,000	16	-0.5	-1.0	-0.5	- 1	78,300	-78,301	0	0