THE ECONOMICS OF FISH PRODUCTION AND MARKETING IN THE WHITE NILE STATE- SUDAN

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Dedication

To the soul of my father

Mother

Sisters

Brothers

Family and friends whose love inspired me

at different times.

Acknowledgement

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ABSTRACT

This study was concerned with the fish production and marketing at While Nile State to indicate the problems and constraints that face and limit the development and improvement of the State's fishery sector.

The magnitude and trend of fish resources utilization and the level of development of the fisheries sector is handicapped by a number of problems and constraints. Small- scale fishermen in the country are faced with several limitations with regard to availability of resources and techniques, landing and marketing infrastructure, access to credit and extension services, as well as organizational constraints.

The area of the study produces about 30% of the Sudan inland fisheries. The study showed that the fish production in the state was traditional in terms of fishing gears, storage, transportation or fish processing which leads to increasing the losses and perhaps large share of costs production.

The objective of this study was to look into the economics of fish production and marketing at the While Nile State, estimation of the total costs of production, marketing costs and margins.

The study was carried out in some selected areas representing north, middle and south of the state, while the marketing study was for fish transporters and the wholesalers and retailers at Khartoum central market which represents the largest market for White Nile fish.

Primary information were collected through structured production and marketing questionnaire, from randomly selected 39 fishermen producers, 6

fish mongers and 15 wholesalers and retailer at Khartoum central market. Secondary information was collected from the Department of fisheries at White Nile and Khartoum States and was used to supplement the primary data. Descriptive statistical analysis and budget analysis were used to analyze the data.

The descriptive statistical analysis of the fishermen socio-economic characteristics revealed that the fishermen are homogenous, their fishing gears and methods were inadequate. Sometimes illegal fishing gears were used which leads to over fishing decreasing the fish potential at the White Nile river.

The budget analysis showed that the highest proportion of the consumer's price goes to the fish transporters, and the transportation cost and value of losses represented the highest marketing cost items.

The study recommended the provision of legal fishing gears at suitable prices, give attention to extension services for the sake of fisheries development and improvement, facilitate access to refrigeration, means of transport, credit facilities and enforcing rules of fishing regulations.

ملخص الأطروحة

أهتمت هذه الدراسة بإنتاج وتسويق أسماك ولاية النيل الأبيض لتحديد المعوقات والمشاكل التي تحول دون تنمية قطاع الأسماك بالولاية.

يعاني قطاع الأسماك من عدد من المعوقات والمشاكل خاصة في كيفية استغلال الحجم الكبير من الثروة السمكية وتنميته، وهناك أوجه قصور متعددة يعاني منها قطاع صغار الصيادين بالبلاد من حيث محدودية الموارد والتقانات – البنيات التحتية للصيد والتسويق- الحصول علي القروض والخدمات الإرشادية إلي جانب المعوقات التنظيمية لهذا القطاع.

تنتج ولاية النيل الأبيض حوالي 30% من أسماك الأنهار بالسودان، وقد وجدت الدراسة أن إنتاج الأسماك بالولاية يتم بصورة تقليدية من حيث أدوات الصيد من قوارب وشباك صيد إضافة لطرق حفظ وترحيل وتصنيع الأسماك مما يعرض المنتج لفاقد كبير يمثل اكبر مساهم في رفع تكلفة الإنتاج.

هدفت الدراسة إلي معرفة اقتصادية إنتاج وتسويق الأسماك بالولاية وقياس التكاليف الكلية للإنتاج والتسويق وتحديد الهوامش التسويقية.

أجريت الدراسة في مناطق مختارة تمثل شمال- وسط وجنوب ولاية النيل الأبيض، أما التسويق فقد شمل مرحلي الأسماك وتجار الجملة والقطاعي بسوق الخرطوم المركزي حيث يمثل أكبر أسواق أسماك النيل الأبيض.

تم جمع المعلومات الأولية عن طريق استبيانات محددة (Structured) شملت عدد 39 منتج تم اختيارهم عشوائياً وكذلك عدد 6 تجار مرحلين وعدد 15 تجار جملة وتجزئة بسوق الخرطوم المركزي ودعمت هذه البيانات بأخرى ثانوية تم جمعها من إدارات الأسماك بولايات الخرطوم والنيل الأبيض. وقد اعتمدت الدراسة أسلوب التحليل الإحصائي الوصفي للوصول للخصائص الاقتصادية والاجتماعية لمنتجي الأسماك وقد أظهرت النتائج أن هذه الفئة ذات خصائص متجانسة بكل الولاية

وأن نسبة كبيرة من الصيادين الذين تم استبيانهم يستخدمون معدات صيد تقليدية ذات كفاءة قليلة وغير قانونية في بعض الأحيان الأمر الذي يقود للصيد الجائر وتقليل المخزون السمكي.

تحليل الميزانية أظهر أن أكثر الأرباح يجنيها التاجر المرحل للأسماك لولاية الخرطوم، وتمثل تكلفة الترحيل ونسبة الفاقد أكبر مساهم في تكلفة الإنتاج.

وقد أوصت الدراسة بضرورة دعم قطاع المنتجتين بتوفير معدات صيد قانونية بأسعار مناسبة وجذب المستثمرين للاستثمار في هذا القطاع الهام مع التركيز علي تقديم الخدمات الإرشادية التي تساعد في الإسراع بتنمية وتطوير المهنة وتوفير القروض وتطبيق قوانين تنظيم صيد الأسماك.

CHAPTER ONE
INTRODUCTION

1-1Background:

Sudan is predominantly agricultural country. Agriculture contributes 39.2% of GDP and employs about 80% of the population (FAO, 2006). S well, Sudan has one of the largest and most diversified species of livestock populations in Africa (FAO, 1997). In addition to the huge livestock base, the country has great wealth in wildlife, fish and poultry. The livestock sector contributes 20% of the agricultural GDP (including 170$ million foreign exchange) (FAO, 2002).Table (1) shows the Sudan livestock population.

Table 1: Annually estimates of livestock population in (000) heads, (2000-2006)

year	Cattle	sheep	goat	camels
2000	37.093	46.095	38.548	3.108
2001	38.325	47.043	39.952	3.203
2002	39.479	48.136	41.485	3.342
2003	39.669	48.440	42.030	3.503
2004	39.763	48.910	42.179	3.724
2005	40.468	49.797	42.526	3.908
2006	40.994	50.390	42.756	4.078

Source: Ministry of Animal Resources and Fisheries (MOARF), Statistics and Information Department, Khartoum – Sudan, (2007)

Livestock production in Sudan is predominantly pastoral. 90% of livestock population is owned and managed by this sector. Livestock production provides livelihood for about 20% of the population and livestock exports generate 25% 0f the national foreign exchange earnings (Animal Resources Services Company, 1999).

1-2 Fisheries:

Sudan's huge fishing potentialities and fish resources are represented by the 800 kilometers coastline on the Red Sea and about 42 billion square meters of fresh water stretched from lakes and rivers, the most important of which are the river Nile and its tributaries. That collectively harbors an estimated fish potential of 23700 tons annually and produces 17000 tons annually. The fish inventory reservoirs at Sennar, Roseiris, and Jebel Awlia Dam in addition to the Nubian lake at Wadi Halfa, account for hundreds of thousand tons of fish in fresh and marine waters (FAO and MOARF 2006). Table (2) shows the basic features of fish reservoirs in the country.

Table 2: The basic features of fish reservoirs.

River basin	Gebel Awlia, White Nile	Lake Nubia, River Nile	Roseriris, Blue Nile	Sennar, Blue Nile	Khashm Elgirba, Atbara River
Altitude (meters above sea level)	377	170-185	-	422	-
surface area (km2)	600-1500	830-1144	290	140-180	125
Total length (km)	629	180	70	-	-
max depth	12	25	68	-	-
Fish potential (tons/year)	15000	5100	17000	1000	800
Fish landing (tons/year)	13000	1000	1500	1000	500
Number of fish species	56	43	22	22	15
Number of fishermen	3500	150	1200	800	350
Number of boots	2000	60	550	450	140

Source: FAO information on fisheries management in the Republic of the Sudan, 2002.

1-3 Fish uses and food value:

People in the developing countries are generally much more dependent on fish as apart of their daily diets than people living in the developed world. It may be used fresh, frozen, canned, cured salted, dried or smoked. Fish meal and fish flour are two products of the fishing industry used for the dairy animals and poultry feeds and so add to the world's supply of protein rich food. Fish is an important and highly desirable food for people suffering from protein, energy and malnutrition which is a leading cause of infant mortality in the developing world. It could be good source against endemic goiter caused by lack of dietary iron and iodine. Each 100 grams of lean or white fish contains less than 1% of fat, about 18% of protein and an energy value range of 50-80 k.cal. Oily fish contains 8-15% of fat and so has a higher energy value (80-160kal/100g) (Mohamed Y. 1999).

