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REGIONAL FRAMEWORK PLANNING FOR LAKE TANGANYIKA FISHERIES MANAGEMENT

by

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PREFACE

The Research for the Management of the Fisheries on Lake Tanganyika project (Lake Tanganyika Research) 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 Programme for United Nations Development Organizations (AGFUND).

This project aims at 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, Democratic Republic of Congo and Zambia).

Particular attention will be also 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.

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TABLE OF CONTENTS

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1. INTRODUCTION

Understanding the immensely complex patterns and processes underlying Lake Tanganyika's fisheries clearly requires a broad, ecosystem-wide perspective. Yet the lake's vast size and remoteness can pose considerable logistical difficulties for the conduct of comprehensive, basin-scale physical and biological investigations or any other fisheries-related studies. Modern political boundaries dividing the lake between the different national sectors of Burundi, the Democratic Republic of Congo (DRC), Tanzania, and Zambia add a further dimension of complication to the organisational picture. Difficulties notwithstanding, a great deal of information has accumulated over the years on the geology, limnology, species composition, and other aspects of the lake and its fisheries. Pioneering studies date back to the late 19th and early 20th centuries, and extensive work of varying degrees of scale and ambition and covering a wide range of disciplines has since been carried out through numerous special projects and expeditions.[1]

Considerable initiatives have been taken from the early 1960s in fisheries research, technical assistance, and institution building within the Lake Tanganyika basin, under the new national development agenda of the post-independence era. However, these have mostly been organised as country-specific projects. Though of potential benefit to particular national sectors and resource user interest groups, from a regional point of view they have tended with few exceptions to operate in separate and uncoordinated ways. Recognition of the need to bolster regional integration of fisheries management efforts on the lake led to the preparation of a draft project document and its tabling at the First Session of the CIFA Sub-Committee for Lake Tanganyika in 1978. This initiative was followed up through a series of draft revisions and eventually resulted in the establishment of the present project, Lake Tanganyika Research (LTR),[2] which became fully operational in January 1992 (Hanek 1994).

Principal LTR objectives are to expand scientific understanding of fish production dynamics in the lake and to use this improved knowledge base in helping to build towards a common, regional approach to the management of its fisheries resources. The project design calls for all aspects of the research programme to be conducted in full collaboration with the national fisheries authorities and institutes of the respective lacustrine states, and to this end strong training and other institution-building components are incorporated. Headquarters were established at the beginning of the project on the compound of the Département des Eaux, Pêches et Pisciculture in Bujumbura (Burundi), and the national research institutes at Uvira (DRC), Kigoma (Tanzania), and Mpulungu (Zambia) have from the outset provided facilities and counterpart staff for the operation of LTR sub-stations around the lake.

Core activities of LTR's ecosystem research approach were organised under the scientific sampling programme (SSP), which started in July 1993 (immediately upon completion of the project's preparatory phase) and ran through July 1996.[3] The six major components of the

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[1] All of these efforts have resulted in a very extensive literature. See Coulter (1991a) for an overview of major research projects and expeditions that have investigated various aspects of the lake and its ecosystem from the turn of the century to the present, and for a comprehensive bibliography.

[2] Officially chartered as project GCP/RAF/271/FIN, Research for the Management of the Fisheries of Lake Tanganyika. LTR 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).

[3] Some aspects of SSP work extended into 1998. The series of lakewide hydroacoustic and pelagic trawling surveys was interrupted in April 1996 due to a breakdown in the hydroacoustic equipment. Delays continued owing to a

SSP include hydrodynamics, limnology, fish and zooplankton biology, remote sensing, fish genetics, and fisheries statistics. The project's research vessel, *Tanganyika Explorer*, was used extensively as a platform for the conduct of complementary hydroacoustic studies (to develop biomass estimates) and sampling surveys related to various other SSP components (Hanek 1994; Hanek and Craig 1996). Some aspects of the SSP have been carried out in collaboration with the Lake Tanganyika Biodiversity Project (LTBP).[4] SSP work along with other LTR activities and research outcomes has been extensively documented through the project's publication series, now numbering more than one hundred references (Hanek 1998).

Evaluation of LTR results during the latter half of 1996 led to recommendations for the continuation of activities over the course of a further four year period (FAO/FINNIDA 1996; Hanek and Craig 1996). At the same time it was stipulated that socio-economic issues needed to be addressed more directly in order to complete the foundation work for a regional framework management plan. During 1997, therefore, and with most of the hydrobiological and fisheries research activities initiated over the first five years of the project either complete or nearing completion, the LTR team embarked on a programme of socio-economic (SEC) investigation that involved a lakewide survey of landing sites, fishers, and trader/processors. Particular efforts were made to collect information on fishery problems and prospects from the viewpoint of local stakeholders (Reynolds 1997; Reynolds and Paffen 1997a, 1997b).

Completion of the SEC investigations and finalisation of remaining SSP work and reporting set the stage for preparation, during the first half of 1998, of the present framework management planning document. Following this Introduction (Section 1), the main body of the document is presented in five major sections. A broad geo-historical background on the lake and its fisheries is set out in Section 2, which also provides an overview of recent developments in terms of fishing techniques, distribution of effort, and the post-harvest situation. Section 3 sets out another sort of broad context, normative in character, in its review of the 'Responsible Fisheries Precepts' that have guided LTR's framework planning efforts. Section 4 then proceeds with an assessment of management requirements and prospects according to the 'readings' provided by the various LTR investigations and surveys to date. These include catch and effort statistic studies, work on production dynamics and biomass estimation, investigation of pelagic fish distribution and ecology, studies of institutional and legal issues, and SEC survey work. The draft regional framework plan itself is laid out in Section 5, first in terms of provisional policy content and then in terms of provisional management aims and measures. Section 6 suggests a series of accompanying measures for the plan in the form of institutional and legal provisions, development initiatives, and research and monitoring follow-ups.

References cited in the document are noted in Section 7, and two annexes provide, respectively, an example audit or checklist of the status of national policies and policy instruments in relation to responsible fisheries guidelines (Annex 1), and a suggested programme for the conduct of local community consultations or referenda on the provisional management measures identified in the LTR framework plan (Annex 2).

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combination of technical problems, unavailability of scientific staff, and civil unrest within the region. Survey work was resumed in late 1997 and was completed in early 1998.

[4] LTBP is a five-year project that began in 1995 with funding from the United Nations Development Programme/Global Environment Facility. It has as its principal objective the creation of regional basin management plan involving the four lacustrine states, through which pollution can be controlled and the biodiversity of the lake sustained. The five components of the LTBP include those of Biodiversity (investigations of species, species complexes, and habitats to determine which are under threat), Pollution (identification of pollution sources, effects, and possible preventative measures), Sedimentation (monitoring of impact and evaluating possible ways of amelioration), Socio-economics, and Environmental Education. Activities under the latter two components cover subjects including fishing and agricultural practices, appraisal of possible aquatic reserve sites and their local acceptability, and the legal issues that are or will be involved with regionally co-ordinated efforts at sustainable development and conservation of the lake's resources.

2. LAKE TANGANYIKA AND ITS FISHERIES[5]

2.1 Background

Basic geo-physical and biological characteristics of Lake Tanganyika (map, Figure 1) have been described in a variety of earlier reports and studies, and need only be briefly recapitulated here. The lake is highly remarkable on a number of counts. With an area of 32,900 km^2, a maximum depth of 1,470m, and a volume of 18,880km^3, it qualifies simultaneously as: a) the largest of Africa's Great Rift Valley lakes, the second largest of all African lakes, and the fifth largest of the world's lakes; [6] b) the deepest of all African lakes and the second deepest lake in the world;[7] and c) by cubic size, the greatest single reservoir of fresh water on the continent and the second greatest in the world.[8] Entrenched within the Western Rift Valley between the countries of Burundi, the Democratic Republic of Congo (DRC), Tanzania, and Zambia, the lake's surface lies at an altitude of 773m and stretches in a generally north to south orientation between the narrow confines of the steep eastern and western escarpments of the Rift from 03°20'30"S to 08°48'30"S latitude. The lake averages almost 50 km in width and runs to a total length of 673 km. Mean depth is 570m. Maximum depths are found in the 'deeps' of the major northern and southern basins (1,310m and 1,470 respectively), which may in turn be divided into the several sub-basins listed in Table 1. As noted by Coulter and Spigel (1991:49), 'Despite high water temperatures (23.25 - 27.25°C), thermal stratification is well marked and varies seasonally above an apparently permanent anoxic hypolimnion. The lake can be classified as meromictic.' Table 2 summarises additional data on the allocation of surface area and shoreline frontage between each of the lacustrine states.

Lake Tanganyika is notable in terms of its fauna composition as well. Owing to its geological history as a deep isolated basin formed by rifting that interrupted an ancient east-west river drainage system, of which the present-day inflowing Malagarasi and outflowing Lukuga rivers probably constituted the major channels, the lake features a high rate of endemism amongst its fish and invertebrate populations. Beadle (1981:281), following Lowe-McConnell (1969), notes that: 'The figures for percentage endemism in both the cichlids (98%) and non-cichlid fishes (57%) of Lake Tanganyika are remarkably close to those from lakes Victoria and Malawi which have also had a long history of isolation....' He goes on to comment that:

> What distinguishes Lake Tanganyika and reflects its greater age and period of isolation is the wider divergence in the speciation of the non-cichlids....There are as many as eight endemic genera. Apart from one (*Xenoclarias*) in Lake Victoria, no endemic genera of non-cichlid fishes are to be found in any of the other African lakes, though cichlids have produced 30 in Lake Tanganyika, 20 in Malawi and 4 in Victoria. Lake Tanganyika is remarkable also for the extensive speciation among animals other than fish. Most of the invertebrate groups have several endemic species, and in some cases genera [*ibid*].

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[5] This section draws primarily from the following sources: Beadle 1981; Coenen *et al*. 1998; Coulter 1991a; Hanek 1994; Hanek and Craig 1996; Mannini 1998; and Paffen *et al.* 1997.

[6] Lake Malawi, with a surface of 30,800km^2, is the second largest of the Great Rift lakes. Lake Victoria's 68,800km^2 makes it the largest lake on the continent and the second largest in the world by surface area. Lakes Superior (82,680 km^2), Huron (59,800 km^2), and Michigan (58,100 km^2) in North America are respectively the first, third, and fourth largest in the world (van der Leeden *et al*. 1990).

[7] Lake Baikal in Siberia is the world's deepest, at 1,741 m (van der Leeden *et al*. 1990).

[8] Lake Malawi's volume is reported as 8400 km^3, and that of Lake Victoria as 2760km^3 (Bootsma and Hecky 1993). Baikal is the world's largest freshwater lake by volume, with an estimated 23,000km^3 (van der Leeden *et al*. 1990).

