GCP/RAF/271/FIN-TD/60 (En)

GCP/RAF/271/FIN-TD/60(En)

February 1997

SYNTHESIS OF THE 1995 SIMULTANEOUS FRAME SURVEY OF LAKE TANGANYIKA FISHERIES

by

P. PAFFEN, E. COENEN, S. BAMBARA, M. WA BAZOLANA, E. LYIMO AND C. LUKWESA

FINNISH INTERNATIONAL DEVELOPMENT AGENCY

FOOD AND AGRICULTURAL ORGANIZATION OF THE UNITED NATIONS

Mpulungu, February 1997

The conclusions and recommendations given in this and other reports in the Research for the Management of the Fisheries on the Lake Tanganyika Project series are those considered appropriate at the time of preparation. They may be modified in the light of further knowledge gained at subsequent stages of the Project. The designations employed and the presentation of material in this publication do not imply the expression of any opinion on the part of FAO or FINNIDA concerning the legal status of any country, territory, city or area, or concerning the determination of its frontiers or boundaries.

#### <u>PREFACE</u>

The Research for the Management of the Fisheries on Lake Tanganyika project (LTR) became fully operational in January 1992. It is executed by the Food and Agriculture Organization of the United Nations (FAO) and funded by the Finnish International Development Agency (FINNIDA) and the Arab Gulf Program for the United Nations Development Organization (AGFUND).

LTR's objective is the determination of the biological basis for fish production on Lake Tanganyika, in order to permit the formulation of a coherent lake-wide fisheries management policy for the four riparian States (Burundi, Tanzania, Zaïre and Zambia).

Particular attention is given to the reinforcement of the skills and physical facilities of the fisheries research units in all four beneficiary countries as well as to the build-up of effective coordination mechanisms to ensure full collaboration between the Governments concerned.

Prof. O.V. LINDQVIST LTR Scientific Coordinator Dr. George HANEK LTR Coordinator

LAKE TANGANYIKA RESEARCH (LTR) FAO B.P. 1250 BUJUMBURA BURUNDI

Telex: FOODAGRI BDI 5092

Tel: (257) 229760

Fax: (257) 229761

#### GCP/RAF/271/FIN PUBLICATIONS

Publications of the project are issued in two series:

\* a series of technical documents (GCP/RAF/271/FIN-TD)
related to meetings, missions and research organized by the
project;

\* a series of **manuals and field guides (GCP/RAF/271/FIN-FM)** related to training and field work activities conducted in the framework of the project.

For both series, reference is further made to the document number (01), and the language in which the document is issued: English (En) and/or French (Fr).

For bibliographic purposes this document should be cited as follows:

Paffen, P., E. Coenen, S. Bambara, M. Wa Bazolana, E. 1997 Lyimo, C. Lukwesa, Synthesis of the 1995 simultaneous frame survey of Lake Tanganyika Fisheries. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/60 (En) : 22p.

Ms. P. Paffen is an APO Fisheries Biologist at LTR/Mpulungu, Zambia; Mr. E. Coenen was Fisheries Statistician at LTR/Bujumbura in 1992-1995. Mr. S. Bambara is Head of Services of the Department of Fisheries in Bujumbura, Burundi. Mr. M. Wa Bazolana is Head of Fisheries Statistics at the Center for Hydrological Research in Uvira, Zaïre. Ms. E. Lyimo is Senior Scientist at the Fisheries Department in Dar es Salaam, Tanzania.

**Mr. C. Lukwesa** is a Fisheries Officer at the Department of Fisheries in Mpulungu, Zambia

## TABLE OF CONTENTS

LIST OF FIGURES	vi
LIST OF TABLES	vii
SUMMARY	viii
1. INTRODUCTION	1
1.1 Lake Tanganyika	1
1.2 The fisheries	1
1.2.1 Classification	1
1.2.2 The introduction of artisanal and	
industrial gear	2
1.2.3 Transport of fish	2
1.3 Lake-wide statistical surveys	3
1.4 Objective	3
2. METHODS	3
2.1 The frame survey in 1995	3
2.2 Status of the statistical information	
systems	3
	4
3.1 The fighing fleets	4
3 2 The fishing gears	5
5.2 me ribning gearb	5
4. DISCUSSION AND CONCLUSIONS	5
4.1 Characterization of the fisheries in 1995	5
4.2 Development of the fisheries	6
4.3 Recommendations	6
	_
5. ACKNOWLEDGMENTS	8
6. REFERENCES	9
	2
7. FIGURES AND TABLES	12

## LIST OF FIGURES

- Fig. 1: Lake Tanganyika, showing the areas in which the coast of each country was divided in March 1995, Districts, Regions and Provinces, major towns, rivers, roads and railways. -.-.- : international boundary ..... : regional boundary ====== : major road - - - - : railway
- Fig. 2: Contribution of the shoreline, the number of landing sites, fishermen, lamps, vessels and engines per country, Lake Tanganyika, March 1995.
- Fig. 3: Contribution of the number of fishing, auxiliary, transport and broken vessels at the landing sites and of the number of vessels out on Lake Tanganyika during FS 1995.
- Fig. 4: Composition of the fleet per country, Lake Tanganyika, March 1995.
- Fig. 5: Contribution of the number of traditional, artisanal and industrial gears per country, Lake Tanganyika, March 1995.
- Fig. 6: Composition of the traditional gears per country, Lake Tanganyika, March 1995.
- Fig. 7: Composition of the artisanal gears per country, Lake Tanganyika, March 1995.