When processed, preserved and cooked properly, fish retains most of its high nutrient contents. However, this can be lost during poor handling and storage. Fish protein has a high biological value similar to the protein of land animals but the contents of protein are somewhat less than meat, and there is often a large waste in the scales and bones.

Marine fish is a rich source of iodine in the diet and a good source of fluoride. Small fish may be a useful source of calcium when eaten as a whole together with the bones (More And Wood, 1986). Table (3) shows a comparison of protein and energy contents between fish and other animals.

Table 3: Average amount of protein and calories for fish and other animals or animal products per 100 grams:

Source	Amount of protein	Amount of calories
Fish	18	120
Poultry	19	100
Beef	20	310
Eggs	13	160
Milk	4	60

Source: Strategy and Action Program for Fisheries. FAO -publications Rome 1989.

As Table (3) shows, fish protein contents are almost equal to that of beef and poultry and higher than that of eggs and milk. However fish amounts of calories are higher than that of poultry and milk.

1 - 4 The nature of fishing in Sudan:

Fishermen are considered in most of the developing countries as one of the most neglected and poorest groups within society, having traditionally inherited fishing methods that are not adapted to modern fishing ones, gears, handling and preservation. Actually, the same conditions are prevailing in Sudan and thus there is a huge gap between the world modern fisheries and the traditional fisheries in the country.

Fishing boats in Sudan are mostly wooden canoes with few steel and fiberglass boats. Generally, there is low motorization level and most engines are in fact used by fish collection boats and seldom engaged in fishing operations (Bellemans, 1989).

The main types of fishing gear used in Sudan are fishing nets with occasional use of long lines (Sarima). The types of nets used are the same but with different application. Their material is often nylon twin but in some areas nylon monofilament is also used.

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Fishing nets are imported, as there is no local made ones.

The beach facilities which include clean water, ice factories, cold stores, processing units and marketing facilities are of the most important services that should be provided for fishermen at the landing areas, which are hardly availed, making most of the landing sites in a real need of vital fishing facilities (Moursy, 1987).

1 - 5 Fish production in Sudan:

Table (4) shows that the inland fisheries are mainly on the River Nile and its tributaries, contributing over 90% of the estimated production potential of the country. The sudd swamps in the south and the man – made lakes on the White Nile (Gebel Awlia Reservoir), the Blue Nile Reservoir Sennar Reservoir and Atbara River (Khashm Elgirba Reservoir) are the major fishing localities with respect to fish resource magnitude and exploitation thrust.

Table 4: Surface area, fish production, potential and recent statistics on fish landings in the main fishing areas.

location	Surface area (km)	Fish potential (tons/year)	Fish landings (tons/year)	% of landing to potential
Sudd Region adjacent areas	16500	75000	30000	40
Gebel Awlia Reservoir	1500	15000	13000	86.7
Rosairs Reservoir	290	1700	1500	88.2
Sennar Reservoir	160	1100	1000	91
Khashm Elgirba Reservoir	125	800	500	62.5
Lake Nubia	1144	5100	1000	19.6
Red Sea	91600	10000	5000	50

Source: FAO, report, 2006

The fishing production prevails in the inland water with different degrees of occurrence in the various localities. The commercially important fish are _lates niloticus_, _Bagrus bayad_, _B. docma_, (first class), _Tilapia spp_, _Disichod niloticus_, _Labeo spp_, _Bar bus bynni_, _Clorias_. _Mormyrus niloticus_ (second class), _Drocyon spp_, and _Alestes spp_ (fermented fish), (Department of Fisheries in W.N.S.).

1 - 6 Fish consumption in Sudan:

The per capita consumption of fish in Sudan is about 1.3 kg/year and it is considered very low when compared to the international level, which is about 13 kg/year according to FAO statistics (FAO, annual (2006). (FAO, 1995) estimated the per capita consumption of fish in Sudan as a national average was close to 1 kg/year. In urban areas consumption was estimated to be as > 2 kg/year, while for rural population it was < 0.5 kg/year. Comparing this with other countries, it was 7.5 kg/year in Austria, 12.6 kg/year in Germany, 16.3 kg/year in Norway and the African average was about 7 kg/year. Fisheries resources in Sudan, are not fully exploited therefore there are considerable resources which could contribute significantly to rectifying the low per capita consumption, the marketing services are traditional and inefficient resulting in the waste of a large portion of the total production in addition to the use of non-insulated trucks for fish transportation and the unavailability of other preservation facilities. Khartoum is considered the main fish marketing centre, Table (5) shows the fish transported to Khartoum during the period 2002 – 2008 and imported quantities during last three years 2006 – 2008 (according to Khartoum Stat Fisheries Department, 2008.While Table (6) and Figure (1) show the fish imported during the year 2008 in species, Nile Perch boneless (Lates niloticus) was about 40% from total imported and this species is produced locally.

Table 5: Fish domestic production during 2002 – 2008 and the import quantities during 2006 - 2008:

Year	Fish production (tone)	Imports (tone)
2002	5614.7	-
2003	3916.7	-
2004	7087.6	-
2005	500.2	-
2006	7448.3	235.8
2007	8516.9	268.9
2008	16447.5	288.2

Source: Khartoum State Fisheries Department, (2008)

Table 6: Sudan fish imports in 2008 by species:

Species	Quantities in tone	% from total quantity
Nile Perch (boneless)	115.7	40.12
Perch (boneless)	6	2.1
Perch (whole fish)	14.9	5.2
Shrimp	23.1	8
Cuttle fish	2.9	1
Live Tropical fish	0.4	0.14
Hmour	120.4	41.8
Kilimary	4.1	1.4
Other	0.7	0.24
Total	288.2	100

Source: Khartoum Stat Fisheries Department, (2008)
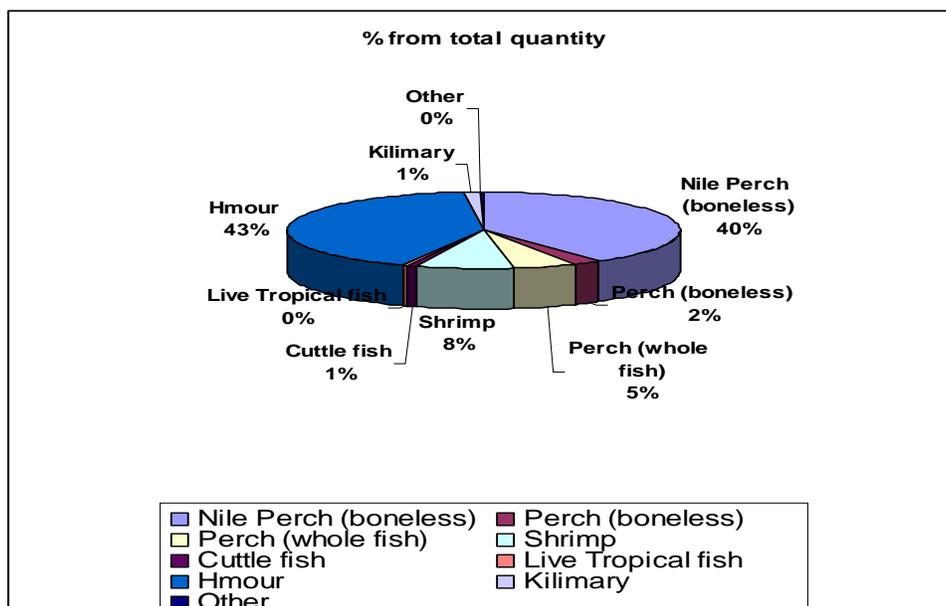
Figure (1) The percentage of the fish imported in species during 2008

Source: Khartoum Stat Fisheries Department, (2008)

1 – 7 World fish production:

Table 7: The fish production in 2004 and projections for 2010. All figures, other than percentages, are in million tons.

Item	2000	2004	2010
Information source	FAO statistics	FAO statistics	FAO study
Marine capture	86.8	85.8	86
Inland capture	8.8	9.2	6
Total capture	**95.6**	**95.0**	**93**
Aquaculture	35.5	45.5	53
Total production	**131.1**	**140.5**	**146**
Food fish production	96.9	105.6	120
Percentage used for food fish	74%	75%	82%
Non-food use	34.2	34.8	26

Source: FAO World Review of fisheries and aquaculture, 2006

1- 8 Fishermen and fish farmers:

Millions of people around the world depend on fisheries and aquaculture, directly or indirectly, for their livelihoods. During the past three decades, the number of fishers and aquaculturists has grown faster than the world's population, and employment in the fisheries sector has grown faster than employment in traditional agriculture. In 2004, an estimated 41 million people (worked part timer or full time) as fishermen and fish farmers, accounting for 3.1 percent of the 1.36 billion people economically active in agriculture worldwide and representing a growth rate of 35 percent from the corresponding figure of 2.3 percent in 1990. The great majority of fishermen and fish farmers are in developing countries (FAO World Review of fisheries and aquaculture, 2006).Table (8) shows fishermen and fish farmers in the world.