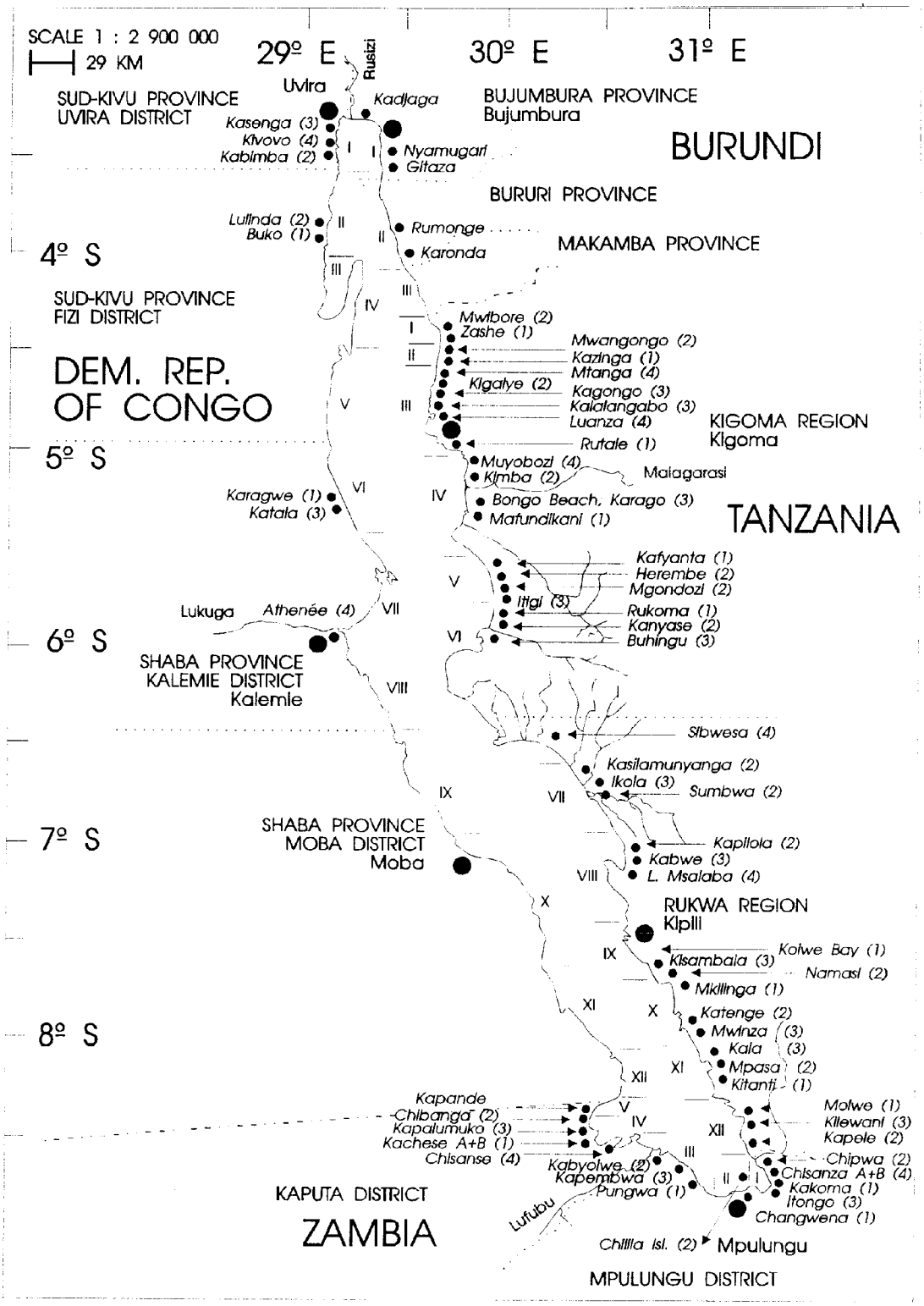


Fig. 1 Lake Tanganyika. Map showing relative locations of 1997 Socio-economic survey sample landing sites lakewide. Geographical strata areas are indicated by Roman numerals within each national sector. Landing site class codes appear in parentheses behind village names.

Although the antiquity of subsistence fishing within the Lake Tanganyika basin proper does not seem to be well documented, the archaeological record for the region generally shows that early groups were exploiting aquatic resources at riverine and lacustrine sites thousands of years ago (Sutton 1981; Stewart 1989; Yellen *et al.* 1995). The earliest historical accounts confirm that peoples living around Lake Tanganyika's shorelines were accomplished boat handlers and fishers. Descriptions exist, for example, of the 'catamaran' rafts used by fishers off the coast of Burundi (Hore 1892), and of the traditional technique of attracting fish at night through the use of brushwood fires set on platforms on the bows of canoes (Beadle 1981; Coulter 1991a).

Table 1. Lake Tanganyika: Geomorphological features*

Major Basin	Latitude Range	Sub-basin	Length	Width	Max. Depth
North-Tanganyika Trough	03°20' - 05°40' S	Bujumbura	70 km	25 km	350 m
		Rumonge (Karonda area)	80 km	35 km	1150 m
		Kigoma	170 km	80 km	1310 m
South-Tanganyika Trough	06°50'S - 09°S	Kalemie	130 km	40 km	800 m
		Moba	70 km	50 km	600 m
		East-Marungu (Kipili area)	120 km	30 km	1470 m
		Mpulungu	100 km	25 km	800 m

* Adapted from Mannini (1998), after Tiercelin and Mondeguer (1991).

Table 2. Lake Tanganyika: Division of national waters and shorelines

Country	Latitude Range	Lake Area (km^2)	Lake Area (%)	Shoreline (km)	Shoreline (%)
Burundi	03°20'30"S - 04°26'40"S	2,600 km^2	8%	159km	9%
DRC	03°21'00"S - 08°13'40"S	14,800 km^2	45%	795km	43%
Tanzania	04°26'00"S - 08°36'00"S	13,500 km^2	41%	669km	36%
Zambia	08°13'40"S - 08°48'30"S (West shore)	2,000 km^2	6%	215km	13%
Lakewide totals	03°20'30"S - 08°48'30"S	32,900 km^2	100%	1,850km	100%

2.2 Overview of Recent Developments

Fishing has intensified considerably over the course of the 20th century in association with the dramatic expansion of human population and settlements around the lake and the introduction of various technological innovations, such as paraffin oil (kerosene) pressure lamps for night-fishing, synthetic netting material, and motorised craft. Modern harvest operations primarily exploit six endemic non-cichlid pelagic species. These include the two schooling clupeid 'sardines' (known variously as 'ndagala' (Burundi and DRC), 'dagaa' (Tanzania), or 'kapenta' (Zambia) along different sections of shoreline), *Limnothrissa miodon* and *Stolothrissa tanganicae*, together with their major predators, all centropomids of the genus *Lates* -- viz: *L. stappersii*, *L. angustifrons*, *L. mariae*, and *L. microlepis*. Of the *Lates* species, the latter three are incidental to the catch: the lake's commercial fishery is essentially based on the two clupeids (ca. 65% by weight) and *L. stappersii* (ca. 30% by weight). Annual harvest levels in

recent years have been estimated to vary in the range of 165,000 - 200,000 t -- volumes that translate into annual earnings on the order of tens of millions of US dollars.

The lake's present-day fisheries are conventionally classified according to gear kit into 'traditional,' 'artisanal,' and 'industrial' types. The traditional fishery is based on the use of lusenga or scoop nets (in conjunction with fire light or lamp light attraction) for the harvest of clupeids, and gillnets, long lines, hand lines, traps, spears, and poisons for the capture of demersal species. It is strongly if not predominantly a subsistence activity undertaken by fishing units comprised of one or two persons operating with dugouts or simple plank canoes propelled by paddles and, in some cases, lateen-rigged sails. Traditional fishing with lusenga nets has undergone substantial decline in recent decades in the face of widespread adoption of more efficient artisanal gear.

Artisanal fishing is primarily carried out for commercial purposes using lift nets, 'chiromila' seines, and beach seines. The artisanal fishery has grown immensely from the late 1950s, when the technique of liftnetting from catamaran vessels (usually two wooden planked canoes lashed together with poles) outfitted with pressure lamps and operated by a 4 to 5 person team was first introduced in the northern portion of the lake. Within the past decade the introduction of so-called 'Apollo' liftnets has greatly increased the fishing power of artisanal units, to the point where they are almost as effective as the large purse seines deployed by industrial units (see below). The liftnet fisheries primarily target clupeids from the Kipili area northwards, with *S. tanganicae* accounting for the greater proportion of the catch by weight. *L. stappersii* appears to replace clupeids as the dominant target species of the liftnet fishery from Kipili southwards. In the southernmost portion of the lake, however, liftnetting has only developed in a minimal way, reportedly because of the difficulties of operating in wind-exposed offshore waters. Most artisanal operations in Zambian waters are therefore based on the kapenta beach seine, worked at night by shore crews (net haulers) operating in conjunction with net-laying and light attraction boats. Kapenta seining is an inshore fishery that tends to capture juvenile *L. miodon*. The seine codends usually have mesh sizes of <6 mm (stretched), as compared to the 6-8 mm (stretched) mesh sizes that are standard in the lift net fishery.

Industrial fishing units are each comprised of a large (16-20m) steel main vessel, a smaller net-setting vessel, and 3 or more light boats, all requiring a crew of from 20 to 40 persons to operate. The industrial fishery traces back to the mid-1950s, when Greek nationals introduced the technique in Burundian waters. Purse seine units operated from larger ports throughout the lake in subsequent years, but are now concentrated in the southern portion. This fishery mostly targets *L. stappersii*, which account for about 95% of the catch in recent years.

2.2.1 1995 Frame Survey

The disposition of fishing effort lakewide and on a country-by-country basis as reflected in the results of the 1995 Frame Survey (Paffen *et el.* 1997) is summarised in Tables 3 through 5 below. These results, directly and by implication, convey a great deal about the nature and significance of the lake's fisheries.

To begin with, some 45,000 fishers are recorded for a total of 786 landing sites around the lake. Such figures immediately direct attention to the important socio-economic role played by the fisheries. The tens of thousands of boat and equipment owners/operators and crew active in the harvest sector represent a first tier of fisheries employment and income generation. Secondary fisheries-generated employment has also to be taken into account. Local processors and traders, long-distant transporters and marketeers, and various others who provide services and support at landing sites and throughout the distribution chains are reckoned to number in the hundreds of thousands. And if the individuals tied to the families and households of all of these operators and service providers are considered as well, it can quite plausibly be estimated that some one million people living around Lake Tanganyika -- one-tenth of the estimated population of the entire lake basin -- are directly dependent on the fisheries for their livelihoods.

Other salient points to note with regard to the 1995 FS findings include the following:

1) The DRC portion of the lake, which contains the largest proportion of the total shoreline (43%), accounts also for the highest proportions and greatest densities (per 10 km of coast) of landing sites, fishers, lamps, and vessels.[9] Burundi, with the smallest proportion of total shoreline (9%), also hosts the smallest proportions of landing sites, fishers, lamps, and vessels. At the same time, it contains the highest densities of lamps and engines per 10 km of shoreline. Although Burundi registers as having the second highest density of vessels, it also ranks first by a wide margin as having the highest density per 10 km of shoreline of inactive/broken craft.
2) Out of the some 17,100 vessels in active service, wooden planked canoes constitute by far the most common (≈60%) type, followed by catamaran and dugout units (19% each). Industrial units make up less than 1% of the lakewide fleet. Catamarans figure most prominently in the Burundi (48%) and Tanzania (26%) fleets, and dugouts appear to be most popular in the DRC (27%).
3) Of traditional gear, lusenga scoop nets are most commonly encountered in Tanzania, gillnets in Tanzania and Zambia, longlines and handlines in the DRC and Tanzania. Traps appear to be extremely rare.
4) Lift nets dominate the artisanal gear kit except in the case of Zambia, where the kapenta or night beach seine rates as the most common. The higher capacity Apollo lift net is mostly limited to Burundi waters, and the chiromilla seine (of Lake Malawi derivation) is restricted to the Zambian portion of the lake. Day beach seines represent about 30% of artisanal gear units in both the DRC and Tanzania, but are far less important components of the overall gear kit in Burundi (3%) and Zambia 13%).
5) Almost half of the industrial units enumerated in 1995 were reported as non-operational. The 1995 distribution of operational units registered as follows: Zambia = 16; DRC = 6; Tanzania = 4; and Burundi = 2.