## LIST OF TABLES

- Table 1: Summary of the results of the simultaneous FS of Lake Tanganyika, March 1995. The number of active vessels at the landing sites (IN) includes fishing, auxiliary (lamp carriers and helper boats) and transport vessels. The total number of vessels includes the active and inactive or broken vessels at the landing sites and the active vessels OUT on the lake during the survey.
- Table 2: The number of landing sites, fishermen, lamps, vessels and engines per 10 km of shoreline, Lake Tanganyika, March 1995.
- Table 3: The number of fishing, auxiliary, transport, broken, and absent vessels per 10 km of shoreline, Lake Tanganyika, March 1995.
- Table 4: Summary of the results of the simultaneous FS of Lake Tanganyika, March 1995. The number of inactive/broken vessels is included. All gears classified were active.

#### SUMMARY

In March 1995, the fisheries departments of Burundi, Tanzania, Zambia and the Center for Hydrological Research of Zaire, conducted the first simultaneous fishing village frame survey by classical means on Lake Tanganyika with help of the LTR.

In 1995, there were marked differences in the popularity of certain types of gear in different areas of the lake. The traditional fisheries used gill nets along the north and south coasts and hand lines on the west and east coasts. The artisanal fisheries used lift nets on the north, west and east coasts and kapenta beach seines on the south coast. The industrial fisheries were concentrated at Mpulungu.

It was concluded that the riparian fisheries departments of the riparian countries should collaborate closely to assure optimum sustainable yields for the fisheries over the entire lake. The statistical information systems of the riparian countries have the important role of providing catch and effort statistics for all fisheries. This information is essential to asses the impact of the fisheries.

#### 1. INTRODUCTION

#### 1.1 Lake Tanganyika

The lake is shared by four riparian states, Burundi, Tanzania, Zaïre and Zambia (Fig. 1).

The <u>Burundian</u> shoreline is 159 km long, 9% of the lake total. It comprises the Bujumbura, Bururi and Makamba Provinces in the north, middle and south. The capital of Burundi, Bujumbura, is situated at the lake shore. Other important harbours are Rumonge and Nyanza-lac in the middle and south.

The <u>Zaïrian</u> shoreline is 795 km long, 43% of the lake total. It is shared by the Uvira, Fizi, Kalemie and Moba Regions from the north to the south. The most important towns and harbours are Uvira, Baraka, Kalemie and Moba.

The <u>Tanzanian</u> shoreline is 669 km long, 36% of the lake total. It is shared by two administrative regions, Kigoma Region in the north and Rukwa Region in the south. Kigoma is the most important town and has the only harbour at the Tanzanian shore.

The <u>Zambian</u> shoreline is 215 km long, representing 12% of the total coastline of Lake Tanganyika. The east coast, south coast and west coast encompass Hore Bay in the Mbala District. Nsumbu and the coastline north of Cape Kapimbi encompass Cameron Bay in the Kaputa District. Mpulungu is the most important town and has the only harbour in Zambia.

## 1.2 The fisheries

#### 1.2.1 Classification

There are three types of fisheries in Lake Tanganyika (Challe and Kihakwe, 1994; Coenen, 1994a; Coulter, 1991; Katonda and Kalangali, 1994), namely:

- (1) the traditional fishery employing lusenga or scoop nets, gill nets, mosquito nets, long lines, hand lines, traps, spears and poisoning;
- (2) the artisanal fishery employing chiromilla seines, beach seines and lift nets;
- (3) the industrial fishery, one unit of which is made up of a steel purse seiner and 4 auxiliary vessels, 3 are small light boats (the total crew of the unit may be 20-40 fishermen).

Most seines and all lift nets, including the traditional lusenga net, are fished at night. Fishermen use lights to attract the fish. The traditional beach seines along the northern and middle shoreline of the lake operate during the day and catch mainly demersal fish. The kapenta beach seines in Zambia operate during the night catch mainly clupeids (kapenta). They are made with a netting normally used for codends with a stretched mesh size < 6 mm (Plisnier, 1995). Other artisanal gears have codends with a stretched mesh size of 6-8 mm. The stretched mesh size in the codend of purse seines is 10 mm.

## 1.2.2 The introduction of artisanal and industrial gears

The first artisanal gears were introduced in the 1950-60s. Lift nets were introduced in 1957 in Bujumbura (Katonda and Kalangali, 1994). The employment of lift nets spread southward to Zaïre and Tanzania. They were introduced to Kigoma by Burundian fishermen in 1972. In 1995 the use of lift nets was common along the entire Tanzanian (Paffen and Lyimo, 1996) and Zaïrian coasts (Mambona wa Bazolana, 1996). In Zambia a few lift nets operated before the 1990s although they had been constructed at Mpulungu in the late 1970s and 1980s (Cole, 1975; Hill, 1977). The artisanal fisheries in Zambia were restricted to inshore areas due to strong winds in the open water and a beach seine fishery developed (Paffen *et al.*, 1996).