Table 8: World fishermen and fish farmers:

Item	2002	2003	2004
	Thousands		
Fishermen			
Africa	2 981	2 870	2 852
North and Central America	891	841	864
South America	706	689	700
Asia	34 103	36 189	36 281
Europe	766	653	656
Oceania	49	50	54
World	**39 495**	**41 293**	**41 408**
Fish farmers			
Africa	83	117	117
North and Central America	75	62	64
South America	194	193	194
Asia	8 374	10 155	10 837
Europe	30	68	73
Oceania	5	5	4
World	**8 762**	**10 599**	**11 289**

Source: FAO World Review of Fisheries and Aquaculture, (2006)

1- 9 Economic importance:

Fish is marketed and consumed fresh (63%), sun- dried (28%) or wet salted (9%). The fresh fish is transported from distant fishing grounds to consumption areas in the capital, Khartoum and other towns, either chilled or refrigerated. Sun- dried fish is mostly marketed in rain- fed and mechanized agricultural schemes. Wet-salted fish mainly (hydrocyon, spp, Atestes spp and mugil spp) is intended for both domestic consumption and export.   Shells of the mother of pearl oyster are exported to some European countries. Other molluse shells are harvested and sold locally as a source of calcium for poultry feed or as souvenirs.   Shrimps   and prawns are sold locally as a highly- valued delicacy food, particularly in the first class hotels (FAO, information on fisheries management in the republic of the Sudan, 2002).

1- 10 Fresh water fish culture:

Fresh water fish culture started in Sudan in 1953, with the establishment at the experimental demonstration fish farm within the premises of the fisheries research center in Khartoum. Experimental triads and subsequent applications were primarily concerned with the pond-based culture of   tilapia using a semi – intensive system.

Apart of Oreochromis niloticus, other indigenous species such as labio spp lakes niloticy and clarias spp were also experimented in combination with the former species. Grass carp was introduced for the eradication of aquatic weeds using controlled experimentation. Common carp was also tested in combination with tilapia. Private and public sector fish farms were established around the capital Khartoum and other cities. Production from these farms has been extremely low, with a maximum of 1000 tones/year (MOARF, (2007).

1-11 The problem statement:

The contribution of fisheries to the Sudan G.D.P is presently marginal about 0.4% (FAO, 2002). The per capita supply is only 1.64 kg/year (live weight equivalent) - which is mostly obtained by capture fish landing. However, the world per capita supply is 16.6 kg/year (FAO 2007).

The magnitude and trend of fish resource utilization and the level of development of the fisheries sector is handicapped by a number of problems and constraints. Small-scale fishermen in the country are faced with several limitations with regard to availability of resources and techniques, landing and marketing infrastructure, access to credit and extension services, as well as organizational constraints.

Fish being a highly perishable commodity, high post-harvest losses are common due to lack of proper handling on board, suitable shore-based fish handling, collection, storage, transportation equipment, distribution facilities and deficiencies in marketing practices. Fishing grounds either suffer from over fishing (Gebel Awlia Reservoir) or are virtually untapped (Sudd region and Lake Nubia). No attention has been paid to the development of rain water bodies within the savanna belt in west, central and eastern Sudan. Fresh – water fish culture has not been developed, due to serious handicaps including limited skilled personnel, inadequate research, extension and infrastructure facilities and limited operational funds.

The aquaculture industry is not developed as yet. Due to their basic characteristics, the Sudan inland and marine capture fisheries are of small-scale and semi- industrial nature if properly managed. On the other hand aquaculture plays a basic role in closed season where fishing is not allowed during the period from mid- March to mid- August.

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The implementation of different fishing regulations in Sudan face certain obstacles to the extent that, the present situation is more similar to that of an open access fisheries than that of regulated one. On the other hand, the Fisheries Administration, which is responsible for the conservation of resources through rationalizing the fishing efforts, also faces problems such as monitoring and regulation of the different fishing activities (Fisheries Department, 2004 Seminar).

1- 12 Objectives of the study:

The main objective is to study the economics of fish production and marketing in the White Nile state.

1- 13 The specific objectives are:

1. To identify the main constraints to fish production.
2. To describe the marketing channels.
3. To calculate the marketing costs and margins so as to identify the present efficiency.

1-14 Hypotheses:

1. The post harvest losses and fishing gear are the main cost items of the fish production at the White Nile State.
2. The present marketing system of fish is not efficient and transportation is the main cost item of marketing.
3. Infrastructure and the system of fishing are very traditional.
4. Marketing margins are relatively law for wholesalers.

1-15 Research Methodology:
1-15-1 Area of study:

The White Nile State area of study is considered one of the important areas for fish production in the Sudan as it contributes by more

than30% of the total production of the inland fish in the country (Fisheries Department W.N.S, 2008).

1-15-2 Data collection:

The study depended on primary and secondary data. Two surveys were conducted during the period March – August 2008.The first survey was for fishermen, and the second was for fish mongers. Structured questionnaires were used to interview the respondents. Secondary data was collected from various ministries, fisheries department, research centers, books and bulletins. Marketing surveys were conducted in the main marketing areas (El Hidaib – El Zilate – El Mounjara) and Khartoum during the period from March to December 2008.

1-15-3 Sample design:

The White Nile State has been stratified into three strata, the northern, central and southern parts. Edduam and El Shikh El Sidig were selected to represent the northern area which is dominated by Arabic tribe (Hassania). The central part included Kosti and Guly (50 kms north of Kosti) on the western bank of the W.N. State , and El Hidaib (42 kms south of Kosti) on the eastern bank of the W.N. State , which is dominated by fishermen from west Africa (Haus and Falata)

El Gabalain and El Hidaib (42 kms south of Kosti) were selected to represent the southern part of the State. The fishermen who occupied those areas are from southern tribes (Sholuk) and some Arabic tribes (Nazzi).

1-15-4: Sample size:

The number of fishermen in the White Nile State is about 1198 according to Department of Fisheries in the State Ministry of Agriculture, Animal Wealth and Irrigation. The fishermen were movement far from

residence area towards the richest fishing areas to get higher production, Fishermen some times misunderstand the survey purpose and deal with the interviewer as if she is a tax collector. Hence they were reluctant to release information. More ever the fishermen in the State were homogenous in their characteristics. For these reasons a convenience sample of 39 fishermen was selected (13 from each stratum), in addition to 6 fish merchants and 15 retailer at Khartoum central market.

1-15-5 Method of analysis:

The data were subjected to descriptive statistical analysis, budget analysis, marketing costs and margins estimation.

1-16 Organization of the study:

The study consists of five chapters:

Chapter one is the introduction.

Chapter two is a review of available literature on fisheries.

Chapter three presents the descriptive socioeconomic characteristics of fishermen.

Chapter four contains two sections:

Section one is the fish production in the study area.

Section two presents the marketing system (marketing channel).

Chapter five is the summary, conclusion, and recommendations of the study.

Chapter Two
Literature Review

2-1 Fishes:

Fish in general is being defined as cold-blooded, aquatic vertebrate animal, which breathe oxygen in simple solution in water by means of gills, and has fin for movement. Some fishes have scales and others have not. Fish flesh is composed of an average of about 75% to 80% of water, which is strongly bound to proteins in structure. This protein makes up from 15% to 28% of fish muscles and consists of essential amino acids (William, A. (1988).

2-2 Fishing:

Fishing is defined as the operation through which the natural production of fish could be harvested from the open water for human benefit (Mohamed Y. 1999).

2-3 Fish spoilage:

Fish starts to spoil as soon as it dies. Spoilage is the result of a whole series of complicated changes brought about in the dead fish by its own enzymes, chemical action, bacteria or other physical damage. We can reduce spoilage by cooling the fish – reducing the amount of water available in the fish and keeping the fish clean (FAO, 2004).

2-4 Fishing gears:

Hodgson, (1998) defines fishing gear, as any net, trap, sieve, line, spear or other implement or tool used for fishing and fishing effort is the number of fishermen and gears.

2 – 5 The Traditional Fish Marketing System:

In most small-scale fishing communities in developing countries, the traditional fish marketing system is characterized by fishermen landing their catches on scattered beaches, normally in small quantities. The fishermen have little bargaining power in the markets, with most marketing activities being financed by fish traders who also function as a source of informal credit, providing necessary cash for the fishermen's family needs, especially during the extended seasonal periods of limited catch and income. This situation can create a strong inter-dependence between traders and fishermen which influences market decisions over the latter. Marketing relationships between fish traders and fishermen tend to be long-lasting, providing an assured market outlet to the small-scale fishermen and a source of steady supply to the traders. Fishermen/traders ties should be carefully evaluated when looking for new marketing strategies, taking into consideration the socio-economic conditions in which the traditional market system operates (FAO fisheries technical paper 291, Rom 2005).