Table 3. 1995 Frame Survey summary results: Landing site, fishers, craft, and engine counts by country

Country	Landing Sites	Fishers	Lamps	Dugouts	Planked [a,b]	Catamaran [a,b]	Transport [a]	Industrial Units [a,c]		Eng
Burundi	54	2,021	2,444	46	642	630	3	29	56	241
DRC	417	26,308	7,712	2,553	5,471	1,389	22	1,095	877	415
Tanzania	208	12,510	7,635	577	2,836	1,213	4	146	90	494
Zambia	107	4,118	2,588	46	1,490	28	23	--	90	114
Lakewide totals	786	44,957	20,379	3,222	10,439	3,260	52	1,270	1,113	1,264

[a] Figures include limited number of inactive/broken vessels. These latter amount to some 12% of the overall vessel total lakewide. [b] Figures include limited number of metal and fibreglass vessels. [c] Transport/auxiliary craft included with planked canoes in Zambian count.

Table 4. 1995 Frame Survey summary results: Fishing density measures by country

Country	Coast km	Landing Sites/10km	Fishers/ 10km	Lamps/ 10km	Craft/ 10km	Inactive/ broken craft/ 10km	Engines/ 10km
Burundi	159	3.4	127	154	88	21.7	15.2
DRC	795	5.2	331	97	143	9.5	5.2
Tanzania	669	3.1	187	114	73	13.6	7.4
Zambia	205	5.2	201	126	82	12.2	5.6
Lakewide totals	1,828	4.3	246	111	106	12.4	6.9

[9] With the greatest concentrations occurring in the northern part of the DRC shoreline, falling within Uvira District.

Table 5. 1995 Frame Survey summary results: Artisanal and traditional gear counts by country

Country	Chiromilla seines	Day beach seines	Night beach seines	Std. lift nets	Apollo lift nets	Lusenga nets	Gill nets	Long lines[(a)]	Hand lines	Traps
Burundi	0	16	0	438	101	37	196	9	193	0
DRC	0	601	0	1,350	23	8	237	12,630	--	9
Tanzania	0	496	0	1,158	4	271	2,917	410	6,747	0
Zambia	16	30	154	27	0	0	2,950	24	731	4
Lakewide totals	16	1143	154	2,973	128	316	6,300	13,073	7,671	13

[(a)] Longlines and handlines enumerated together in DRC.

2.2.2 Post-harvest sector

Processing, distribution, and marketing patterns associated with the Lake Tanganyika fisheries are not nearly as well documented as the harvest sector.[(10)] Available reports consistently emphasise that the remote location of most landing sites and the steep escarpments along much of the shoreline impose severe constraints on both processing and marketing possibilities. Roads running parallel to the coast are only found in Burundi and along stretches of shoreline in Uvira and Fizi districts in the DRC. Other major roads link principal towns like Kigoma, Kalemie, Moba, and Mpulungu with their hinterlands but are not effectively served by feeder roads from outlying landing sites. Railway links exist at Kigoma, with service to Tabora and Dar es Salaam, and at Kalemie, with connections (present status unknown) to Lubumbashi and the Shaba mining districts. Furthermore, electricity supplies and other amenities needed to support energy-intensive techniques of fish handling and processing, e.g. chilling, freezing, or canning, are only found in the largest towns. The most developed facilities are to be found in Mpulungu and on a more limited basis in Kalemie. Commercial fishing companies in both towns run small industrial type cleaning, brining, smoking, freezing operations, mainly dealing with clupeids (kapenta/ndagala) and *L. stappersii*. A kapenta canning line has also been established in Mpulungu within the last few years.

Generally speaking, opportunities for trade in fresh fish are limited to localities in the immediate vicinity of landing sites except for places situated close to or within easy road access of major population centres. The bulk of the catch landed at most sites must of necessity be processed in some fashion in order to extend its shelf life for marketing purposes. Simple sundrying on the beach or ground is easily managed under local conditions, requiring few inputs other than labour. It is by far the most common method of processing clupeids and *L. stappersii*, which constitute the greater bulk of the lakewide catch. Smoking kilns for the curing of *Lates* spp. and larger cichlids are in widespread use, but do not account for large volumes of fish.[(11)]

For residents of the vast majority of landing sites along the lakeshore, non-existent or poor and irregular overland transport links are historical conditions and the lake itself has always remained the main 'highway' of travel and commerce. Huge but largely undocumented tonnages of dried fish thus move north and south as well as across the lake from local landings to major bulking, distribution, and marketing centres such as Kigoma, Kalemie, Moba, and Mpulungu. Much of this traffic currently is carried from south to north along the eastern coast to Kigoma aboard the two Tanzania Railway Corporation vessels *Liemba* and *Mwongozo*. Large

[10] Studies and reports touching on post-harvest sector issues include the following: for Burundi, Dampha (1993); for DRC, FAO (1990), Leendertse and Mambona Wa Bazolana (1992); for Tanzania, Midtgaard (1975), Rupamoorthy (1982), MALD (1984), Schack (1985), Mlay and Mutsekwa (1993), Gibbon (1997); for Zambia, Beatty (1969), Bernascek (1985), GOPA (1989), Hoekstra and Lupikisha (1992), Kanondo and Luhila (1993).

[11] Development interventions to improve local processing efficiency and product quality, such as the introduction of brining and elevated racks for dried clupeids and improved kilns for smoked fish, have been attempted through a variety of projects around the lake. They have proved largely unsuccessful, presumably because the extra effort and expense required is not sufficiently compensated by market returns.

transport canoes or 'water taxis' haul smaller consignments from scores of local landing sites that are not on the steamer routes.

Although reliable statistics are lacking on the volume of product flow along the various marketing channels that reach beyond the lake basin, the major outlets for dried fish are long established and well known. In addition to the mining districts of Shaba Province in the DRC and the Zambian Copperbelt, supplies reach the Dar es Salaam market through the railway connection from Kigoma. North of the lake, Bukavu and Goma in the DRC and towns in Rwanda have in recent years become important market destinations as well, owing in no small part to the growth of displaced populations resulting from regional civil conflicts, and the requirements of various agencies involved with emergency food assistance for refugee camps and repatriation schemes.

3. RESPONSIBLE FISHERIES PRECEPTS

3.1 Project Orientation

As already indicated, LTR basically aims to facilitate a regional management framework that is grounded in the best available scientific evidence. Special attention to socio-economic concerns in recent phases of project work has helped to ensure that management planning preparations also develop in a consultative fashion, by involving local user groups in problem evaluation and review of options for future actions. Key management issues to be addressed were identified through reference to previous assessments of the fishery situation in Lake Tanganyika and the East African Great Lakes Region in general (e.g., Gréboval 1990, 1992; Hanek 1994; Hanek and Everett 1995; Cacaud 1996; Maembe 1996), and with close regard to management principles highlighted in the recently published FAO *Code of Conduct for Responsible Fisheries* (FAO 1995).

3.2 Code of Conduct for Responsible Fisheries (CCRF)

The FAO Conference unanimously adopted the CCRF in October 1995 (FAO 1995). It is the outcome of initiatives that trace back to the Nineteenth Session of the Committee on Fisheries (COFI) in 1991 and the International Conference on Responsible Fishing (Cancún, Mexico) in 1992 -- initiatives sparked by growing concerns that exploitation and development trends within world fisheries over recent decades either are approaching or have already overrun the limits of what can be sustained by the constituent resource bases. The COFI and Cancún initiatives sought to foster a fundamental reorientation of priorities, such that all aspects of world fisheries could be conducted with due regard for conservation and environmental concerns. The twelve articles of the CCRF, listed under Outline 1 below, were formulated under FAO co-ordination as a voluntary model framework through which such reorientation can effected.

Outline 1. Articles of the *Code of Conduct for Responsible Fisheries*

Article 1	Nature and scope of the Code	**Article 7**	Fisheries management
Article 2	Objectives of the Code	**Article 8**	Fishing operations
Article 3	Relationship with international instruments	**Article 9**	Aquaculture development
		Article 10	Integration of fisheries into coastal area management
Article 4	Implementation, monitoring and updating		
Article 5	Special requirements for developing countries	**Article 11**	Post-harvest practices and trade
		Article 12	Fisheries research
Article 6	General principles		

An overall context is set by Article 6 of the CCRF, its General Principles, the key points of which are paraphrased in Outline 2.

Outline 2. Synopsis of 'General Principles,' *Code of Conduct* Article 6 [12]

1) *Use of living aquatic resources carries with it the obligation to do so in a responsible manner, ensuring their effective conservation and management.*
2) *Management should promote maintenance of quality, diversity, and availability of resources in sufficient quantities for present and future generations, mindful of requirements for food security, poverty alleviation, and sustainable development.*
3) *States should adhere to management measures to ensure a balance between fishing effort and sustainable utilisation of the resource base, guard against over-harvesting, over-capitalisation, and excess fishing capacity, and seek to rehabilitate resource populations as and when appropriate.*
4) *Conservation and management decisions should be formulated according to the best available scientific evidence and taking into account traditional resource and habitat knowledge, environmental and social factors. Priority should be given to research and data collection for improvement of the scientific and technical fisheries and ecosystem knowledge base.*
5) *Precautionary approaches should be applied to conserve aquatic ecosystems and resources based on the best available scientific evidence. Absence of adequate scientific information should not be an excuse for postponing conservation measures.*
6) *Conservation of biodiversity and population structures should be promoted through the use of selective and environmentally-safe fishing gear and practices. States and users should minimise wastage of target and non-target species as much as possible.*
7) *Harvesting and post-harvest treatment of fishery products should aim at maintaining their nutritional value, quality, and safety, and to reduce waste and negative environmental impacts*
8) *Critical fisheries habitats (wetlands, reefs, lagoons, nursery and spawning areas) should be protected and rehabilitated as and where necessary, with particular effort made to protect them from destruction, degradation, pollution and other human impacts that threaten the health and viability of fishery resources.*
9) *States should ensure that fisheries and resource conservation interests are taken into account in multiple use management, planning, and development of coastal zones.*
10) *Within their respective competencies and in accordance with international law, and within the framework of regional fisheries conservation and management organisations or arrangements, States should ensure compliance with and enforcement of conservation and management measures and establish appropriate mechanisms for monitoring and control of fishing vessels.*
11) *States should ensure that vessels authorised to fly their flags adhere to the proper application of this Code, respect conservation and management measures taken in accordance with international law and adopted at national, regional, or global levels, and fulfil obligations concerning fisheries data collection and provision.*
12) *States should co-operate through fisheries management organisations or other suitable arrangements to promote responsible fishing and ensure effective conservation and protection of living aquatic resources throughout their range of distribution, recognising the need for compatible measures in areas within and beyond national jurisdiction.*
13) *States should facilitate consultation and effective participation of industry, fishworkers, environmental, and other interested organisations in decision making with respect to laws and policies on fisheries management, development, and international lending and aid.*
14) *International trade in fishery products should be in accordance with World Trade Organisation standards and relevant international agreements, and polices, programmes and policies should not result in obstacles to this trade, environmental degradation, or negative social, including nutritional impacts.*
15) *States should seek to prevent fisheries disputes and, when they arise, seek to ensure their settlement in a timely, peaceful, and co-operative manner.*
16) *States should promote awareness of responsible fisheries amongst fishers and fishfarmers through education and training.*
17) *States should ensure that fishing facilities, equipment, and activities allow for safe, healthy, and fair working and living conditions in accordance with standards adopted by international organisations*
18) *As artisanal and small-scale fisheries make important contributions to employment, income, and food security, States should appropriately protect the rights of workers in subsistence, small-scale, and artisanal fisheries to a secure and just livelihood, along with preferential access to traditional fishing grounds and resources lying within waters under their national jurisdiction.*
19) *States should consider aquaculture as a means to promote diversification of income and diet, and in doing so ensure that resources are used responsibly and that adverse environment and local community impacts are minimised.*

[12] A partial and unofficial synopsis only. Refer to the full *Code* (FAO 1995) for verification.