The first purse seine was made in 1946 in Kalemie, but was quickly abandoned after poor catches (Katonda and Kalangali, 1994). The purse seine was introduced successfully in 1953 at Bujumbura and the Burundian and Zaïrian industrial fisheries expanded rapidly. The gear was used in Zambia (Mpulungu) from 1962 (Paffen *et al.*, 1996) and in Tanzania in the early 1970s (Coenen, 1994b).

## 1.2.3 Transport of fish

Locally traded clupeids and *Lates stappersii* are mainly sundried. Some *Lates* spp. and cichlids are smoked. Most industrial companies at Mpulungu have freezing facilities and export frozen fish to inland markets (Pearce, 1992). The former industrial fleet in Burundi sold most of their catch fresh at Bujumbura market (Paffen, 1994). In Burundi fish was quickly transported by car along the coastline (Fig. 1). Elsewhere along the lake shore roads are poor and the marketing of fish in excess of local needs is difficult (Coenen, 1993a).

## 1.3 Lake-wide surveys

LTR conducted the first lake-wide frame survey (FS) by aircraft from 29/9 to 3/10/1992 (Hanek *et al.*, 1993). The number of landing sites, transporters and fishing vessels were counted. The latter were divided into four categories: canoes, catamarans, trimarans and industrial units. The FS in 1995 was conducted on the ground.

## 1.4 Objective

The aim of this report is to present the results of the simultaneous FS carried out in March 1995.

## 2. METHODS

#### 2.1 The frame survey in 1995

In <u>Burundi</u>, the survey was executed by the Department of Water, Fisheries and Fish culture (DWFF) in Bujumbura. Two recorders and 1 supervisor visited all landing sites by boat and/or car on 27 February, 2, 6 and 10 March 1995 (Bambara, 1995).

In <u>Zaïre</u>, the survey was executed by the Center for Hydrological Research (CHR) at Uvira and the sub-regional office of the Ministry of Environment, Nature Conservation and Tourism (MENCT) at Kalemie. Three enumerators and one supervisor surveyed all landing sites by boat from 28 February to 22 March 1995 (Mambona wa Bazolana, 1996).

In <u>Tanzania</u>, the survey was executed by 45 FD local beach recorders and supervised by two officers from the Fisheries Department (FD) in Dar-es-Salaam (Paffen and Lyimo, 1996).

In <u>Zambia</u>, the survey was executed by the Department of Fisheries (DOF) in Mpulungu. Two teams, each consisting of two recorders and one supervisor, visited all landing sites by boat from 7 to 16 March 1995 (Paffen *et al.*, 1996).

The lakeshore of each country was divided into the same areas as used for statistical purposes during the aerial FS in 1992 (Fig. 1), and previously referred to as strata (Hanek *et al.*, 1993). In Burundi and Zambia the same areas were used as those of the fisheries departments and other fisheries projects (Bellemans, 1991; Pearce, 1990 and 1992). The LTR project provided the total cost of the survey, c. US \$ 10,800 (Coenen, 1994a). Examples of the French and English recording forms used are given in Appendix 1.

## 2.2 Status of the statistical information systems

There was no collaboration between the statistical units of Lake Tanganyika before LTR organized the First Workshop on the Coordination and Standardization of Fisheries Statistics in 1993 (Coenen, 1993b). For details concerning the administrative structure of the statistical units involved, see Bellemans (1991) and Coenen (1993b) for Burundi, Mambona Wa Bazolana (1995) for Zaïre, Paffen and Lyimo (1996) for Tanzania and Pearce (1990 and 1992) and Paffen *et al.*, (1996) for Zambia.

## 3. RESULTS

Results are summarized in Table 1 and 2. The more detailed data have been presented by Bambara (1995) for Burundi, by Mambona wa Bazolana (1996) for Zaïre, by Paffen and Lyimo (1996) for Tanzania and by Paffen *et al.* (1996) for Zambia. The only part of the lake shore that was not monitored was area V in Zambia, 10 km from Cape Kapimbi to the Zairian border.

## 3.1 The fishing fleets

In total, 786 landing sites, 44,957 fishermen and 20,379 lamps were recorded (Table 1). There were 19,356 vessels of which 1,113 were out on the lake during the survey. Of the 18,243 vessels met at the landing sites, 2,263 were broken. The other 15,980 vessels were active fishing vessels (13,192), auxiliary lamp carriers/helper boats (2,256) and transport vessels (532). There were 1,264 motorized vessels recorded at the landing sites.

Most landing sites (53%), fishermen (59%), lamps (38%) and vessels (59%) were recorded in Zaïre which constitutes the largest part of the lake shore (43%) (Fig. 2). Zaïre had the highest density of landing sites, fishermen and vessels on the lake (5.2, 331 and 144/10 km) with the most dense distribution of fishermen and vessels in the Uvira District (734 and 346/10 km) (Table 2). Zambia also had an average density of 5.2 landing sites per 10 km of shoreline with the most dense distribution on the east coast and in the Mpulungu area (7.4 and 10.4/10 km). Burundi had the highest density of lamps and engines on the lake (154 and 15.2/10 km) with the most dense distribution of engines on the middle coast (30.7/10 km). The most dense distribution of lamps was recorded locally in the Uvira District (614/10 km).