2- 6 Constraints of Small-Scale Fisheries Development:

Small-scale fishermen in developing countries are faced with several limitations with regard to availability of resources, fishing craft, gear and techniques, landing and marketing infrastructure, access to credit and extension services, as well as organizational constraints. This study, however, will deal mainly with the landing and marketing infrastructure needs of small-scale fisheries. There are several constraints in the traditional fish marketing system:

1. Fish being a highly perishable commodity, high post-harvest losses are common due to lack of proper handling on board, suitable shore-based fish handling, collection, marketing, storage and distribution facilities and deficiencies in marketing practices;

2. Fishing communities are sometimes located in remote areas at considerable distances from the markets. Therefore, their catches have to be collected from village to village to obtain quantities large enough to justify costs of transportation to the markets;

3. Poor communications make it difficult to operate efficient fish collection and distribution systems due to the problems of establishing adequate fish marketing information systems (FAO fisheries technical paper 291, Rom 2005).

2 – 7 Fermented fish in the Sudan:

Fish is not consumed on any large scale in the Sudan except in the southern region and in the major towns and cities along the River Nile and Lake Nubia. Only about 5 percent is eaten in smoked form. The predominant cured fishery product widely produced and consumed in northern Sudan is (fessiekh), a fermented fishery product. It is used as both a staple food and a condiment in food preparation. About 5 percent of the total fresh fish supply in the Sudan is processed into (fessiekh) but only 30 percent of this is consumed locally. Nearly 70 percent is exported to Egypt where there is a ready market. It has been reported that (fessiekh) originated in Egypt where it is used in the preparation of a special meal during Easter. (Terkeen) is a fermented fish paste which is a delicacy among the people of northern Sudan around Lake Nubia. It is mainly used as a condiment in traditional vegetable sauces. (Mindeshi) is another paste-

like fermented fishery product relished by the people of south-western Sudan. Hard dried fermented fish (kejeick) is popular as food fish for Sudanese farmworkers involved in agricultural sector especially in southern Sudan (Abdalla, 1989)

2- 8 Food security and Natural Resources:

Feeding the world in 21st century will require not only food availability, but also food security, access to the food required for healthy and productive life. It means the ability to grow and to purchase food as needed. It also means that people do not have to rely on staple food such as wheat, rice, potatoes and cassava.   In addition to the expected population growth, the FAO estimates as many as 840 millions people, a number that exceeds the combined populations of Europe, the United States, Canada, and Japan – currently don't have enough to eat. The companion problem of hidden hunger, affects even more people in the developing world. The shift away from the staple traditional food will make this challenge even more difficult (AOAD, 2002).It is clear that all opportunities have to be taken to use all resources more efficiently, in both the short and long terms. Optimizing our management of plant nutrients and water, taking advantage of the opportunities offered by genetic resources and improving the management of fishery resources. The efforts will cross boundaries between technical discipline and nations. Involvement is the key to sustainable use of the planet's natural resources. It is only achieved if farming, fishing and forest communities are participating in seeking innovation and find in them the benefits that they need. Given the right incentives and government support, they can make significant progress towards managing land water resources well, Jul-Lansen, (2003).

2- 9 Climate change affect global fish production:

Climate change could adversely affect the fish production globally. A recent report by United Nation Environment Program (UNEP, 2008) stated that climate change might slow down the global flow of ocean currents, which flush and clean the continental shelves and are critical to maintaining water quality, nutrient cycling and the life-cycle patterns of fish and other marine life in more than 75% of the world's fishing grounds. The effects in developing countries and small island developing states will be more direct on coastal communities and populations, which depend on marine resources for sustenance and livelihoods.

According to Food and Agriculture Organization (FAO, 2006) estimates, the global annual fish production is around 125 million tons. Out of this around 30% is contributed by China. India's fish production has increased from 5.6 million tons during 2000-2001 to 6.5 million tons during 2006-2007. India ranks third in fish production behind China and Japan.

About 50 million people could be at risk by 2080 because of climate change and increasing coastal population densities, according to a FAO policy brief on the impact of climate change on fisheries. "Projections suggest that these combined pressures could result in reef loss and a decline in fish availability for per capita consumption of approximately 15% by 2015.The UNEP report also found that up to 80% of the world's primary fish-catch species are exploited beyond or close to the harvesting capacity. Advanced technology combined with subsidies, mean the world's fishing capacity is 2.5 times more than what could be harvested in a sustainable manner.

2–10 Global environmental degradation:

Recently environmental degradation has become the concern of industrialized as well as developing countries. Environmental conservation, far from being a luxury, is an essential ingredient for maintaining the natural resource base upon which most nations depend for their continued sustainable economic development. Environmental degradation in many forms constitutes threat to economic growth and development. Many of environmental problems are blamed on the modern living pattern and human activities. Indeed, when the 20th century began, neither human being, nor human technology had the power to radically alter the global ecosystems and create interrelated problems on the entire earth (Hamid, 2000).

The common global environmental problems, air and water pollution on an international scale, in the form of acid rain, global warming threat to ozone layer and the pollution of the oceans and seas reflect the growing physical and economic interdependence among nations on this planet. In fact it could be argued that environmental problems in most cases of global nature in trumps of causes and effects (Hamid, 2000)

Therefore, there is doubt that since the turn of the 20th century human activities have resulted in detrimental change in the soil, water, and land in the biological potential of terrestrial and aquatic ecosystems.

2 – 11 Sugar industry waste water effluent:

The raw sugar industry uses large amount of water mainly for cane washing and condensing of vapor that is the reason why in Sudan the factories are always located by the river Nile and its tributaries (Hammid, 2000) reported that large amount of wastewater throughout the operational season were disposed off in the watercourses without being treated. This

was because it was the cheapest possible manner ignoring the adverse possible effects on the water quality and aquatic life down stream.

Assalya Sugar Factory, as other sugar factories located near the river, is said to use about $6 * 10^3$ cubic meter of water/day for washing the cane and other industrial processing. This factory disposes off its effluents into Khor Djassir (Earthen dam embanked on the right arm of White Nile River during Mahadia resistance movement). These effluents contain organic and inorganic mater from sugar processing operation, pesticides, herbicides and fertilizers from sugar cane field surrounding the factory (Osman, 1989).

From the field visit to Assalya Sugar Factory in May 1998 to collect information about seasonal activities for sugar processing, wastewater from factory activities is divided into two:

1. Wastewater from sugar processing operation.
2. Wastewater from irrigation of sugar cane field.

These effluents pass through certain canals to gather in one main canal west of Khartoum- Kosti road to be discharged in White Nile River at mid of Khor Djassir area.

Wastewater effluents originate from sugar processing contains the following effluents:

1. Cane washing effluents, which is about 1200 m3/hour for 13-18hrs/day during the operational season, which extends for 7 months from November to May. This amount is equivalent to 4,536 thousand m3 of wastewater during the whole operational season.

2. Cooling water, which is about 600 m3/hour for the whole operational season. This equivalent to 1,868 thousand m3 in whole operational season.

3. Processing floor wash effluents is considered very low when compared with cane washing and cooling effluents.

Therefore the total effluents being discharged in White Nile from Assalya Sugar Factory is about 6.404 thousand m3 during the operational season. This huge amount of effluents contains chemical substances that are originating from washing and processing of sugar such as Sodium hydroxide.

2-12 Management process:

Fisheries management is a complex process that requires the integration of biology and ecology resource, with socio-economic and institutional factors affecting the behavior of fishers and policy makers. The purpose of this multidisciplinary team is to aid design marketing to achieve a sustainable development of the activity, so that future generations can also benefit from the resource. However, sustainability has been far more difficult to achieve than is commonly thought: fish population are becoming increasingly limited, world catch has begun to drop, and almost 70% of the individual fish stocks around the world are fully to heavily exploited, overexploited or depleted. Indeed, depressed yields coupled with a rise in demand and prices, determined a systematic decreasing trend in catch rates and global landings. Conventional management measures, such as minimum size and reduction in catch or in fishing efforts, have been used to promote stock rebuilding by reducing fishing mortality and increasing survival of spawning stocks (Lansen, 2003).

2-13 The classical approaches of fisheries Management:

Rational exploitation of fish stocks involves control of fishing mortality (effort and fishing methods) in such a way that annual catches of specific stocks can be continued indefinitely according to pre-determined objectives related to the productivity at different stock levels. The catch effort curve of sustainable yields (Schaefer, 1954) exemplifies this approach: at any level of fishing effort up to the level where the surplus yield is maximized, a yield can be found that is theoretically sustainable and stable.