3.3 Management Process for Responsible Fisheries

3.3.1 Components of management design and implementation

Figure 2 depicts an idealised representation of how the components of the responsible fisheries management approach are integrated into an overall process. The important point to note is that the process is designed to function in a self-reinforcing, self-renewing fashion, with its various biological and socio-economic reference points and decision-making, consultation, review, and reporting transactions constantly working in tandem to generate and regenerate desired outcomes -- i.e., the '...continued productivity of the resources and accomplishment of other fisheries objectives.'

3.3.2 Engaging the process: management measures and approaches[13]

The management process is initialised through deliberations on fisheries policy and objectives within the context of existing biological and socio-economic circumstances, including the potentialities they offer and the constraints they impose. A programme of actions to secure the identified objectives has then to be planned and implemented. As observed in the 'Fisheries Management' module of the *FAO Technical Guidelines for Responsible Fisheries* (FAO 1997), these transactions must be based on the fundamental recognition that fishing mortality will have to be regulated in some fashion or another,. The module section on 'management measures and approaches' (Section 3) notes that:

> ...the only mechanism available to maintain the biomass and productivity of a resource at a desirable level, at least in wild capture fisheries, is controlling fishing mortality by regulating the amount of fish caught, when they are caught and the size and age at which they are caught. In regulating fishing mortality there are a number of approaches which can be used, and each one will have different implications and different efficiencies for regulating fishing mortality, impact on fishers, feasibility of monitoring, control and surveillance and other facets of fisheries management [45].

Possible management measures and critical issues of equity and accommodation of user interests are then reviewed, under the respective themes of 'options to regulate fishing,' 'limiting access,' and 'management in partnership.' It is with reference to these three key organising themes that terms of engagement with the responsible fisheries process are set.

3.3.3 Options to regulate fishing

Fishing regulation options include: a) technical measures for the restriction of gear and operating areas and times; and b) input and output controls.

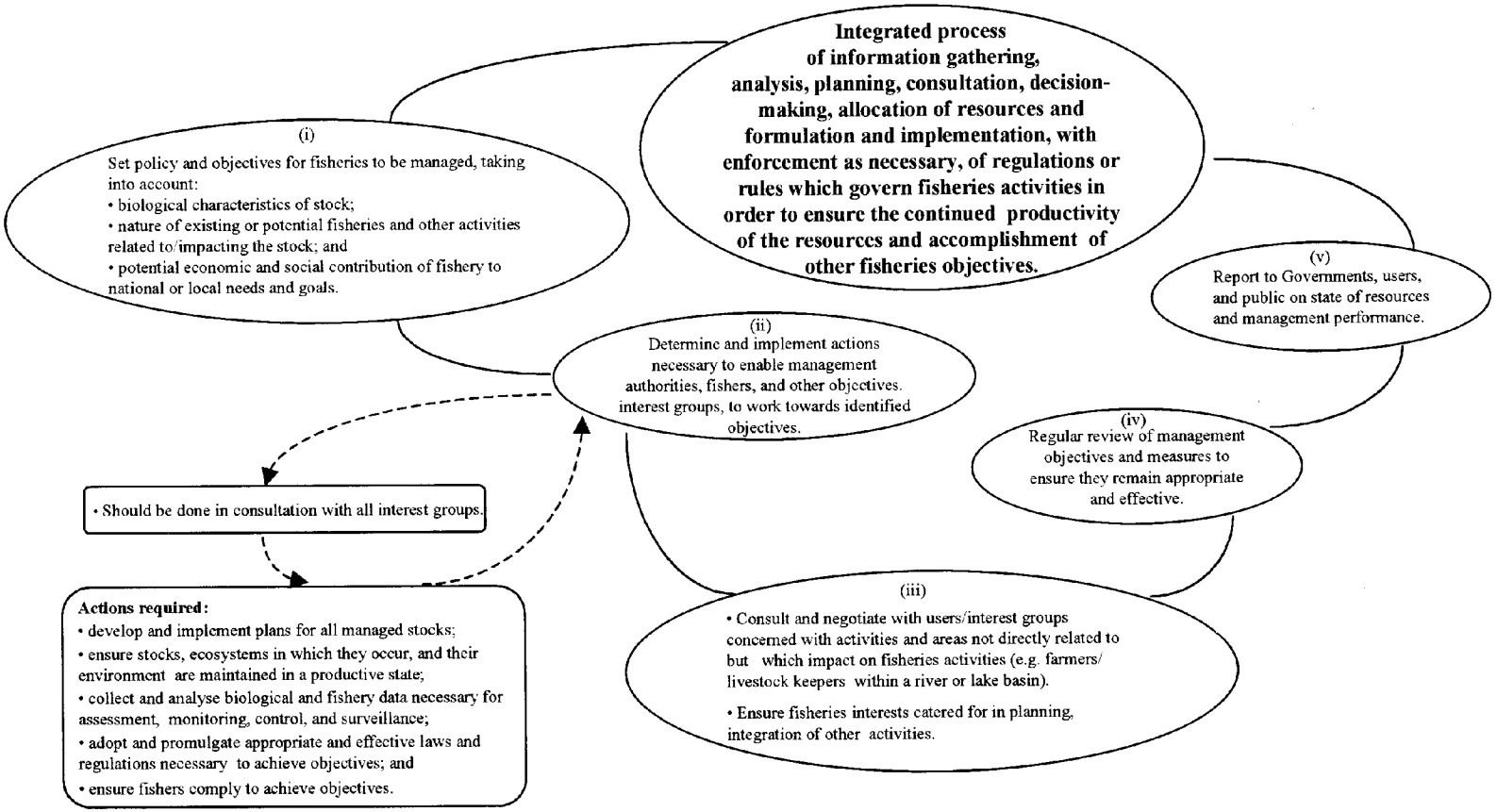
Technical measures

Gear restriction modalities noted in the *Guidelines* include those pertaining to: a) type of gear (e.g. gillnet); b) gear characteristics (e.g. net mesh size); and c) operation of gear (e.g. 'active' gillnetting).

Area and time restrictions define open and closed 'windows' for the application of fishing effort, as for example with 'no fishing zones' in known breeding and nursery grounds during particular months, or with aquatic reserves for the conservation of critical habitat and biomass. Whilst it is theoretically possible to use seasonal and spatial restrictions '...to regulate total fishing mortality on a resource' (FAO 1997: 47), their implementation may be extremely problematic. To be effective, they must not only be established with reference to appropriate biological considerations, and with due concern for effort concentration or transfer effects (too much effort during 'open window' conditions or excessive effort displacement to other areas); they must also be accepted and respected by user groups.

[13] Discussion in this section is largely extracted from Reynolds and Hanek (1997).

Fig. 2. The fisheries management process*



* Source: Adapted from FAO (1997: 7-8).

Input (effort) and output (catch) controls

Input control can be used to regulate fishing mortality through the imposition of limits on fishing capacity and effort. Typical mechanisms include licensing ceilings, individual effort quotas on fishing units, and the use of technical specifications to limit the harvesting power of vessels and/or their gear kits.

Output control is a commonly encountered management measure that theoretically '…allows estimation and implementation of the optimal catch to be taken from a stock by a given harvesting strategy' (FAO 1997: 50). It typically entails '...setting a total allowable catch (TAC) which is then sub-divided into individual quotas by fishing nation (in the case of international fisheries), fleet, fishing company, or fishermen (e.g. in the case of individual quotas)' (*ibid*).

3.3.4 Limiting access

As remarked in the *Technical Guidelines*, use right regimes in free-range resource exploitation systems such as fisheries can broadly be divided into open access and limited access systems. Open access is basically a 'free-for-all' or 'first come, first served' condition which, if left totally unregulated. '...will invariably lead to over-exploited resources and declining returns for all participants' (FAO 1997: 52). Even in situations where controls on exploitation levels are put in place, such as TACs or seasonal closures, '...open access systems are characterized by a race to fish in which all participants strive to catch as much of the resource ... as they can, before their competitors do so' (*ibid*).

It is generally recognised that, for a fishery to be sustained, the 'free-for-all' situation must give way to one of access limitation in some form. In most instances where fisheries resources fall within national jurisdictions, this involves the granting of conditional use rights by the State or its management authority such that the State, whilst retaining ownership of the resources, allows their exploitation by designated communities, user groups, firms, or individuals.

3.3.5 Management in partnership

Co-management, or what the *Technical Guidelines* refer to as 'management in partnership,' is a central tenet of responsible fisheries. Fisheries typically involve a complex of interests, which share differing or even contradictory aims. Responsible management endeavours to accommodate such interests and recognises that '...the efficiency and implementability of the management measures are often highly dependent on the support gained from the interested parties' (FAO 1997:55).

The *Guidelines* go on to note that:

> Management in partnership encompasses the various arrangements which formally recognize the sharing of fisheries management responsibility and accountability between a fisheries management authority and institutions either public, such as local level government, or private, such as a group of interested parties. Hence, ...[it] is likely to ...[have] a decentralized and unstandardized nature. It often reflects a concern for efficiency or equity at the State or management level, coupled with proven capacity for self-governance, self-regulation and active participation at the level of the interested parties concerned [*ibid*].

Depending on circumstances, co-management arrangements may feature higher or lower degrees of intervention and support by the State -- higher where local-level commitment and capabilities are weak, lower where they are strong.

4. READINGS ON MANAGEMENT REQUIREMENTS AND PROSPECTS: LTR INVESTIGATIONS, 1992 -1998

4.1 CPUE Study[14]

The LTR study of catch and effort statistics for different areas and gear assembled by Coenen *et al.* (1998) mostly draws on data collected over the three year period (7/93 -6/96) covered by the project's Scientific Sampling Programme (SSP). Principal findings and observations are summarised as follows.

4.1.1 Fishing unit types and distribution of effort

The 1995 Frame Survey (FS) data (Paffen *et al.* 1997) indicate that the dominant type of fishing unit currently active on the lake is the 'traditional' unit, equipped mainly with longlines and gillnets. 'Artisanal' units equipped with lift nets are the next most common, followed by those that operate beach seines. Industrial units (each consisting of a purse seiner with four auxiliary vessels) are the least common of the major types, and are concentrated mostly in the Zambia sector at the southern end of the lake.

Density of fishing effort expressed as number of fishing units/km shoreline is highest along the north-west coast (Uvira area, DRC), followed by the south-west coast (Moba area, DRC) and the East Coast and Mpulungu areas (Zambia).

When effort of all units is standardised in terms of the dominant gear kit, i.e. scaled as 'traditional effort units,' in order to derive a longitudinal north-south profile for the lake, it becomes clear that the northern and southern extremities are subject to the greatest fishing pressure per unit of fishing area. In the case of the north end, this outcome can be attributed to the concentration of lift net units in the Uvira area; for the south, it results from the combined effects of industrial and traditional unit operations.

As for the greater expanse of the lake that lies in between, a decreasing effort gradient running from north to south is apparent.

4.1.2 CAS estimates

Review of Catch Assessment Survey (CAS) estimates provides the following country-by-country picture.

Table 6. CAS annual yield estimates by country

Country	Annual yield est. (Year)	Remarks
Burundi	21,000 t (1995)	Widespread closure of landing sites for security reasons in 1996 provoked drastic reduction of catch to an estimated level of 3,000 t.
DRC	90,000 t (1995)	Estimate based on extrapolation of fishing effort counts (FS 1995). No continuous catch monitoring system in place.
Tanzania	55,000 t (1994-95)	Down from estimates of 72,000 t for 1992 and 80,500 t for 1993.
Zambia	12,700 t (1994)	Yield split between 9,100 t traditional/artisanal and 3,600 t industrial. No continuous catch monitoring system in place, except for industrial fishery based in Mpulungu. Declining industrial CPUE trend registered during 1994-96 period indicates local overfishing by these units, especially on *Lates stappersii* stock (dominant catch species).