Most fishing (66%), transport (65%) and absent vessels (79%) were recorded in Zaïre (Fig. 3). Zaïre also had the highest density of fishing, transport and absent vessels on the lake (110, 4.3 and 11/10 km) with the most dense distributions in the Uvira District (204, 20 and 48/10 km) (Table 3). Zambia had the highest density of auxiliary vessels on the lake (24/10 km) with the most dense distribution in the Mpulungu area (40/10 km). Burundi had the highest density of broken vessels on the lake (22/10 km) with the most dense distribution on the north coast (33/10 km).

The 16,973 vessels classified at the landing sites were wooden/planked canoes (60%), catamarans (19%), dugout canoes (19%), metal canoes (1%), industrial units (0.3%), fibre-glass canoes (0.2%) and trimarans (0.1%) (Table 4). Figure 4 shows the composition of the fleets per country. The largest part of the fishing fleet in all riparian states were planked canoes (> 47%), especially in Zambia (90%). On the north and east coasts of the

lake, in Burundi and Tanzania, a substantial part of the fishing fleets were catamarans (47% in Burundi and 25% in Tanzania). On the west and east coasts and in the middle of the lake, in Zaïre and Tanzania waters, dugout canoes were common (24% and 12%).

## 3.2 The fishing gears

The number of traditional gears employed in Burundi was 44% and in other countries > 85% of the total (Fig. 5). Fifty-six per cent of the gears operated in Burundi and < 15% in other countries were artisanal. The number of industrial gears were < 1% to the total number of gears employed in all countries.

The <u>traditional</u> gears consisted of 20,744 lines, 6,300 gill nets, 316 lusenga nets and 13 traps (Table 4). The most used was the gill net in Zambia (80%) and Burundi (45%) and lines in Zaïre (98%) and Tanzania (69%) (Fig. 6). The distinction between hand and long lines made in Zaïre (see Mambona wa Bazolana, 1996) was incorrect. Indicated were hand lines and longer lines which could be hand or long lines. True long lines are bottom set while hand lines are used vertically (see Challe and Kihakwe, 1996). In the other countries < 5% of all lines were long lines. The number of traps counted at the landing sites were under-estimated as most traps are submerged for a week. The number of traps employed could only be assessed by questioning the fishermen at the landing sites.

The <u>artisanal</u> gears consisted of 2,973 lift nets, 1,143 traditional beach seines, 154 kapenta beach seines, 128 Apollo lift nets and 16 chiromilla seines (Table 4). Zambia was the only country in which kapenta beach seines (68% of the total) and chiromilla seines were used and it was the only country which did not use Apollo lift nets. The most common artisanal fishing gear in Burundi, Tanzania and Zaïre was the lift net (79%, 70% and 68% of the total) (Fig. 7).

A total of 52 <u>industrial</u> units were stationed at the lake (Table 4) of which 24 were not operational in March 1995. Of the operational units 16 were in Zambia (15 based at Mpulungu and 1 at Isanga). Zaïre had 6 operational units (3 at Baraka and 3 at Kalemie). Tanzania had 4 operational units (3 at Kigoma and 1 at Kirando). Burundi had 2 operational units (1 at Rumonge and 1 at Muguruka).

#### 4. DISCUSSION AND CONCLUSIONS

#### 4.1 Characterization of the fisheries in 1995

In 1995, the fisheries along the lake shore generally employed similar types of vessels and gears, with the planked canoe being the most popular. However, there existed marked differences in the popularity of certain types of vessels and gears employed in different areas of the lake. The traditional fisheries used mainly gill netting on the north and south coasts and hand lining on the east and west coasts. The artisanal fisheries employed lift nets on the north, west and east coasts and kapenta beach seines on the south coast. More than half of the industrial fishing fleet was concentrated at Mpulungu on the south coast. The highest densities of fishermen, fishing lamps and fishing and transport vessels were recorded at Uvira on the north coast.

## 4.2 The development of the fisheries

The introduction of the artisanal gears in the 1950-1970s stopped the growth of the traditional fleets while the number of vessels employing the more effective artisanal gears increased (Paffen and Lyimo, 1996; Paffen *et al.*, 1996). Before the 1980s, clupeids had been the main target of the traditional fisheries in Burundi and Zambia (Paffen *et al.*, 1996). The most effective and popular traditional fishing method to catch clupeids had been lusenga netting. The number of lusenga nets used in Tanzania had decreased from c. 8,000 in the 1960s to 271 in 1995 (Paffen and Lyimo, 1996). Alternative traditional gears, such as the gill net, catch other fish than clupeids in smaller quantities.

The artisanal lift net fishery employs cheaper vessels and gears, using less fuel and fishermen than the industrial purse seine fishery (Coenen and Nikomeze, 1994). In Burundi, the interaction between these two competing fleets probably resulted in the collapse of the economically less viable industrial fisheries. In Zambia, the popular kapenta seine is operated closer to shore and does not compete directly with the industrial fisheries. Juvenile L. miodon is the main species targeted by kapenta seining in Zambia (Plisnier, 1995; Paffen *et al.*, 1996). Lift nets and chiromilla seines catch adult stages of both S. tanganicae and L. miodon and are generally more appropriate for the sustainable exploitation of clupeids than kapenta seines.

The development of a fishery generally has a stimulating effect on the production of fish as long as the fishing pressure does not become too heavy. Over-fishing occurs when the effort is so high that the total yield decreases with increasing effort which may eventually lead to stock collapse when the parent stocks can not recover (Hillborn and Walters, 1992; Sparre and Venema, 1992). The yield of the industrial fisheries in Zambia appears to have declined in the 1990s, whereas the number of industrial units has increased sharply between 1983 and 1995, indicating over-exploitation (Paffen *et al.*, 1996).