Which level of fishing effort is chosen depends on a number of strategic objectives such as securing minimum biomass, maximizing food production, maximize the resource rent (maximum economic yield, MEY)or employment. Of these objectives, the concept of maximum sustainable yield (MSY) at which effort level should be set in order to maximize food production has gained most prominence. Various models estimating MSY, or maximum yield per recruit, have been used extensively in African freshwater fisheries, and the concept of MSY has formed part of the research goals in many fisheries development projects as well (Lansen, 2003).

Chapter Three

Socio Economic Characteristics of the Fishermen

This chapter presents the result of analysis of primary data.

3-1 Fishermen Living:

As in Table (9) 59% of the fishermen are living in the areas around their fishing. 33,3% are living in near village and only 7.7% are found to be living in the near town .

Most of the fishermen in the northern part of the State migrate south due to better catches south of Kosti when the Jabel awlia Dam is opened (November – February) .

Table 9: Distribution of the interviewed fishermen according to residential area:

Living area	Number	Percent
Area around their fishing	23	59
Near village	13	33.3
Near town	3	7.7
Total	39	100

Source: field survey, (2008)

3-2 Fishermen Ethnic groups:

Table (10) shows that 51.3% of the fishermen are from Arab tribes (Hassania – Kawahla – Kinana), 38,4 % are Hausa and Falata , 10,3% are southern tribes (Shoulok) .

Table 10: fishermen ethnic group:

Ethnic group	Number	Percent
Arabic tribes	20	51.3
Falata and Hausa	15	38.4
Shoulok	4	10,3
Total	39	100

Source: field survey, (2008)

3-3 Age:

Age has an important effect on fishing job, as it reflects experience and manual abilities. The age structure may prove that the fishing process is not easy and needs strength plus experience, so the middle age prevail this job as we shows in Table (11).

Table 11: the distribution of fishermen in term of age:

Age class	Number	Percent
20 - 34	6	15.4
35 - 55	29	74.4
56 -	4	10.2
Total	39	100

Source: field survey, (2008)

3-4 Education level:

Table (12) shows that 15.4% of the fishermen are illiterate , 28.2 % attended (Khalwa), 30.8% primary, 7.9% intermediate and 7.7% secondary schools as in the table .

Table 12: fishermen according to education level:

Education level	Number	Percent
Illiterate	6	15.4
Khalwa	11	28.2
Primary	12	30.8
Intermediate	7	17.9
Secondary and higher	3	7.7
Total	39	100

Source: field survey, (2008)

3-5 Marital Status:

Table (13) shows that 7.7% of fishermen interviewed said that they are not married, 23.1%are married and 69.2% of them are married with children.

Table 13: fishermen according to martial status:

Martial status	Number	Percent
Not married	3	7.7
Married have no children	9	23.1
Married hve children	27	69.2
Total	39	100

Source: field survey, (2008)

About 51.3% of the fishermen interviewed said that their sons don't work with them and 48.7% mentioned that their sons worked beside them. Almost all sons who work with their fathers (92.3%) work on temporary basis while (7.7%) worked permanently.

3-6 Experience;

Table (14) shows that 82.1% of the respondents have experience of more than 10 years which indicates the long experience of fishermen, and their knowledge about location of catch and the best time of fishing.

Table 14: The length fishermen's experience year:

Length	Number	Percent
< 5	2	5,1
5-10	5	12.8
> 10	32	82.1
Total	39	100

Source: field survey, (2008)

3-7 Main Occupation:

This gives clear indication that most fishermen (79.5%) have fishing as their main occupation, while (20.5%) have other occupation beside fishing either farming (15.4%) or trading (5.1%).

Table 15: the main occupation of fishermen:

Variables	Number	Percent
Only fishing	31	79.5
Fishing and farming	6	15.4
Fishing and trading	2	5.1
Total	39	100

Source: field survey, (2008)

3-8 Best seasons for fishing:

Respondents indicated that the best season for fishing is winter 56.4% then summer 20.5% and autumn 15,4%.

Table 16: The best season for fishing:

Season	Number	Percent
Winter	22	56.4
Summer	8	20.5
Autumn	6	15.4
All year	3	7.7
Total	39	100

Source: field survey, (2008)

3-9 Fishing times during the day:

The best times for fishing is morning which represent 51.3%, then morning and evening 38.5% and evening 10.2%. They prefer early morning because it is the suitable time for fishing and marketing since they have no enough cooling equipment to keep their production fresh till the time of marketing.

Table 17: The best times for fishing:

Fishing time	Number	Percent
Morning	20	51.3
Morning and evening	15	38.5
Evening	4	10.2
Total	39	100

Source: field survey, (2008)

3 – 10 fishing tools:

3-10-1 Type of boat:

From Table (18) the methods used most frequently in fishing are shroog (sonot wood).

Table 18: The types of boat:

Type of boat	Number	Percent
Wooden boat	9	23.1
Motor boat	3	5.1
Shroog boat	28	71.8
Total	39	100

Source: field survey, (2008)

3-10-2 Type of nets according to eye:

The fishing nets are of different types according to the size of eye. Table (19) shows the different types usually used. Gill net of 6 cm. mesh size or more than this number are legal because almost all the fish caught by them have reached maturing stage, while gill nets below or less than 6 cm are illegal due to the fish caught by them have not standardize length and have not reached maturing stage (Seer). Nevertheless gill nets less than 6 cm size are allowed for the fishing of fish which are used as fermented fish (fessiekh).

Table 19: Type of nets according to eye size:

Type of nets	Number	Percent
Less than 6 cm	15	38.5
More than 6 cm	16	41.
Use two size	8	20.5
Total	39	100

Source: field survey, (2008)

3-11 Annual production:

   Most of the respondents noticed that the production has decreased during the last few years. About 66.7% stated that there is an annual decrease while 25.6 % said that the annual production was constant, the rest (7.7%) said there is an increase as shown in Table (20).

   Table 20: The level of annual production:

Annual production	Number	Percent
Constant	10	25.6
Increasing	3	7.7
Decreasing	26	66.7
Total	39	100

   Source: field survey, (2008)

3-12 Reasons for decrease:

   Most of fishermen agree that the main reason behind the reduction of the annual production is the increase of the number of fishermen in the area.

   Table 21: The reasons of the reduced amount of fish production:

Reasons of decreases	Number	Percent
Over fishing	36	84.6
Environmental change	3	15.4
Total	39	100

   Source: field survey. (2008)

3- 13 Transportation:

The most common means of transporting fish from the river bank to the local market is motorcycle, about 61.6 %, while transportation by cart is 25.6 % and by vehicle 12.6 %.

Table 22: The means of transportation of fish :

Type of transportation	Number	Percent
Motorcycle	24	61.6
Animal cart(Caro)	10	25.6
Bus	5	12.8
Total	39	100

Source: field survey. (2008)

3-14 The role of women in fishing:

The fishing activity is mostly dominated by men. The women in their communities help only in net repairing and fish processing.

3-15 Finance:

All the fishermen in the study area said that they have not taken any loan or credit because they afraid of not being able to repay the instalment, due to fishing fluctuation in production.

3-16 Main problems faced by fishermen:

All of fishermen interviewed mentioned that the main problems facing them are higher prices of fish equipment (boats and fish net). About 74% mentioned that the aquatic plant or water weeds (Eichhornia crassipes) are decreasing their production, and some times become entangled in their nets. More than 61% of them said that water level

fluctuation increase and decrease the production due to the closing and opening the Dam respectively. About 92.3% of the respondents said the social relations effects negatively their fishing operations.

About the effect of water pollution in production about half of them (53.8%) said there is not any effete and only 46.2% mentioned that water pollution decreases the production.

Barada is a fish species that makes some problem to the fishermen as it attaches with electric shocks.

All of the fishermen interviewed about the services offered to them by the campus or by the fishery department said that there are no any services offered to them at the landing sites.

Figure (2) Traditional fish production and marketing in Sudan

Chapter Four

Fish production and marketing

4-1 Fish production

Table 23: Number of fishermen and fish equipments of fisheries in White Nile State 2007:

Station	Boats	Fishermen	Vehicles
Kosti	360	291	5
Elgablain	317	272	7
Eddwaim	357	336	3
Elmongara	292	299	10
Total	1326	1198	25

Source: Department of Fisheries W.N.S. (2007)

4-1-1 Fish catches (yield):

The monthly catch tends to fluctuate from one month to another. Table (24) shows the monthly catch during 2007, while Table (25) and Figure (2) show the fish consumption in and out the state. The lowest yields were received in September (15.5 tonnes) because of the rainfall, while the highest yields were received in November (180 tonnes) when the Dam of Jebl awlia was opened and the water declined from the lagoons and Bays.