[14] Summary review extracted from Coenen *et al*. 1998.

4.1.3 CPUE estimates by gear and area

CPUE analyses based on CAS, FS, and fish biology sampling data obtained during the three year period of the SSP (7/93 - 6/96) yield more specific readings for different gear types, fishing areas, and time intervals. Of particular note is the increasing north to south CPUE trend that is demonstrated for the liftnet fishery. A breakdown of CPUEs per species shows that this trend is mainly explained by the dominance of *Lates stappersii* in the catches from around Kipili southwards, reinforced in the Mpulungu area by the effect of the kapenta beach seine fishery which mainly harvests *Limnothrissa miodon* from waters closer inshore. *Stolothrissa tanganicae* figure only marginally in catches from southern areas, but dominate the liftnet catches towards the north.

The detailed CPUE analyses also provide further confirmation of local over-exploitation of the *Lates stappersii* stock by the industrial fishery in the Mpulungu area. Significant monthly CPUE decrease is measured over the three-year period of the SSP.

4.1.4 Using CPUE results as a measure of abundance

Coenen et al. (1998: 33) stress that extreme caution is warranted when interpreting CPUE results, since in the context of Lake Tanganyika they do not in and of themselves constitute a measure of fish abundance. Partly this is due to the inherent characteristics of the target stocks, partly to the method of fishing, and partly to the method of computation:

1) the three principal commercial species are all fast swimming, shoaling, and migratory fish;
2) one species, *S. tanganicae*, is very short-lived and its stock therefore subject to rapid turnover;
3) CPUE estimates are derived from units that utilise lights to concentrate fish for their gear to capture, and may thus not be a true indication of a stock's natural abundance; and
4) since CPUEs are based on catch averages for specific intervals of time in specific area, they might give a misleading picture of uniformity in situations where considerable variation of stock density is occurring.

4.1.5 Environmental influences

The difficulties of CPUE-based stock estimation are greatly compounded by the extensive but incompletely understood role of environmental factors in regulating species abundance. A range of influences including elevated air temperature, reduced wind speeds and upwellings, and alteration of other hydrodynamic events all can act in interrelated ways to reduce primary production, species abundance, and fish yields. Coenen *et al.* (*ibid:*31) surmise that such environmental factors have contributed to a recent decline of lakewide catch levels (presently estimated to be on the order of 178,000 t) from those of previous years (perhaps on the order of 200,000 t, taking into account the probable under-representation of the DRC sector's contribution in previous estimates).

4.1.6 Future monitoring needs

The CPUE study concludes with a set of recommendations for a long-term collaborative Monitoring Programme that would allow events of continuity and change in the lake's fisheries to be traced on a regular basis. Key recommendations for concerted action by the four countries include the following.

1) Establishment, re-establishment, or significant strengthening, as appropriate, of catch/effort survey activities in the form of continuous Catch Assessment Surveys (CAS) and periodic (every 2-3 years) Frame Surveys (FS).

2) Adoption of a standardised set of methods and formats for catch/effort data collection and reporting, as earlier recommended in the report of the Fisheries Statistical Co-ordinators' Meeting (Coenen 1994).

3) Establishment or significant strengthening, as appropriate, of fisheries statistical units within the respective fisheries administrations/departments, staffed by officers fully skilled in the planning and execution of FS, CAS, and other relevant surveys, and in the analysis and presentation of survey findings.

Additional recommendations are directed towards the LTR or any successor project that might be charged with the implementation of the Monitoring Programme during its pilot phase.

1) Provision of broad technical and training support for new or upgraded fisheries statistical units within the respective fisheries administrations/departments of the four lacustrine states, including:
   a) support in the planning and execution of CAS and FS exercises; and
   b) support for efforts to standardise statistical collection and reporting procedures.

2) Ensure the collection of additional catch/effort (CPUE) statistics for specific gear, following the same procedures that were used in conjunction with the fish biology sampling activities during the 1993-96 SSP period. The aim should be to collect data for each type of gear from four fishing units every week or at least every two weeks. Since traditional fishing units are the dominant type found on the lake, they should be included in the sampling scheme along with the artisanal and industrial types.

4.1.7 Indicators for management planning

The CPUE study raises a variety of important management considerations, in the nature of both positive findings and cautionary observations.

- **Concentration of fishing pressure** per unit of fishing area is most pronounced in the northern and southern extremities of the lake, owing to high densities of lift net units around Uvira (north) and of combined industrial and traditional units around Mpulungu (south).

- **Overfishing** of *L. stappersii* is clearly apparent from the CPUE analyses of the Mpulungu-based industrial fishery. This trend should be understood in association with the effects of the kapenta seine fishery on *L. miodon* stocks. Indications point to the need selectively to reduce fishing pressure in the southernmost waters of the lake.

- **CPUE provides an inconclusive measure of fish abundance** for Lake Tanganyika because of the characteristics of the pelagic stocks in question, the method of fishing, and the way CPUE indices are calculated.

- **Environmental factors heavily condition production processes,** although the exact scope and underlying mechanisms of these influences have yet to be determined. It seems likely in any event that they have contributed to recent declines in annual harvest levels.

- **Collaborative lakewide monitoring** through a long-term programme is obviously fundamental to the management process. It would provide feedback on the effectiveness of new measures that the lacustrine states might introduce as part of a regionally co-ordinated effort to govern fisheries activities, as well as indications on how such measures might be adjusted or augmented.

4.2 Production Dynamics and Biomass Estimation[15]

Data collection requirements for the various SSP component investigations were met through routines of weekly or fortnightly sampling of physical, chemical, and biological parameters at the three project field stations. *Tanganyika Explorer*, the project's research vessel, made a total of 17 cruises in support of multidisciplinary studies. Numerous LTR technical documents report on study activities and outcomes, and results have also been presented at various international scientific fora. Findings of SSP work in hydrodynamics, limnology, plankton distribution, and production/biomass estimation have been summarised by Mölsä *et al.* (1998). This summary is itself summarised below. Reference should be made to the final version of the LTR Scientific Report now nearing completion, since it will provide an overall compendium of SSP results.

4.2.1 Hydrodynamics and limnology

Hydrodynamic modelling of the lake was carried out in order to characterise major current and thermal regimes, sediment transport patterns, and upwelling systems. This work was partly executed in collaboration with the Lake Tanganyika Biodiversity Project. The model was validated through extensive field-testing, data obtained through automatic recorders, and AVHRR/NOAA satellite imagery studies.

Investigations recorded the primary upwelling in the southern basin off Mpulungu and verified the role of prevailing SE winds in causing the vertical mixing and horizontal currents. Thermal stratification appears to remain permanently intact in the middle (Kigoma basin) part of the lake, but horizontal circular patterns and secondary mixing of minor scale can be clearly detected in all three main basins. Local inputs from rivers show up as longitudinal sediment distribution. Water temperature measurements verify earlier descriptions of a '…tilting of the thermocline along the main axis of the lake' (*ibid*:4). Also evident is a 'Transversal tilting in the Kalemie strait during dry and wet seasons ….' (*ibid*). This tilting '…was observed in connection with uninodal internal seiching. Internal wave motion with a periodicity of 23.4 d during the dry season and of 34.8 d during the wet season was found with [the aid of] automatic devices for the first time' (*ibid*). Measurements also confirmed the existence of 'High and variable current speeds … at surface waters down to 20-40 m…' and demonstrated that '…water flows below this level …[are] steadier but …[have] clear seasonal variations' (*ibid*).

During the dry season, starting in May-June, south-east winds drive the surface water towards the north. The SSP summary report notes that this causes '…accumulation of warm water and deepening of the thermocline in the north (down to 70-90m in Bujumbura). At the south end of the lake these winds …[cool] the surface water …[through convection and turbulence,] first deepening the thermocline and finally breaking it around August' (*ibid*:5). The SE winds disappear in the following months (September or October), and vertical stratification is typically re-established by November. Tilt in the thermocline produces '…a density imbalance that acts as a store of potential energy' (*ibid*). As wind decreases the water masses '…move towards equilibrium. The degree of wind shear stress on the lake surface (the Wedderburn number W) around Mpulungu …[is] low …in the dry season… indicating thermocline tilting, mixing, and possible upwelling' (*ibid*). The lower metalimnion boundary at the southern end of the lake approaches the 300m depth level during this period.

Seasonal changes in Lake Tanganyika's physical limnology substantially affect water chemistry and the nutrient regime. 'In general, epilimnic concentrations of phosphate, nitrate, ammonia and silica …[are] very low compared to those in the hypolimnion, probably due to uptake by autotrophic organisms' (*ibid*). Replenishment of nutrients into the euphotic zone, and thus biological production itself, appears to be driven by a complex of factors including relative thermocline, oxycline and chemocline positions, and the relation between mixing depth and

[15] Summary review extracted from Mölsä *et al.* (1998). The original text with its technical phrasing is kept intact as much as possible, but parts have been paraphrased and condensed for the sake of brevity, and a number of details have had to be skipped over altogether.

euphotic depth. The horizontal transport of upwelled nutrients from the south towards the other basins is less pronounced than earlier studies have indicated.

4.2.2 Plankton biomass and production

Phytoplankton and bacterioplankton primary production assessments were constructed on the basis of the most extensive data sets so far available for the lake. The data are derived from trans-seasonal measurements taken at the Bujumbura, Kigoma, and Mpulungu stations and from three lakewide survey cruises. Measurements taken independently through both *in situ* and simulated *in situ* means were similar, and variability of the former was moderate. The production estimates also took into account solar irradiance factors and dissolved inorganic carbon (DIC) loads. SSP results for dissolved organic carbon (DOC) concentrations are within the ranges reported for earlier studies, and confirm that Tanganyika's surface waters have relatively low DOC levels. It is inferred that dissolved organic matter does not play a major role in the planktonic food web.

Based on weekly sampling of zooplankton communities, '…the northernmost end of the Lake is characterised by higher numbers of Cyclopoida, while in the southern end calanoids and cyclopoids …[are] more or less equally abundant' (*ibid*:9). In biomass terms the areal differences diminish,

> '…because the small cyclopoids …[that are] dominant in the north …[have but] a minor role in the south. The difference between calanoids and cyclopoids as clupeid food is significant: a calanoid nauplius is comparable with a small cyclopoid adult in biomass. In Lake Tanganyika calanoids probably are more vulnerable to predation than cyclopoids owing to their larger size [*ibid*].

Observation of high numbers of zooplankton in the northern extremity of the lake corroborate earlier determinations that the water mass in this portion features different biological properties than water in the main basins. 'Plankton abundances also …[show] higher variability in the north' (*ibid*). Furthermore,

> …medusae …[dominate] the macrozooplankton community in the northernmost …[portion], while the southern pelagic ecosystem ...[is] distinguished by a …[preponderance] of shrimps….[However, the calculation for shrimp abundance] may be an underestimate, because of possible net avoidance; a considerable part of the shrimp population may also have stayed deeper than 100 m at the time of routine sampling…[*ibid*].

Because '…data from lakewide cruises indicate a more uniform distribution of zooplankton and only minor differences in community [makeup] between different parts of the lake…'(*ibid)*, the permanent sample site off Bujumbura may represent a distinct, non-typical sub-area of the North basin. This is likely in view of the fact that it is subject to particular anthropogenic influences (Bujumbura town) and inputs of the Rusizi River. The Mpulungu sub-basin, on the other hand, is known to be more liable to the effects of dry season winds than the rest of the lake.