## 4.2 Recommendations

The riparian fisheries departments should collaborate closely to assure optimum sustainable yields for the fisheries over the entire lake. The statistical information systems of the riparian countries have the important role to provide the catch and effort statistics of all fisheries essential to asses their impact on the fish production in Lake Tanganyika. The execution of proper statistical surveys is difficult due to poor transportation facilities in most parts of the lake. This is especially apparent for the 43% of the lake in Zaïre where no functional monitoring system exists (Mambona Wa Bazolana, 1995).

All riparian countries should combine efforts to conduct tri annual simultaneous FS which cover the entire lake shore. Funds should be raised in time. The next simultaneous FS should be carried out in March 1998. It is advisable to use the same method as used in 1995.

## 5. ACKNOWLEDGMENTS

We thank all persons involved in the execution of the simultaneous frame survey conducted in 1995 at Lake Tanganyika.

We wish to express special thanks to Dr. J. Craig and Dr. G. Hanek for discussing and editing this report.

#### 6. REFERENCES

- Bambara, S., Rapport sur L'Enquête cadre simultanée pour le Lac 1995 Tanganyika, Burundi. FAO/FINNIDA Recherche pour l'Aménagement des Pêches au Lac Tanganyika. GCP/RAF/271/FIN-FM/39 (Fr): 36p.
- Bellemans, M., Structural characteristics of the Burundian 1991 fisheries in 1990 and historical review. UNDP/FAO Regional Project for Inland Fisheries Planning (IFIP). RAF/87/099-TD/25/91 (En): 37p.
- Challe, N.A. and A.D.B. Kihakwe, TAFIRI catalogue of fishing gears for the Kigoma and Rukwa Regions of Lake Tanganyika. In: Coenen, E.J., Historical data report on the fisheries, fisheries statistics, fishing gears and water quality of Lake Tanganyika (Tanzania). FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/15 (En): 115p.
- Coenen, E.J., Field guide containing maps of the Lake 1993a Tanganyika shoreline. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-FM/01 (En & Fr): 89p.
- Coenen, E.J., Report on the first Workshop on the Coordination and Standardization of fisheries statistics for Lake Tanganyika. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/11 (En): 10p.
- Coenen, E.J., Report on the first fisheries statistical 1994a coordinators meeting for Lake Tanganyika, 12-13.12.1994, Bujumbura (Burundi). FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/28 (En): 28p.
- Coenen, E.J., Semi-industrial fishing on Lake Tanganyika, with
  special reference to the fisheries statistics of
  the semi-industrial fishing fleet in Kalemie (Zaïre),
  10.92-11.93. FAO/FINNIDA Research for the Management
  of the Fisheries on Lake Tanganyika.
  GCP/RAF/271/FIN-TD/16 (En): 39p.
- Coenen, E.J. and E. Nikomeze, Lake Tanganyika, Burundi, 1994 results of the 1992-1993 catch assessment surveys. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/24 (En): 27p.
- Cole, R.C., Republic of Zambia, fisheries education and 1975 training. FAO Fisheries Training and Development Project. ZAM/73/009/1: 42p.

Coulter, G.W., Lake Tanganyika and its life. Oxford University 1991 Press, ISBN 0-19-858525 X (En): 354p.

- Hanek, G., E.J. Coenen and P. Kotilainen, Aerial frame 1993 survey of Lake Tanganyika fisheries. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/09 (En): 34p.
- Hill, K.H., Zambia, artisanal fishing. FAO Fisheries
  1977 Training and Development Project. ZAM/73/009/5, 48p.
- Hillborn, R. and C.J. Walters, Quantitative fisheries stock 1992 assessment. Chapman and Hall, ISBN 0412022710 (En), 570p.
- Katonda, K.I. and A.N.M. Kalangali, Historical review of the artisanal and industrial fisheries of Lake Tanganyika. In: Coenen, E.J., Historical data report on the fisheries, fisheries statistics, fishing gears and water quality of Lake Tanganyika (Tanzania). FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/15 (En): 115p.
- Mambona wa Bazolana, C., Données historiques sur les statistiques et économie de pêche de la partie zaïroise du Lac Tanganyika. In: Coenen, E.J., Historical data report on the fisheries statistics, limnology, bromatology, zooplankton and fish biology and scientific publications review of Lake Tanganyika (Zaïre). FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/31 (En & Fr): 153p.
- Mambona wa Bazolana, C., Enquête cadre simultanee pour le Lac 1996 Tanganyika, Zaïre. FAO/FINNIDA Recherche pour l'Aménagement des Pêches au Lac Tanganyika. GCP/RAF/271/FIN-TD/47 (Fr): 100p.
- Paffen, P., Station report, fish biology, LTR/Bujumbura, Karonda, 1994 Uvira, Kalemie and Moba. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/FIN/271/FIN-Station Report: 17p.