Table 24: The monthly catch recorded at Kosti Station during 2007:

Month	Catch/tonnes	Percent
Jan	22.4	4
Feb.	37.4	6.7
March	70.7	12.7
April	24	4.3
May	33	5.9
Jun	39	7
July	27.2	4.9
August	21.1	3.8
September	15.5	2.8
October	20.8	3.7
November	97.8	35.5
December	48.2	8.7
Total	457.1	100

Source: Department of Fisheries W.N.S. (2007)

Table 25: The classification of monthly catch/tonnes recorded at Kosti

Station in 2007:

Month	Consumed at the state	Transported out of the state	Total
Jan	22.4	0	22.4
Feb.	22.4	15	37.4
March	25.7	45	70.7
April	6	18	24
May	18	15	33
Jun	15	24	39
July	8.2	19	27.2
August	6.1	15	21.1
September	15.5	0	15.5
October	13.8	6	20.8
November	17.8	80	97.8
December	21.2	27	48.2
Total	192.1	264	457.1

Source: Department of Fisheries W.N.S. (2007)
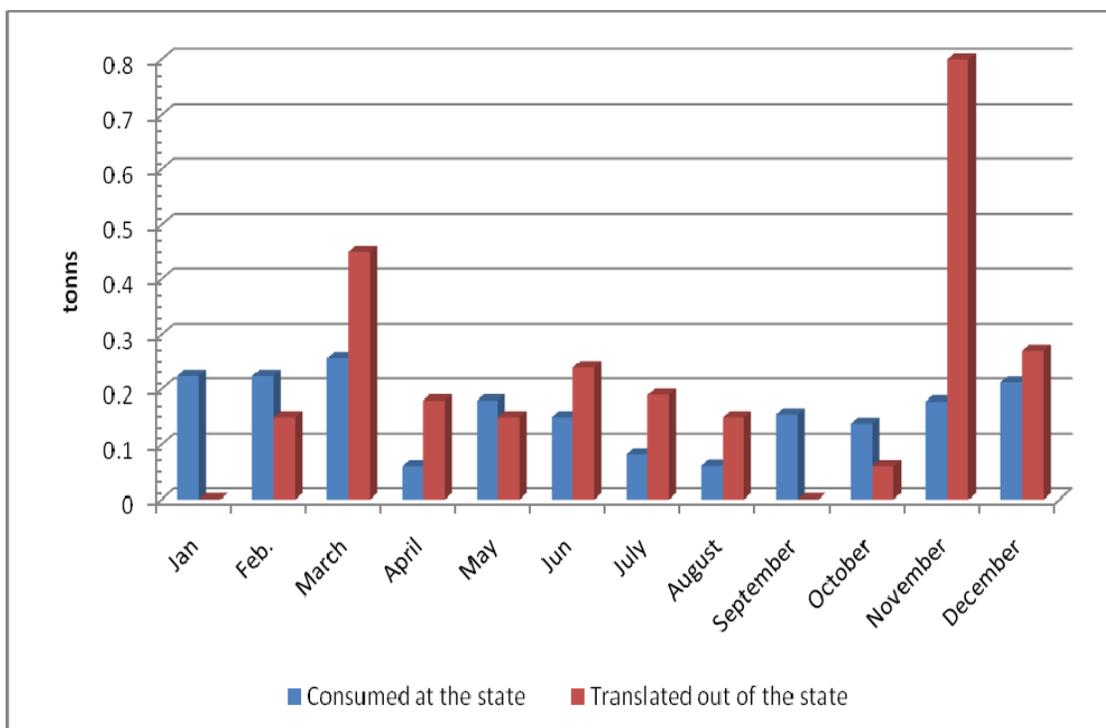
Figure (3) Comparing the monthly fish consumed and transported in
and out the State in 2007:

Table 26: Comparing the year fresh fish product
at Kosti Station 2005 - 2007:

Item	2005	2006	2007
Fresh fish	282.6	421.6	457.1
Dried	975.0	616.5	189.1
Salted	35.6	44.3	18.37
Total	**3298.2**	**3088.4**	**2671.57**

Source: Department of Fisheries W.N.S. report 2007

Table (26) shows that the fresh fish production has increased
annually, while the quantity of fish dried and salted decreased as a result of
the establishment of cold stores. The total production also decreased due to
over fishing.

36

Table 27: Total fish production at W.N.S. in October 2008

Spices Scientific name	Number unit	Weight K.G	Percentage from total weight
Lates niloticus	279	755.3	2.4
Bagrus docma	168	367.6	1.2
Bagrus bagrus	177	217	0.7
Tilapia sp	86211	22213.7	69.8
Labeo	3007	1000.9	3.2
Hydrocyon	181	132.9	0.4
Synodontis	3131	1426	4.5
Clarias	580	345.4	1
Disichod niloticus	567	987.6	3
Mormyrus niloticus	420	496	1.6
Others	5509	3866	12.2
Total	**100230**	**31808.4**	**100**

Source: Department of Fisheries W.N.S. (November 2008)

4-1-2 Prices

Fish prices in Sudan, are determined by the forces of supply and demand. The lowest prices are received in summer due to peak supply at that season while the highest prices are received in winter and autumn.

4-1-3 Gross returns

The average yield and prices were used to calculate the average annual returns/tone for both fishermen and fish mongers (transporters).

The result is presented in Table (29). The average annual gross retunes were found to be 52284.2 SDG and 525600 SDG for fishermen and transporters respectively.

Table 28: The total annual gross retunes:

Item	Fishermen (producer)	Monger (transporters)
Quantity of fish/tonne (production or purchasing)	13.76	72 .00
Price SDG/tonne	4200	8800
Total annual revenue	57792	633600

Source: field survey, (2008)

4-1-4 Variable costs of production

The following items were considered in the calculation of the variable costs for tonne/SDG of fresh fish production: labour cost – fish losses – cooling– transportation and taxes. Table (29) shows a breakdown of the average variable costs:

Table 29: The average variable costs for tone in SDG for the producer and merchant (wholesalers) at the White Nile State:

Items	Producer	%	Monger (wholesalers)	%
Labour cost	1266.57	74.64	37.5	0.67
Ice /cooling	100	5.89	600	10.76
Transportation	66.57	3.92	500	8.97
Taxes/fees	4.36	0.26	59.25	1.06
Fish purchase	0.00	0	4200	75.35
Fish losses (2.5%)	105	6.19	105	1.89
Cost of net	54.51	3.21	0.00	0
Other costs	100	5.89	72.22	1.3
Total	**1697.01**	**100**	**5573.97**	**100**

Source: field survey, (2008)

From table (29) it is obvious that labour cost scored the highest share in the total variable cost of production which was about 74% from total variable cost for producer - due to specific sharing system as mentioned earlier, while the cost of the labour for mongers (wholesalers) was about 0.67 %. The fish purchase value of fish for the monger has the highest share about 75 %.

The fish losses were ranked second for the producer, about 6 % , while for the monger about 1.9 %.

The other cost (unseen cost) that included (net mending and value of paddles) about 5% for producer, while for the monger other cost included (the increase of oil and fish prices, living during the journey) was represented only 1.3 %.

The ice/cooling cost came in the third place as with 5 % for the producer. On the other hand, the same cost for the monger about 10% from total variable cost due to the longer distance between the area of production (W.N.S.) and the capital.

while the fish net cost was incurred by the producer (fisherman) only and it represented 3%.The taxes/fees came last for both producer and monger as it scored 0.26% and 1.6 % respectively.

4-1-5 Fixed cost of production:

The fixed costs of production which are incurred only by the gear owners included one item as boat depreciation. The average price of a fishing canoe (Sharoog) that used by producer was about 900 SDG. The depreciation cost was found to be 300 SDG/year (based on 360 day/year and 3 years of services), the share of tone was 21.8 SDG/ year. The average price of Sunut boat (morkab) was about 9000 SDG, the

depreciation cost was found to be 1800 SDG/year (based on 360 day/year and 5 years of services), the share of tone was 25 SDG/ year, this boat used only by fishmonger.

4-1-6 Gross margin and net income:

Table 30: The average annual gross margin and net income for tonne in SDG:

Item	Producer (fisherman)	Monger (transporters)
(A) Average annual revenue	4200	8800
(B) Average annual variable costs	1697.01	**5573.97**
(C) Gross margin (A – B)	2502.99	3226.03
(D) Average annual fixed cost	21.8	25
(G) Net income (C – D)	2481.19	3201.03

Source: field survey, (2008**)**

4-2 Fish marketing

4-2-1 Introduction

The Sudan has considerable wealth of livestock and a favourable ratio of livestock to population. The development of the livestock marketing system could rectify the protein deficiency especially in rural areas and could provide cheaper and better meat for the urban areas.