The SSP summary report points out that differences in the plankton community are reflected also in fish biology data. '[According]… to fish stomach analysis and simultaneous zooplankton sampling … shrimps ...[are] highly selected as prey for clupeids in all areas…' (*ibid*) and for *Lates stappersii* in Mpulungu. Elsewhere *L. stappersii* feed more on copepod zooplankton. The report notes that 'The effect of seasonal mixing …[is] clearly seen also in the vertical distribution and migration … as the planktonic community of the southern end occupied the water…[to depths] of around 220 m, which is about twice as much of the vertical space utilised by zooplankton in the north (*ibid*:10).

LTR zooplankton abundance estimations are based on literature-derived production-to-biomass (P/B) ratios as well as the project's own rearing experiments and carbon/energy calculations. The data were generated through short-interval sampling covering two successive years, although areal comparisons are difficult since only three sample sites were involved.

Zooplankton production is estimated to be much lower than what has been reported earlier for Lake Tanganyika, but are similar to estimates that have been made for Lake Malawi.

4.2.3 Fish production and yield

Length-frequency analyses (LFA) were used to determine growth and mortality rates of *S. tanganyicae*, *L. miodon*, and *L. stappersii* from weekly fish samples taken from commercial (lift net, beach seine, and purse seine) catches at the three main research stations and six substations. Average production-to-biomass ratios of fish derived from LFA are roughly similar to annual values that have previously been calculated for *Stolothrissa.* Growth and mortality estimations generally correspond to results of earlier analyses and are partially supported by clupeid age readings from counts of daily increment rings in the otoliths.

Fish biomass values used in formulating preliminary production estimations were drawn from earlier studies. Results from the LTR hydroacoustic cruises are only recently available (Szczucka 1998), and like all earlier estimates for the lake show wide temporal and spatial variation. Based on catch studies, commercial landings in the northern end of the lake are dominated by young *L. stappersii* and clupeids whereas those in the southern end of the lake are comprised mainly of adult *L. stappersii* and various growth stages of clupeids. In the lakewide catch, clupeids account for about 65% and the *Lates* species for some 30% of the total. Production calculations based on the assumption of similar biomass proportions, and using derived P/B ratios, work out (in carbon-converted units) to 5.8 g $Cm^{-2}a^{-1}$ for planktivorous pelagic fish (*Stolothrissa* and *Limnothrissa*) and 1.4 g $Cm^{-2}a^{-1}$ for the *Lates* predators. These estimates correspond to the range of values calculated in earlier studies, but still appear to be unrealistically high when compared to pelagic fish biomass figures reported for Lake Malawi, which are based on numerous lakewide acoustic surveys.

The SSP summary observes that annual catches from Lake Tanganyika show an increasing trend over the period from the late 1960s to the early 1990s. LTR catch figures for the early 1990s, derived from the most comprehensive statistical collection effort yet mounted on the lake, are the highest reported thus far (equivalent, in 1992, to 51 kg ha^{-1}). They nevertheless remain lower than the potential yield levels of 380,000 – 460,000 tonnes (116 – 140 kg ha^{-1}) reported in earlier literature. However, present realised yield in Burundi waters, where fishing pressure is highest, already approaches the more conservatively estimated potential yield level of 100 kg ha^{-1}. Since catches per unit area have decreased for the last three decades or so in these waters, it is quite possible that sustainable catch levels are lower than previously reported. This is corroborated by the project's calculations for zooplankton production, which give a lower figure than previous estimates. It is noted that productivity in the large central expanses of the lake may be lower than that of inshore waters, since primary production is mainly dependent on internal nutrient cycling and mixing regimes.

4.2.4 Carbon flow and trophic structure

Analysis of the LTR SSP data is generating '… a new view of the trophic structure of Lake Tanganyika…' (*ibid*:16). Specifically, '…phytoplankton production and carbon biomass figures are higher than those reported in earlier estimates….. In contrast, …[the] new zooplankton data indicate lower biomass and production than previously estimated' (*ibid*). Thus, contrary to earlier assessments, the LTR data show that '… the trophic efficiency between zooplankton and phytoplankton or between fish and phytoplankton in Lake Tanganyika are low…. Likewise, fish yield seems to be relatively low in comparison with primary production…' (*ibid*). Though the uncertainty of fish biomass values still needs to be resolved, the preliminary findings on fish production relative to primary production '…fall within the normal range reported from other large lakes' (*ibid*). The findings related to bacterioplankton also compare well with literature values.

Though still tentative, findings so far point to the general conclusion that:

> …trophic efficiencies in the pelagic food web of Lake Tanganyika are not unusually high. The crustacean zooplankton production is small, but the recorded fish yields quite normal relative to the measured primary production of pelagic phytoplankton. Thus the flourishing fisheries in Lake Tanganyika are not so much based on any exceptional productivity of the system, but on the fact that most of the pelagic production is canalized into a few fish species that have short life cycles and rapid reproduction, … are relatively easy to catch and [are] thus suitable targets for an economic fishery [*ibid*].

4.2.5 Indicators for management planning

Studies conducted under the various SSP components of the complex of physical, chemical, and biological mechanisms that drive production processes in Lake Tanganyika have generated a rich array of findings. Whilst these are important in their own right, either as corroboration of or possible corrective additions to elements of earlier work, the broader significance of the SSP studies for management planning purposes is that they demonstrate the feasibility of constructing models which can be used to forecast changes affecting fish stocks and fish production in the lake.

- **Estimates for potential primary production** and thus the basis for secondary production can be developed through study of major weather and wind patterns, relationships between water mass layers, and levels of primary nutrients.

- **Calculation of future fish production in the pelagic zone** is possible through monitoring of relationships between zooplankton abundance/production and fish production.

- **Inter-annual and regional trends in stock sizes and fish populations** can be tracked through catch and CPUE monitoring, combined with analysis of fish biology data.

- **Collaborative lakewide monitoring**, conducted through a long-term programme as already recommended in section 4.1 above, is again indicated as a necessary measure in support of the management process. For predictive modelling purposes, such a programme would need to provide for regular observations of meteorological, hydrophysical, and limnological events as well as collection of basic data on fish biology. Yet attention to these dimensions of variation alone will not suffice. A truly ecosystem-based, holistic management strategy for Lake Tanganyika will have to take human influence on the lacustrine environment and the fish community into careful account as well. Thus, the measurement of socio-economic parameters should also be included as a major component of any lakewide monitoring programme.

4.3 Distribution and Ecology of Pelagic Fish[16]

The LTR technical document assembled by Mannini (1998) reports on pelagic fish and shrimp distribution and species relationships within Lake Tanganyika. It is based on data gathered over a series of five integrated acoustic and pelagic trawling lakewide surveys aboard *R/V Tanganyika Explorer*, as part of the SSP, and draws also on findings from previous work using commercial fishery-dependent information (Coenen *et al*. 1998; Mannini *et al*. 1996). Results, subject to further confirmation once acoustical analyses are completed (Szczucka 1998), are evaluated in terms of their implications for management of the three most important commercial species -- the clupeids *Stolothrissa tanganicae* and *Limnothrissa miodon*, and the centropomid *Lates stappersii*.

4.3.1 *Stolothrissa tanganicae*

The *S. tanganicae* stock appears to be unevenly distributed within the lake, with most of

[16] Summary review extracted from Mannini (1998).

its biomass found in the northern half (from Kalemie to Bujumbura). This pattern is also borne out by commercial catch composition (section 4.1 above), but seems to be a fairly recent development. Whilst decline coincides with the expansion of industrial purse seining in Zambian waters, fishery exploitation in itself probably does not explain *S. tanganicae* stock collapse in southern waters. The stock has not declined in northern waters despite the fact that for some decades it has been exposed to high levels of fishing pressure in fairly confined areas. The explanation may lie instead in the susceptibility of clupeid stocks to '...considerable fluctuations or collapses principally related to environmental factors, which undermine the recruitment process.... [When] several consecutive recruitment periods are very poor the stock size of short-lived species declines quickly' (Mannini 1998:26).

Contrary to suggestions in earlier studies that juvenile *S. tanganicae* have an inshore phase and that inshore-offshore distributions of juveniles and adults largely coincide, LTR pelagic trawling survey results indicate that there are separate distribution patterns. Young fish concentrate in offshore areas and move towards shallower water at around 2-3 months of age and 30-40 mm in length. The young '...are recruited first to the industrial fishery and then to the lift-net fishery. Fishing grounds of the former are normally more distant from the coast than those of the artisanal fishery' (*ibid*:27).

Survey findings further indicate that the annual round of *S. tanganicae* spawning and recruitment involves a significant expansion of spawning stock biomass in the early months of the year, around the middle of the wet season, with recruitment peaking in subsequent dry season months. Thus,

> The Lake Tanganyika *S. tanganicae* fishery is supported mostly by a single major cohort, which is recruited during the dry season and makes the exploitable stock during the successive wet season. The temporal pattern of the principal recruitment pulse to the fishery is similar around the lake (Mannini *et al*., 1996) and fishery statistics indicate that the bulk of the commercial catch is made from September to December (FAO, 1978; Coulter, 1991b; Coenen *et al*., 1998) [*ibid*:28].

The availability of *S. tanganicae* to the fishery within local grounds appears to be further restricted by the high mobility of its schools, a characteristic that confers advantages in terms of predation avoidance and location of food sources.

4.3.2 *Limnothrissa miodon*

LTR survey results confirm a more uniform lakewide distribution of the *L. miodon* stock in comparison with that observed for *S. tanganicae*.

Catch composition observations indicate that *L. miodon* contribute less to the lift net and purse seine harvests than do *S. tanganicae* and *L. stappersii*. At the same time, the species dominates catches in the highly unselective beach seine fishery that operates close inshore over shallow, sandy bottoms, particularly along the southernmost coastlines. Since juvenile *L. miodon* tend to be concentrated within the inshore areas beach seine hauls are mostly comprised of immature fish. The widespread use of very fine mesh covers on the seines further intensifies pressure on the immature stock.

L. miodon move into deeper waters offshore as they grow, and are recruited first to the lift-net and then to the purse seine fisheries. The pelagic trawling study notes that the largest adults (>125 mm) '...occur almost exclusively offshore, in the central areas of the lake, outside the range of the artisanal fishery. These fish are believed to compete for food with *L. stappersii* preying upon pelagic shrimps and young *S. tanganicae* ...' (Mannini 1998:31). The study goes on to observe that 'The inshore-offshore separation between the very young and adult fish in Lake Tanganyika has probably evolved to minimise juvenile mortality due to cannibalism and *L. stappersii* predation (the latter is rare inshore)' (*ibid*).

4.3.3 *Lates stappersii*

The centropomid *L. stappersii* is a relatively long-lived (5 to 7 years), fast-swimming, and highly mobile pelagic predator of both clupeids (principally *S. tanganicae*), and shrimps. Its stock is distributed throughout the lake, but is most common to the central portion, in the waters lying between the Kigoma and East Marungu sub-basins. This stretch of the lake, with its steep shoreline, narrow shelf, and great water depths, seems to offer the optimal *L. stappersii* habitat. Juveniles and adults generally share geographical areas, but the former often range along inshore shelf and slope zones whereas the latter tend to keep to the pelagic zone.