- Paffen, P. and E. Lyimo, Frame survey results for the Tanzanian coast of Lake Tanganyika, March 1995, and comparison with past surveys. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/49 (En): 36p.
- Paffen, P. and C. Lukwesa and L. Mwape, Frame survey results for 1996 the Zambian coast of Lake Tanganyika, March 1995, and comparison with past surveys. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/52 (En): 92p.
- Pearce, M.J., A comparison of the pelagic fisheries of Burundi and Zambia on Lake Tanganyika. UNDP/FAO Regional Project for Inland Fisheries Planning (IFIP). RAF/87/099 (En): 20p.
- Pearce, M.J., The results of a survey of the fisheries of the 1992 Zambian waters of Lake Tanganyika. UNDP/FAO Regional Project for Inland Fisheries Planning (IFIP). RAF/87/099/WP-13/92 (En): 44p.
- Plisnier, P.D., Catch Assessment survey in Zambian waters of 1995 Lake Tanganyika in 1994. FAO/FINNIDA Research for the Management of the Fisheries on Lake Tanganyika. GCP/RAF/271/FIN-TD/41 (En): 26p.
- Sparre, P. and S.C. Venema, Introduction to tropical fish stock
  1992 assessment. Part I Manual.
  FAO Fisheries Technical Paper 306/1 Rev. 1: 376p.



- ----: international boundary .....: regional boundary ====== : major road
  - - : railway



Fig. 2: Contribution of the shoreline, the number of landing sites, fishermen, lamps, vessels and engines per country, Lake Tanganyika, March 1995.



Fig. 3: Contribution of the number of fishing, auxiliary, transport and broken vessels at the landing sites and of the number of vessels out on Lake Tanganyika during FS 1995.



Fig. 4: Composition of the fleet per country, Lake Tanganyika, March 1995.



Fig. 5: Contribution of the number of traditional, artisanal and industrial gears per country, Lake Tanganyika, March 1995.



Fig. 6: Composition of the traditional gears per country, Lake Tanganyika, March 1995.



Fig. 7: Composition of the artisanal gears per country, Lake Tanganyika, March 1995. Table 1: Summary of the results of the simultaneaous FS of Lake Tanganyika, March 1995. The number of active vessels at the landing sites (IN) includes fishing, auxiliary (lamp carriers and helper boats) and transport vessels. The total number of vessels includes the active and inactive/broken vessels at the landing sites and the active vessels OUT on the lake during the survey.

	Í				4			TOTAL	N	No. of ACTIN	/E	No. of	No. of	No. of	No. of	No. of
AREA	LOCATION	LATITUDE	COAST	COAST	No.of	No.of	No.of	No.of	FISH VS.	AUX. VS.	TRANSP.	ACT. VS.	BROK. VS.	ALL VS.	ACT. VS.	ENGINES
			KM	%	L. SITES	F. MEN	LAMPS	VS.	IN	IN	<u>IN</u>	IN	IN	IN	OUT	
I.	North Coast	03°20'30"s - 03°39'00"s	51	32	23	510	422	562	275	81	14	370	166	536	26	7
1	Middle Coast	03°39'00"s - 04"00'20"s	46	29	11	873	1.079	401	311	16	7	334	62	396	5	141
111	South Coast	04°00'20"s - 04°26'40"s	62	39	20	638	943	443	266	26	8	300	117	417	25	93
	Buiumburn Drau	02*20*20*** 02*45*00**			26	070	1 020	705	900	00	16	400	100	675	90	40
	Burun Drov	03°45'00"e "04°09'00"e			12	454	521	327	246	9	5	260	57	217	10	40
	Makamba Prov	04'09'00"s - 04'26'40"s			16	588	895	374	219	26	Ř	253	105	358	16	82
												200				UL .
-	Bur. total	03°20'30"s - 04°26'40"s	159	100	54	2,021	2,444	1,406	853	123	29	1,005	345	1.350	56	241
1	Uvira District	03°21'00"s - 03°30'00"s	24	3	9	1,762	1,473	830	489	94	48	631	83	714	116	68
II-V	Fizi District	03°30'00"s - 05°00'00"s	271	34	130	4,749	3,449	2,911	1,969	422	121	2,512	181	2,698	218	160
VI-VIII	Kalemie District	05°00'00"s - 06°30'00"s	210	26	122	6,397	2,593	2,675	1,939	195	105	2,239	225	2,464	211	111
IX-XII	Moba District	06°30'00"s - 08°13'40"s	290	36	156	13,400	197	4,991	4,331	0	60	4,391	268	4,659	332	66
۴V	Sud-Kivu Prov.	03°21'00"s - 05°00'00"s	295	37	139	6.511	4.922	3,741	2.458	516	169	3.143	264	3.407	334	228
VI-XI	Shaba Prov.	05°00'00"s - 08°13'40"s	500	63	278	19,797	2,790	7,666	6,270	195	165	6,630	493	7.123	543	177
1 1	Tain tatal	00101100*** 00110/40**	705	100	417	26 000	7 710	11 407	0 710	744	044	0.770	757	10.500	077	445
	Zaur. total	03 21 00 5 - 08 13 40 5	785	100	417	20,308	1,112	11,407	0,710			9,773	/6/	10,530	6//	415
HV	Kigoma Region	04°26'00"s - 06°30'00"s	312	47	103	7,644	6,073	8,013	1,732	547	32	2,311	675	2,986	27	354
V-IX	Rukwa Region	06°30'00"s - 08°36'00"s	357	53	105	4,866	1,562	1,853	1,115	374	65	1,554	236	1,790	63	140
ĿХ	Tanz, total	04*26'00"s - 08*36'00"s	669	100	208	12.510	7.635	4,866	2.847	921	97	3.865	911	4.776	90	494
					ļ	-									·	
1	East Coast	08°36'00"s - 08°43'40"s	26	12	19	911	405	364	209	67	23	299	44	343	21	43
H	Mpulungu Area	08°43'40"s - 08°48'30"s	26	12	27	1,354	1,322	473	231	104	13	348	83	431	42	40
10	West Coast	08°48'30"s - 08°29'10"s	64	30	30	882	351	374	188	115	4	307	59	366	8	5
IV	Nsumbu Area	08°29'10"s - 08°17'30"s	89	41	31	971	510	466	146	215	22	383	64	447	19	26
v	Zairean border	08°17'30"s - 08°13'40"s	10	5					·	n	ot monitored					
HII	Mbala District	08°36'00"s - 08°29'10"s	116	54	76	3,147	2,078	1,211	628	286	40	954	186	1,140	71	88
IV	Kaputa District	04°29'10"s - 08°17'30"s	89	41	31	971	510	466	146	215	22	383	64	447	19	26
HV	Zamb. total	04°26'00"s - 06°30'00"s	205	95	107	4,118	2,589	1,677	774	501	62	1,337	250	1,587	90	114
			1 020		700	44.057	20 270	10.050	10.100	2 25 6		15.000	2 200	10.240	1 110	1 264
			1,028		/60	44,307	20,379	19,000	10,192	2,200	03Z	15,960	2,203	10,243	1,113	1,204