The marketing system of agriculture and animal products including fish in the Sudan suffer from many problems resulting in increasing the cost of food especially for the low income consumers.

4-2-2 Fish market Channel

The market channel is defined as the sequence through which goods and services pass from the producer to the consumer (Mohamed Y.1999). The marketing channel for fresh fish at White Nile State is illustrated in Figure(3) which shows that a fisherman may sell his daily catch to local citizens at the river bank immediately after landing or to the local mongers who collect this fish and take it to the nearby market (at the State cities) using bicycles or any local transportation .

Another type of fish mongers were found to be using special cooled cars so as to ship the fish for longer distances supplying the capital or other main towns (Wad Medani and El Obied). Also the mongers deal with collecting boat (engine propelled boat that collect the fish from the scattered fishermen in order to handle and resell it to fish mongers at the capital Khartoum).

```
                    ┌─────────────────────────┐
                    │        Fisherman        │
                    └─────────────────────────┘

          ┌──────────────────────────────────────────┐
          │      Local Citizen at the River bank      │
          └──────────────────────────────────────────┘

  ┌─────────────────────┐              ┌─────────────────────┐
  │    Local Mongers    │              │   Collection Boat   │
  └─────────────────────┘              └─────────────────────┘

  ┌─────────────────────┐              ┌─────────────────────┐
  │    State Market     │              │     Fish Monger     │
  └─────────────────────┘              └─────────────────────┘

  ┌─────────────────────┐        ┌─────────────────────────┐
  │     Consumers       │        │     Wholesale Market    │
  └─────────────────────┘        └─────────────────────────┘

                    ┌─────────────────────┐   ┌─────────────────────┐
                    │     Wholesalers'    │   │      Retailers      │
                    └─────────────────────┘   └─────────────────────┘

          ┌─────────────────────┐   ┌─────────────────────┐
          │    Institutions     │   │      Consumers      │
          └─────────────────────┘   └─────────────────────┘
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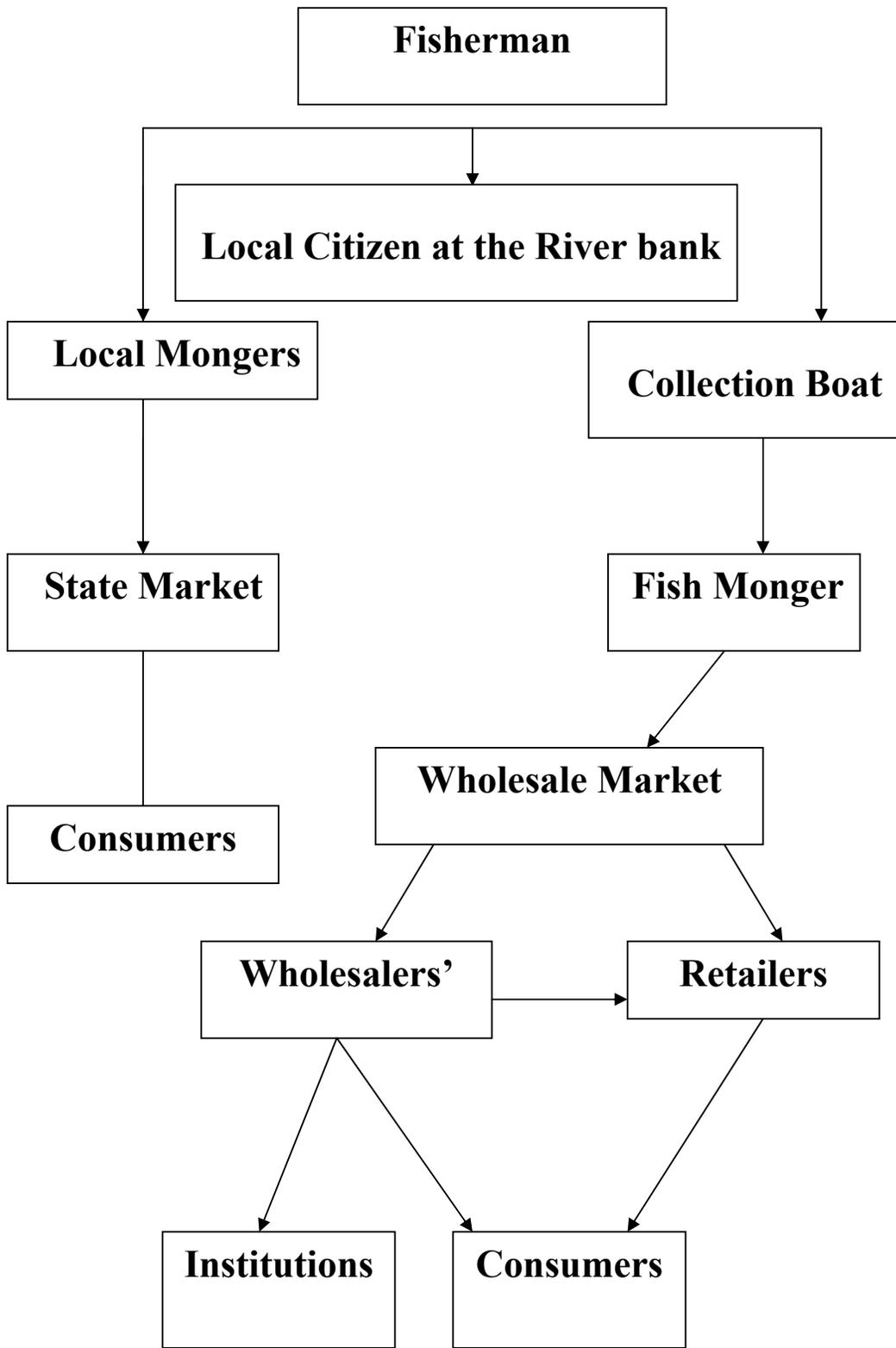
Figure (4): Fish marketing channel.

4-2-3 Market services:

Proper and quick handling is needed for fresh fish as it is a very perishable product especially under Sudan hot climatic conditions. But the existing fish marketing is practiced in traditional ways. Marketing functions include:

4-2-3-1 Transportation:

There are many constraints that face fish transportation in the Sudan in general. Transportation which is a physical function from the fishing boat in which the fishermen have no good preservation means for fish till it is handled to the consumers or fish mongers use water weeds to cover their catch. The cyclists fish mongers and those who use the local transportation means usually do not tend to use ice for fish preservation as they try to take it as quickly as possible to the nearest market. While those who ship the fish for long distances to reach the main consumption areas, had to use ice for fish preservation, and sawdust to fill the spaces between the crushed ice. The existing transportation method may cause great losses in weight especially during the summer season.

The number of ice blocks needed for one journey differs according to the size of the truck, distance between the site of production and consumption area and the season. A medium lorry (6 tonnes) takes about 300 block in summer, while in winter it needed 200 blocks only and the insulated truck needed just 150 flakes for a fishing journey from White Nile area to Khartoum State.

The non-existence of ice factories near the production sites added an extra transportation cost.

4-2-3-2 Storage

Storage of fish is a marketing function which can be performed by fish monger, and retailer. The retailer usually has ice boxes in which ice and sawdust are kept for fish preservation. Fish transporters practice storage by keeping the fish inside the vehicle till the whole quantity is sold.

4-2-3-3   Finance

Finance is an important facilitating function, most of interviewed fishermen or retailers do not want to be financed (especially from commercial banks) as they do not want to have the risk of being unable to repay due to the market fluctuation and their limited business. While the fish mongers (transporters) mentioned they are willing to be financed for fish transportation.

4-2-4 The Retail Markets

Khartoum central market represents the main market for fish trade which serve wholesalers and retailers. When fish transporters fail to sell all the catch they bring to Khartoum to the retailers they leave the unsold quantity, usually 1 to 1.5 tones, to the modern retailers who pay them about SDG 200.

4-2-5 Variable costs of fish at Khartoum central market

Variable costs of fish for retailers were estimated for three fish mongers at the central market. The first was for the modern retailers who incurred additional cost (cooling in refrigerators, cleaning place, packing)

and the second and three for traditional retailer's whole fish and deboned fish.

From the survey conducted at Khartoum central market the most important items of variable costs for fish marketing were as shown in Table (31).

Table 31: The average variable costs in tone/ SDG

Item	Modern retailer	%	Traditional retailer			
			Whole fish	%	Deboned fish	%
Fish purchase	10800	95.94	5700	97.02	5500	96.66
Ice /cooling	88	0.78	22.4	0.38	47.24	0.83
Locality fees	1.94	0.02	8.8	0.15	3.5	0.06
License and card	0	0	1.1	0.02	1.59	0.03
Fish losses (2.5 %) SDG/tone	220	1.95	142.5	2.43	137.5	2.42
Taxes fees	3.06	0.03	0	0	0	0
Zakat	2.78	0.02	0	0	0	0
Labour cost	40	0.36	0	0	0	0
Packing	14.29	0.13	0	0	0	0
Lease rent	86.67	0.77	0	0	0	0
Total	11256.74	100	5874.8	100	5689.83	100

Source: field survey, (2008)

4-2-6 Gross margin:

The annual gross margin for fish marketing by wholesalers, and retailers was shows in table (32 .

Table 32: Annual gross margin for tonnes / SDG:

Item	Modern retailer	Traditional Retailer	
		Whole fish	Deboned fish
(A) Average annual revenue	14500	7100	6300
(B) Average annual variable costs	11256.74	5874.8	5689.83
(C) Gross margin (A – B)	3243.26	1225.2	610.17

Source: field survey, (2008)

Table (32) shows that the average annual revenue for modern retailer was highest than traditional Retailer, and perhaps Gross margin for same commodity due to the services conduct by the modern retailer (cooling, packing, cleaning supply).

4-2-7 Marketing costs and margins of fish sold at Khartoum central market

Marketing cost and margins have been estimated for fish transportation journey from El Gabaleen area (White Nile State). This journey was directed to Khartoum Central Market. Table (33) shows that the fisherman's share of retailer's price was 39.62%, and marketing cost incurred by the fishermen was 6,9%. On the other hand the fishmongers (wholesalers) have gained and obligated the highest portion of the

retailer's price and the market cost as 83 and it incurred 24 % of the retailer's price as marketing cost. The retailer has incurred 6,22% of the retailer's price as marketing cost for fish originating from White Nile State production.

4-2-8 Market Structure:

Market structure is the organizational characteristics which determine the relation of sellers, buyers in the market to each other. The usual way of determining market structure is to measure the degree of concentration of sellers in the market.

From survey at Khartoum Central market there is:

1. Number of fish transporters from W.N.S.   =54 person
2. Number of sellers   = 98 "
   a. Wholesalers   = 10 person
   b. Retailers   = 88 "
3. The average purchases for wholesalers (1 – 2tonne) = 1.5 tonne
   The average purchases for retailers (200-300 kg)   = 250 kg
4. The whole quantities sold / day   = 40 tonne