Although *L. stappersii* is capable of moving and mixing freely across all sub-basins of the lake, from a management perspective it is possible to discriminate a 'northern' and 'southern' stock on the basis of spawning and exploitation patterns. There are indications that the Kigoma sub-basin provides spawning and nursery areas for the 'northern' stock, and that the Moba and East Marungu sub-basins fulfil the same roles for the 'southern' stock. 'Northern' fish range from the Kigoma sub-basin south into the Kalemie sub-basin and north into the Rumonge and Bujumbura sub-basins, and are mostly exploited by the artisanal liftnet fishery. Adults are rare north of Rumonge, and juveniles become rare from about the 90-100 mm size class (around 6 months old), suggesting that these northernmost waters provide only an interim, juvenile-phase habitat for *L. stappersii*. The industrial purse seine fishery working out of Mpulungu mostly exploits the 'southern' fish.

Size composition of catch and length at entry into the fishery are different between the 'northern' and 'southern' stocks. Though probably never highly abundant in the northern end of the lake, adult *L. stappersii* were from the 1960s '...efficiently and quickly reduced by the combined, heavy industrial and artisanal fishing pressure which developed in succession in that region' (*ibid*:35). *L. stappersii* presently account for around 20% of commercial catch composition in northern waters, and most of this contribution is made up of juveniles.

In the southern part of the lake, where *S. tanganicae* was the dominant target species of the purse seine fishery in the 1980s, *L. stappersii* is now the almost exclusive (95%) component of the industrial catch. This fishery appears to be relying very heavily on adult stock migrating in from the Moba and East Marungu sub-basins, and declining commercial CPUEs and high fishing mortality as compared with other areas of the lake raise serious concerns for the future:

> It is reasonable to believe that the stock targeted by the Zambian industrial fishery is sustained by immigration of fish from the less exploited areas north of the industrial fishing grounds. Should the existing industrial fishery reach these relatively poorly exploited areas (provided that this is practically and economically feasible) and/or a new, well organised industrial fishery develop, uncontrolled, to target *L. stappersii* stock in the areas of its main concentrations, then the stock will probably drastically decline and will not be able to sustain the yields recorded by the Zambian fleet during the last decade [*ibid*:36].

4.3.4 Relations between species

Differences between 'northern' and 'southern' *L. stappersii* are further evident in terms of the feeding regime. Planktivorous in its early stages of growth, the species switches to preying on fish, notably *S. tanganicae*, at about the 100 mm size. Earlier work had established that pelagic shrimps could also figure as an important dietary component for *L. stappersii* in southern waters. Lakewide feeding patterns remained unclear, however. LTR investigations demonstrate that the centropomid diet is heterogeneous throughout the lake, but that patterns vary between the north and south. *S. tanganicae* is a main prey of the 'northern' *L. stappersii* stock, and variably so for the 'southern' fish. In general,

> There is not only a simple predator-prey relation between *L. stappersii* and *S. tanganicae*, but this also includes the shrimps. Both clupeids and shrimps alternate in the diet composition of the predator depending on the time of the year, area of the lake, and their abundance in the environment. The important southern *L. stappersii* stock seems to be sustained by the shrimps even when *S. tanganicae* abundance is low [*ibid*:37].

With their high mobility, *S. tanganicae* are apparently far more efficient at predator avoidance than pelagic shrimps. This same mobility enables the clupeids efficiently to seek out copepod prey, and explains their rapidly fluctuating abundance across fishing grounds:

> Local concentrations of mesozooplankton are efficiently located and depleted by the clupeids, which then move away seeking new feeding grounds. Therefore, within the yearly abundance cycle, the availability of *S. tanganicae* stock to the fishery is strongly influenced by the timing and distribution, within local areas, of plankton abundance [*ibid*:38].

4.3.5 Indicators for management planning

Key management planning 'messages' conveyed by findings of the LTR pelagic trawl survey and related biological investigations may be drawn together as follows.

- **Environmental factors and pelagic stock dynamics.** Stocks of short-lived, high turnover species like *S. tanganicae*, with shallow population structures (one or two major cohorts), are inherently subject to dramatic negative effects induced both by environmental and fishery exploitation pressures. Also, effects of the latter may seriously compound those of the former. For example, if climatic factors cause a decline in recruitment and thus a decline in catchable stock, and if fishing effort remains constant, then recruitment overfishing occurs.

- **High risk nature of *S. tanganicae* fishery.** Although *S. tanganicae* display the highest productivity (production/biomass ratio) of the three major commercial species, and theoretically can sustain an annual catch higher than its standing stock biomass, its fishery is inherently risky. Not only is the stock liable to wide environment-induced fluctuation, but its occurrence within local fishing grounds can be very sporadic, owing in part to the patchy distribution of copepod plankton, a primary food item.

- **Signals of possible local overexploitation of *S. tanganicae* stock** are noted for the northern end of the lake, in the form of high juvenile content and smaller mean length in catches as compared with those further south. The sustainable yield level for *S. tanganicae* may have been reached on both west and east coasts north of Karonda, making any moves towards further fishery development inadvisable. The situation for the rest of the lake seems more secure.

- **Adverse impacts of beach seining on *L. miodon* and other stocks.** Whilst there are no indications of overexploitation pressures on late young and adult fish, it is clear that the highly unselective beach seine fishery, mostly prosecuted in Zambia, is heavily targeting juvenile *L. miodon* in their shallow, inshore nursery grounds. The seines are inflicting further untold damage upon the mainly cichlid coastal fish community. A total ban on beach seining is obviously called for. Failing this, a system of 'beach seining prohibited' areas would at least reduce the destructive effects of this practice.

- **Overexploitation of *L. stappersii* in southern waters** is clearly signalled by the seven-fold growth in industrial fishing effort in the last fifteen years or so (from 3 to 23 active units since 1983) in the face of a significant decline in CPUE. Fishing operations based in or around Mpulungu are dependent on in-migration of stock from areas of higher occurrence in the Moba and East Marungu sub-basins, and this should be borne in mind in considering the urgently needed curtailment of purse seining in the southernmost waters.

- **Redistribution of industrial units** to bases in Moba and Kalemie (which would in a number of cases actually be a move back to point of origin) might well have the effect of further reducing the stock now being targeted by Mpulungu units.

- **High exploitation pressures on *L. stappersii* in northern waters.** The situation with respect to the northern end of the lake, though less explicit, warrants attention as well. This is also an area which has undergone relatively intense pelagic fishing development, first with purse seining and then with artisanal liftnetting.

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4.4 Reports on Institutional and Legal Issues

LTR reports on institutional and legal aspects of fisheries management for Lake Tanganyika include those of Hanek (1994), Maembe (1996), and Cacaud (1996).[17] There is also a separate and earlier appreciation of regional fisheries legislation by Bonucci (1990). Major findings and recommendations are briefly summarised below for each of the four lacustrine states. A format for building more detailed assessments of existing management arrangements in terms of adherence to responsible fisheries principles is provided in the sample 'audits' shown as Annex 1.

4.4.1 Burundi

Fisheries affairs are vested with the Department of Water, Fisheries, and Aquaculture under the Ministry of Agriculture and Livestock. Policy emphasises sustainable exploitation of resources to bolster national food security and generate employment and income. In recent years production has fallen drastically from historical levels owing to political unrest and insecurity, culminating in complete closure of landing sites in March 1996.[18] Industrial purse seining, which was pioneered in the Burundi sector of Lake Tanganyika, has for some time been in decline. Before the closure, strong fiscal pressure in the form of taxes and other fees and strict limitation on the number of permits issued was contributing to a withdrawal of effort (idle units or units transferred to other countries), suggesting an implicit policy of fleet displacement in favour of an expansion of the artisanal lift net fishery.

The management authority is severely constrained from fulfilling its monitoring, enforcement, and extension roles by chronic budget shortages. Aside from crippling the Department's normal operational procedures, this problem expresses itself in poor levels of motivation and performance by field staff. Much of the technical assistance provided through external funding in past years, such as for upgrading the fisheries statistics and information systems (FAO/PNUD Project BDI/90/002), has had no lasting impact because national follow-up activities cannot be supported by the weak departmental budget.

Fisheries law is based on decrees dating back to the colonial era that establish a broad framework of authority under which specific regulations can be created to govern questions of fishing techniques, gear specification, fishing seasons and areas, licensing, sanctions, etc. A ministerial regulation issued in 1961 specifically deals with Lake Tanganyika, but is in many respects outdated and incomplete. In some cases practices are banned but corresponding sanctions are lacking; in other cases fine levels are obsolete. Furthermore, regulatory provision is lacking entirely for certain kinds of common gear such as longlines, and destructive practices such as beach seining are ignored.

It is understood that draft fisheries legislation was developed under an FAO Technical Co-operation Programme project in the early 1990s (TCP/BDI/8954) for submission to Parliament, but that the process was interrupted by the outbreak of political turmoil in 1992. This draft now needs to be re-examined and updated as appropriate, taking into account present fishing practices as well as the need to address environmental issues (pollution, habitat protection, etc.) and fish product quality assurance.

4.4.2 DRC

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[17] The latter two reports resulted from a joint mission undertaken by LTR and the FAO Fisheries Management and Law Advisory Programme, GCP/606/NOR/INT, as part of a co-operative mission with LTR.

[18] A partial re-opening of fishing activity at selected landings took place in May 1997.

It is not yet known just how the fisheries institutional and legal situation will evolve in the Democratic Republic of Congo (ex-Zaire) following the events of civil war that resulted in the establishment of the new national government in 1997. Assessments of the situation as of 1996 (Cacaud 1996; Maembe 1996) portray a fisheries administration in a state of collapse after years of political turmoil and economic malaise. The National Department for the Development of Fisheries had no budget allocation and was certainly not in a position to fulfil its management responsibilities. The Department's personnel working on the lake were effectively cut off from the headquarters in Kinshasa and largely left to their own devices. It should be noted however that throughout the difficult period of the past five years or so Uvira-based fisheries staff have continued to carry out valuable work in collaboration with the LTR project.

Past fisheries policy in the country has given priority to production in order to meet national food needs. As in Burundi, fisheries legislation rests on colonial era decrees that enable designated authorities to issue regulations covering particular questions such as fishing seasons, licenses, gear specifications, and so on. Various regulations dealing with Lake Tanganyika are on the books but have not been effectively enforced for years and are widely ignored.

Draft legislation intended to provide a new legal framework for the national fisheries was prepared in 1985 but never took effect. If the wider political and economic situation improves and fisheries administrative functions begin to be revitalised, comprehensive review of the 1985 draft and earlier regulations specific to Lake Tanganyika should be treated as a matter of urgent priority. Substantial work will be called for in order to secure a legal framework that is relevant to current fishing realities and conservation requirements.

4.4.3 Tanzania

The Fisheries Department of the Ministry of Natural Resources and Tourism with headquarters in Dar-es-Salaam, oversees fisheries policy, management and development responsibilities in Tanzania. Research responsibilities are vested with the Tanzania Fisheries Research Institute (TAFIRI), with headquarters close to Dar and various field stations, including the centre that hosts the LTR sub-station at Kigoma. Sectoral policy aims at the sustainable exploitation of fishery resources to serve national food security purposes and to contribute to domestic employment and income generation, and to provide earnings of foreign exchange.

Principal management and development constraints as far as Lake Tanganyika fisheries are concerned include severe budget limitations affecting both DoF operations (poor field staff support capability, weak extension, statistical collection, and enforcement services) and research activities. The 'in-house' base of information on the state of resources and trends in harvest and trading activity is also deficient. Furthermore, the remote location of the lake and poor communications and transportation infrastructure, which limit contact with fishing villages, undermine the effectiveness of fisheries administration and research activities, and pose obstacles to the marketing of fish products. There are in addition problems of security and undocumented trade.