LOCATION	COAST KM	No.of L. SITES/10 KM	No.of F. MEN/10 KM	No.of LAMPS/10KM	TOTAL No.of VS./10 KM	No. of ENGINES/10 KM
North Onwest	<b>F1</b>	45	100			
North Coast		4.5	100	83	110	1.4
Middle Coast	40	2.4	190	235	87	30.7
South Coast	62	3.2	103	152	71	15.0
Bur. total	159	3.4	127	154	88	15.2
Uvira District	24	3.8	724	614	246	20.2
Fizi District	271	4.8	175	127	340	28.3
Kalemie District	210	5.8	305	127	107	5.9
Moba District	290	5.0	462	7	172	2.3
mobu bistriot	200	<b>U</b> .न	402	'	172	2.3
Sud-Kivu Prov	295	47	221	167	127	77
Shaba Prov.	500	56	396	56	153	35
		0.0	000	50		0.5
Zair. total	795	5.2	331	97	143	5.2
Kigomo Bogion	212	2.2	245	105	07	
Rubus Bagion	312	3.3	245	195	97	11.3
Nukwa negion	357	2.9	130	44	52	3.9
Tanz. total	669	3.1	187	114	73	7.4
Fast Coast	26	73	350	156	140	16.5
	26	10.4	521	509	140	10.0
West Coast	64	47	138	55	59	15.4
Nsumhu Area	89	35	100	57	50	0.0
Zairean border		<u> </u>	105	onitored	J2	2.9
Lancan border				Ionitoreu	I	
Mbala District	116	66	271	179	104	76
Kaputa District	89	3.5	109	57	52	29
				Ŭ,	02	2.0
Zamb. total	205	5.2	201	126	82	5.6
Lake total	1,828	4.3	246	111	106	6.9

## Table 2: The number of landing sites, fishermen, lamps, vessels and engines per 10 km of shoreline, Lake Tanganyika, March 1995.

# Table 3: The number of fishing, auxiliary, transport, broken and absent vessels per 10 km of shoreline, Lake Tanganyika, March 1995.

	LOCATION COAS		No. of	No. of	No. of	No. of	No. of
LOCA			FISH VS.	AUX. VS.	TRANSP.	BROK. VS.	ACT. VS.
		КМ	IN/10 KM	IN/10 KM	IN/10 KM	IN/10 KM	OUT/10 KM
		1					
North (	Coast	51	53.9	15.9	2.7	32.5	5.1
Middle	Coast	46	67.6	3.5	1.5	13.5	1.1
South	Coast	62	42.9	4.2	1.3	18.9	4.0
Bur. 1	total	159	53.6	7.7	1.8	21.7	3.5
Uvira D	HSTRICT	24	203.8	39.2	20.0	34.6	48.3
Fizi Di	strict	2/1	/2./	15.6	4.5	6.7	8.0
Kalemie	District	210	92.3	9.3	5.0	10.7	10.0
Moba L	District	290	149.3	0.0	2.1	9.2	11.4
Curd Kin	-	005					
Sud-Kivi	u Prov.	295	83.3	17.5	5.7	8.9	11.3
Shaba	Prov.	500	125.4	3.9	3.3	9.9	10.9
7	- 4- 1	705	100 7				
Zair. 1	lotal	795	109.7	8.9	4.3	9.5	11.0
Kigoma I	Begion	312	55.5	17.5	10	21.6	0.0
Bukwa F	Region	357	31.2	10.5	1.0	66	1.9
r tanti a r	legion	001	01.2	10.5	1.0	0.0	1.0
Tanz	total	669	42.6	13.8	14	126	1.2
, citiz.		000	72.0	10.0	1.4	13.0	1.0
East C	oast	26	80.4	25.8	8.8	16.9	81
Mpulung	u Area	26	88.8	40.0	5.0	31.9	16.2
West C	òast	64	29.4	18.0	0.6	9.2	1.3
Nsumbu	Area	89	16.4	24.2	2.5	7.2	2.1
Zairean I	border				not monitor	ed	
Mbala D	District	116	54.1	24.7	3.4	16.0	6.1
Kaputa [	District	89	16.4	24.2	2.5	7.2	2.1
Zamb.	total	205	37.8	24.4	3.0	12.2	4.4
Lake t	otal	1,828	72.2	12.3	2.9	12.4	6.1