5. Number of buyers on average   = 300 person
6. The market prices depends only on supply and demand force

Concentrating ratio = $\frac{(4)\ (1.5)\ (100)}{40}$ = 15%

There are large numbers of buyers and sellers that no one of them has significant influence. This means products offered by all suppliers are exactly alike.

I appraise the type of fish market was pure (perfect) competition.

Table 33: Marketing costs and margins of fish sold at Khartoum central market (SDG/ tonne)

Item	Value thousand SDG/tone		% of the retailer's prices	
1.Producer price	4200		**41.18**	**41.18**
Cooling and others	300		2,94	
Producer net margin		3900	38.24	
2. Fish monger (wholesalers) price	8800		86.27	
Cost item: A. Purchas price	4200		-	
B. Handling	62		0,61	
C. Cooling(Ice + Saw dust)	600		5,88	
D. Transportation	500		4,9	
E. Living	162		1,59	
F. Taxes	237		2,32	
G. Losses (decreasing weight 22,5 %)	945		9.26	
H. Collecting bout	037		0,36	
Total cost	6740	6740	**24.92**	**24.92**
Fish monger (wholesalers)net margin		2060	**20.21**	**20.21**
4. Retailers price	10200		100	
Costs item: A. Purchas price	8800		-	
B. Handling	037		0,36	
C. Cooling	88		0,86	
D. Losses (2,5 %)	220		2,16	
E. Others	312		3.06	
Total costs	9460	9460	**6,44**	**6,44**
Retailer's net margin		74	**7.25**	**7.25**
Total %				100

Source: Calculated by researcher (2009)

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATION

5.1 Summary:

The capture fisheries of Sudan (in land and marine fisheries) if well exploited, are expected to play a vital role in contributing to food security in the country.

The main objective of this study was to look into the economics of fish production and marketing at the White Nile State. Other objectives were:

Investigation of the fishermen socioeconomic characteristics, estimation of the total costs of production, calculation of the gross margins, and the marketing costs and margin.

The study depended mainly on primary data. Production and marketing surveys were conducted separately during the period March – November 2008. The respondents were interviewed directly through simple random sampling using structured questionnaires. The sample size selected was 39 fishermen and 21 fishmongers (fish transporters, wholesalers and retailers). To achieve the pre-determined goals of the study, some areas within the White Nile State were selected to represent the area of the study, beside Khartoum fresh fish markets. Fishing and marketing budgets were calculated. The statistical analysis of the socioeconomic characteristics revealed that all fishermen were above 55 years age. About 75 % of them were between 35 – 55 years of age (within the active age group), and only 15.4% of them were illiterate. About 80% of fishermen have more than 10 years experience, and about 59 % of them had inherited the job from their fathers. About 79 % of the fishermen had no other jobs beside fishing, while about 15 % of them practice farming

beside fishing. About 71 % of fishermen used shoorog boat and only 5 % mentioned that they used motor boat (almost in collecting boat). About 66 % of fishermen mentioned that the annual production decreased and more than 80 % of them agree that the main reason behind reduction of production is the over fishing in the area. All fishermen mentioned that their family women had no relation with fishing activities, about 50 % of the fishermen mentioned that their children worked with them and 92 % of him worked temporary.

All fishermen mentioned that the scarcity of proper fishing gear was their main problem, also the unavailability of ice factory and presence of water weeds were the big problems. All of fishermen said they did not receive any kind of services from Fishery Department during the last 5 year except extension services.

The main problems mentioned by the interviewed Fishery officers in the area were the lack of trained personnel and means of movement resulting in hindering them of practicing their duties of inspection and laws application.

The average daily catch was 48, 36 and 38 kg. during the Summer, Autumn and Winter season, respectively.

Fishing budget analysis showed that the average annual variable costs in tonne of production were SDG 1697.01, and SDG 6313.97 For the producer and fishmonger (wholesalers) respectively. The annual gross margins for the producer was SDG 2502.99 while for fishmonger was SDG 2386.03.

The average fixed costs of producer were found to be SDG 21.8 while for fishmonger (transporters) were 25 SDG.

The net fishing income for producer were SDG 2481.19, while for fishmonger were SDG 2361.03.

The analysis of variable costs of production revealed that the ice/cooling was the highest cost item followed by the transportation and fish net, while the highest variable cost item incurred by the transporters was the fish losses followed by the transportation. The only fixed cost incurred by both producer and transporters was the boats depreciation.

The marketing of fish in Sudan is practiced in traditional ways as compared to that found in other countries. Marketing services including transportation, storage, and finance are not conduct to an efficient marketing system.

The analysis of marketing costs and margins showed that the fishermen share of the consumer price was about 41.18% of the fish caught at the White Nile State and sold at Khartoum Central Market. The fish transporters gained the highest portion of the consumer price   (86.27 %) and they incurred 24.92%.

The high cost of marketing was due to the high cost of physical losses, cooling and transportation cost.

The study done at Khartoum central market showed that the marked was pure (perfect) competition.

Conclusions:

1. The analysis of the fishermen socioeconomic characteristics revealed that they used traditional fishing methods and their post catch handling of fish resulted in physical losses. Also it seems that their limited financial abilities were hindering them from improving their occupation. The fishermen's women had no clear role to play regarding the fishing activities. The fishermen unions seem not to have any effective role to improve the living conditions of its members.

2. The poor organization of fishers and their low socio-economic status has limited their political influence and effective participation in the development process.

3. The fishery department is suffering from major problems which threaten the fishery resources.

4. Extension, training and public awareness programmes are either lacking or poorly attended to.

5. The present marketing system of fish seems to be inefficient. The marketing costs and the profit margin especially for fish transporters is rather high, these resulting in lowering the fisherman's share and increasing the consumer price.

Recommendations:

The production of fish is constrained by many factors. To improve fisheries management for food security and socio-economic sustainable development the study recommends the following:

1. Rational utilization, conservation and development of fisheries and aquatic resources through sustainable management of production, restocking of depleted resources and pollution control.

2. Increase of productivity and efficiency of fishers and producers through research, technology development and transfer, and capacity building.

3. Establishment and development of fishers and producer organization, to enable them to have access to finance marketing facilities especially with regard to transportation and storage. The formatting of organizations will also help them to market product in groups to have more bargaining power and incur less marketing cost.

4. To protect the fish potential by enforcing rules of fishing regulations.

5. Development of infrastructural facilities.

6. To put more attention to extension services to give the fishermen all optimal information about fish production and resources conservation.

7. The fishery department should be urgently supported with the financial and physical facilities that make it capable of controlling all the fishing activities of the country.

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