	ACTIVE AND BROKEN										ACTIVE											
	TYPE OF VESSEL										IND. GEAR ARTISANAL GEARS TRADITIONAL GEARS											
LOCATION	DUGOUT CAN.	W./PL. CAN.	MET. CAN.	F. GL. CAN.	NO. 01 CAT.	TRIM.	No. of IND. UNITS	No. of TRANSP. CAN.	No. of AUX. CAN.	ALL VESSELS IN	No. of PURSE SEINES	No. of CHIR. SEINES	No. of DAY BEACH S.	No. of NIGHT BEACH S.	No. of LIFT NETS	No. of APOLLO L. NETS	No. of LUSENGA NETS	No. of GILL NETS	No. of LONG LINES	No. of HAND LINES	Tot. No.of LINES	No. of TRAPS IN
North Coast	4	291	71	0	156	0	1	14	incl.	537	0	0	11	0	120	2	37	103	1	55	56	0
Middle Coast	12	96	15	0	265	0	1	7	ind.	396	1	D	1	0	199	43	0	36	Ó	82	82	õ
South Coast	30	156	10	3	209	0	1	8	ind.	417	1	0	3	0	119	56	0	57	8	56	64	0
Bujumbura Prov.	6	323	77	0	253	0	1	16	incl.	676	0	0	11	0	210	5	37	112	1	92	93	٥
Bururi Province Makamba Prov	18	88	13	0	192	0	1	5	inci.	317	1	0	2	0	125	43	0	42	0	58	58	0
Wakamba Prov.	~~~	102		0	165	Ų	1	8	Incl.	30/	1	0	2	0	103	53	0	42	8	43	51	0
Burundian tolal	46	543	96	3	630	0	3	29	ind.	1,350	2	0	16	0	438	101	37	196	9	193	202	0
Uvira District	165	136	2	0	253	0	4	48	106	714	0	0	6	0	248	a	0	17			142	
Fizi District	1,039	583	5	0	515	0	3	121	427	2,693	3	0	178	ò	493	21	8	111	No dist	tinction	1.267	ě
Kalemie District	1,004	528	12	0	592	0	13	105	210	2,464	3	0	256	0	590	2	0	99	betwee	n hand	1,296	Ō
MODA DISEICE	340	4,208	2	0	29	U	2	60	18	4,659	0	0	161	0	19	0	a	10	and lor	ng lines	9.925	0
Sud-Kivu Province	1,204	719	7	0	768	0	7	169	533	3,407	3	0	184	0	741	21	8	128			1,409	9
Shaba Province	1,349	4,731	14	0	621	O	15	165	228	7,123	3	0	417	0	609	2	0	109			11,221	0
Zairean total	2,553	5,450	21	0	1,389	0	22	334	761	10,530	6	0	601	0	1,350	23	8	237			12,630	9
Kigoma Region	550	1,589	0	0	778	16	3	50	incl.	2.986	3	0	216	0	760	2	252	1.948	38	1.945	1 983	
Rukwa Region	27	1,245	1	1	416	3	1	96	ind.	1,790	1	0	280	0	398	2	19	969	372	4,802	5,174	ŏ
Tanzanian total	577	2,834	1	1	1,194	19	4	146	incl.	4,776	4	Q	496	0	1,158	4	271	2,917	410	6,747	7,157	0
Easl Coast	2	327	4	1	8	0	1	ind.	incl.	343	1	6	10	29	8	0		574	1	251	252	
Mpulungu Area	2	308	81	4	15	0	21	ind.	incl.	431	15	1	6	81	15	õ	õ	1.119	14	276	290	õ
West Coast	29	334	0	2	1	0	0	incl.	ind.	366	0	0	4	61	1	0	Ó	666	1	133	134	ō
Nsumbu Area	13	409	1	19	4	0	1	incl.	inel.	447	0	9	10	43	3	0	0	591	8	71	79	1
2419411001491											Not mo	nitored										
Mbala District	33	969	85	7	24	Q	22	ind.	ind.	1,140	16	7	20	111	24	0	0	2,359	16	660	676	3
Kapula Diselici	13	409	1	19	4	u	1	ind.	ind.	447	0	9	10	43	3	0	0	591	8	71	79	1
Zambian total	46	1,378	86	26	28	0	23	ind.	incl.	1,587	16	16	30	154	27	0	0	2,950	24	731	755	4
Lake total:	3,222	10,205	204	30	3,241	19	52			18,243	28	16	1.143	154	2,973	128	316	6,300			20,744	13
% per type: Total classified:	19.0 16,973	60.1	1.2	0.2	19.1	0.1	0.3		I	. 1												

Table 4: Summary of the results of the simultaneaous FS of Lake Tanganyika, March 1995. The number of inactive/broken vessels is included. All gears classified were active.

GCP/RAF/271/FIN-TD/60 (En)