Fisheries legislation is founded in the Fisheries Act, No. 6 of 1970, which broadly establishes the authority of the Ministry over conservation, development, and regulation of fish, fish products, and aquatic flora. The Fisheries Principle Regulations of 1989 and Fisheries (General Amendment) Regulations of 1994, further elaborate, *inter alia*, conditions and procedures for licensing (vessels, fishers, and fish traders), statistical reporting obligations, and export of live fish, prohibited fishing techniques, and pollution liabilities.

The legislative framework as it applies to Lake Tanganyika is incomplete and warrants significant review and revision. Amongst other things, provision should be made for community-based management arrangements, stricter controls on destructive fishing methods, and the creation of underwater protected areas.

4.4.4 Zambia

Policy has emphasised a broad social welfare orientation for the fisheries sector. Four specific objectives are noted, namely: a) increased production; b) improved conservation awareness and use of methods that ensure conservation of stocks; c) improved socio-economic status of fisherfolk and fisheries-dependent populations (small-scale fishers and fish traders, boat builders, fish farmers, etc.); and d) applied research and data collection as a foundation for fisheries planning and development.

A number of problems heavily compromise efforts to achieve these objectives. First of all, the DoF's budget is inadequate for the proper performance of its monitoring, regulatory, and extension functions. Field staff are deficient in both numbers and in training, and levels of staff support in terms of transport and other facilities are wholly inadequate. Furthermore, fishing gear supply problems have forced local operators to resort more and more to the use of destructive harvesting methods. On the side of the industrial fisheries, there has been an inordinate growth in the number of units allowed to operate in Zambian waters.

A substantial overhaul of existing fisheries legislation (based on the Fisheries Act, No. 21 of 1974 and supplemental statutory instruments) is now in progress. Proposed legislation would introduce fundamental changes in the areas of: a) community-based management; b) structure of the DoF; c) stock conservation and protection; and d) extension of the legal framework to cover fish farming.

Of particular interest in the proposed legislation are provisions which would enable local representatives of fishing communities to participate in the decision-making process through appointment to Fisheries Management Boards for various commercial fishing areas. Furthermore, with regard to local-level interests,

> A Statutory Instrument, the Fisheries (Integrated Fisheries Management) Regulations, ...has also been drafted. Under these regulations, the Minister is empowered to designate permanent fishing villages including contiguous fishing grounds as well as to establish integrated Village Management and Zonal Committees to manage aquatic resources in any river, swamp and lake. The functions of the Village Management Committees would consist of implementing an integrated community based approach for the management of aquatic resources, collecting license fees and enforcing fisheries regulations Those of the Zonal Committees would primarily be directed at coordinating activities of Village Management Committees....a revolving fund would be maintained by each Zonal Committee...[supported by] money deriving from license fees, fines and fish levies [Cacaud 1996:4].

Nevertheless, it appears that even with the new framework further provisions will be called for in order to strengthen legal bases for environmental protection and fish product quality assurance. It is also noted that gear regulations should be fully reassessed in light of current fishing practices, and that any new legal framework should provide for the possibility of regional co-operation in the management of shared stocks and transboundary fishing agreements.

4.4.5 Institutional options for regional co-operation

LTR assessments confirm that the fisheries authorities of Burundi, DRC, Tanzania, and Zambia are all strong advocates of enhanced regional co-operation for the management of Lake Tanganyika fisheries. Three major institutional options for facilitating such co-operation have been identified on the basis of interviews with fisheries and other government officials in the four states. The first would involve a variation on the existing CIFA Sub-Committee for the lake, whereas the other two would require establishment of wholly new quadri-partite entities.

Regional working group of CIFA Sub-Committee

This institutional arrangement would provide a regional forum for information collection and exchange. Recommendations and reports would be channelled to the CIFA body. The working group would particularly attend to questions of:

1) conservation of fish stocks and aquatic ecosystems;
2) fisheries legislation harmonisation;
3) co-operation in fisheries monitoring and surveillance activities; and
4) collaborative research needs.

The working group type of institution would be broadly based, with a nesting structure of local stakeholder group members (fishers, traders, local fisheries and other authorities, etc.) combining into National Working Groups headed by National Co-ordinators. Each national group would provide representatives to the regional group. The latter '... would be an advisory body whose primary functions would be to strengthen co-operation among technical and local authorities directly involved in the management of fisheries resources on the Lake and to pursue the agenda set by the FAO CIFA Sub-Committee during the inter-sessional periods' (*ibid*:14).

Such an arrangement offers several advantages:

1) It could be developed through an existing body (the CIFA Sub-Committee).
2) Funding would be required but costs could be kept within reasonable limits.
3) It would provide a ready means of promoting community participation in fisheries management.
4) It has the potential for expansion and integration at a later stage with other institutional arrangements, either to serve expanded lake fisheries purposes or to fulfil larger cross-sectoral purposes, such as the regional environmental body envisioned by the Lake Tanganyika Biodiversity Project.

Possible disadvantages may also be foreseen. As a subsidiary body, the Regional Working Group would very much depend for its effectiveness and relevance on the parent CIFA Sub-Committee. If the Sub-Committee functions in a strong and convincing fashion, then the Working Group has the potential of fulfilling its intended purposes. If not, prospects for this institutional arrangement are poor.

Technical committee with permanent secretariat

This type of institutional arrangement would also serve largely advisory and co-ordination functions. Unlike the Working Group approach, however, it would be endowed with an independent existence outside of the CIFA Sub-Committee structure. Indeed, it would simply replace the latter. As an independently functioning entity the Technical Committee would require a permanent secretariat to arrange for annual meetings, collate the advice and recommendations of National Working Groups (constituted as for the Regional Working Group/CIFA Sub-Committee approach described above), and generally to provide administrative support. Thus,

> ... [the] states would have to work out an agreement determining which country would host the permanent secretariat and setting out the terms and conditions as well as the rate of financial contribution of each contracting party to its functioning. This type of institution consists of a high-level technical body at Fisheries Directors level, which provides policy guidance, thus composed of the Fisheries and Research Directors assisted by the four national co-ordinators [*ibid*].

Advantages offered by the Technical Committee approach include the strengthening of community participation in management within the various national sectors. A certain independence of institutional personality would also be gained, though only if adequate operational funds are forthcoming. Operational costs would be high, and thus must be regarded as a possible disadvantage. The protocol arrangements for such a scheme would also be quite involved.

Lake Victoria Fisheries Organization model

Established through a Convention adopted in mid-1994, the Lake Victoria Fisheries Organization (LVFO) provides the model for a third institutional approach to regional co-

operation. This option is by far the most involved and ambitious, for it requires the setting up of an independent intergovernmental body with considerable funding, staffing, and physical establishment requirements.

> The LVFO has a complex four-tier structure, consisting of: a three-member Council of Ministers, which provides political guidance; a six-member Committee of the heads of the departments in charge of, respectively, fisheries management and fisheries research, with supervisory and general guidance functions; two technical committees; and a permanent international secretariat, headed by an Executive Secretary assisted by a Deputy and by professional and general service staff. In addition, a National Committee for Lake Victoria Fisheries is created in each member country, with consultative functions at the national level [*ibid*].

LVFO-type structures can only be built on a foundation of considerable political will and financial resources. A regional organisation so established would presumably enjoy high measures of visibility and government support. But there are clear disadvantages as well. For example, operating costs are bound to be quite substantial, and institutional stability may come to depend almost entirely on donor funding. Moreover, very long lead times are required in order to set up such elaborate structures. Fully six years were required in the case of the LVFO, even though the three countries involved could draw on historical precedent (the East African Freshwater Fisheries Organization and the East African Community) and a common legal heritage.

4.4.6 Indicators for management planning

LTR reviews of institutional and legal aspects of Lake Tanganyika fisheries indicate that there are a number of shortcomings shared by all the lacustrine states. Whereas national sector policies reflect a common commitment to socio-economic welfare objectives for the fisheries, consistent with the need to use resources in a sustainable, conservation-wise manner, institutional and legal frameworks are very weakly equipped to serve policy objectives effectively. Fisheries departments and research agencies are chronically under-funded, and in some cases disastrously so. Attendant problems of operational paralysis and lack of motivation amongst field personnel are rife. Existing fisheries regulations are outdated and often fail to address current realities; they are in any case widely ignored in practice.

The broad regional picture of institutional capacity and fisheries law development, enforcement, and compliance is therefore not very encouraging. Furthermore, it must be recognised that many of the problems afflicting the fisheries sector within each of the lacustrine countries are but particular expressions or consequences of wider, macro-level socio-economic and political circumstances, the amelioration of which will only be accomplished in gradual and possibly uneven ways.

This having been said, direct and immediate actions are still required to improve institutional and legal modalities in support of more effective fisheries management on Lake Tanganyika. LTR assessments identify the following key areas of need.

- **Community based management.** Mechanisms which would allow greater participation of local stakeholders in management decision-making and regulation enforcement processes should be negotiated and implemented. Preliminary moves have already been taken in Zambia, and initiatives for other sectors of the lake should use the Zambian experience as a reference point.

- **Destructive fishing practices.** These appear to be serious and widespread. Effective regulatory control of such practices as beach seining, the use of very small mesh sizes, and 'active' gillnetting is an obvious requirement.

- **Environmental quality.** Measures for the protection and conservation of the aquatic ecosystem (e.g. pollution prevention/abatement; habitat preservation; designation of aquatic reserves, etc.) are generally weak or non-existent.

- **Regional co-operation.** Institutional arrangements are needed to facilitate co-operation between the four lacustrine states on a range of management-related tasks. These latter include, for example: harmonisation of fisheries legislation; standardisation of data collection procedures; monitoring of shared fish stocks and fishing effort trends; reduction of fishing pressure in areas of excessive concentration through fleet unit redistribution and/or retirement; research to identify habitats, areas, and seasons critical to the maintenance of aquatic biodiversity or the protection of stock components passing through sensitive life cycle phases; and encouragement of community participation in the regulation of fishing. Possible institutional options for quadri-partite regional co-operation include adaptation of existing arrangements (the CIFA Sub-Committee) or creation of new structures (independent Technical Committee or intergovernmental organisation). The last two options would however require ambitious -- and probably under current circumstances unrealistic -- levels of financial commitment and formal administrative support (governing organs, permanent secretariat, general service staff, etc.).

4.5 Socio-economic Investigations[19]

Results of the 1997 LTR socio-economic (SEC) sample survey of small-scale fishers (N = 923) and post-harvest operators (N = 431) at 66 landing sites around the lake are reported in a series of project technical documents covering each of the four national sectors (Reynolds (ed.) 1997a, 1997b, 1997c, 1997d). The lakewide survey overview prepared by Reynolds and Hanek (1997) synthesised information drawn from the country reports, placing particular emphasis on the implications of respondent opinions and views for management planning questions. Major findings were presented in terms of the three primary management concerns for: a) regulation of fishing; b) limitation of access; and c) community participation. They may be condensed here as follows.

4.5.1 Options to regulate fishing: technical measures

Restrictions on gear -- type

Moderate to strong levels of majority sentiment are registered in favour of possible measures to place restrictions (e.g. time and/or place of operation) on industrial fishing amongst fishers of both categories and post-harvest respondents in Burundi, Rukwa (Tanzania), and Zambia. Majority opinion does not support such a move amongst any of the fisher groups in the DRC or Kigoma Region (Tanzania), nor amongst the post-harvest group in the DRC. Processors/traders in Kigoma (Tanzania) are divided in their views on this question. The idea of imposing an outright ban on industrial operations finds no majority support within any of the national sample groups. It is moderately to strongly rejected in all cases except those of the Burundi fishers and post-harvest sample members in the DRC and Rukwa Region (Tanzania), all of whom remain divided or undecided in their opinions (Tables 7a and 7b).

Measures that would place some form of restriction on beach seining only meet with majority support within the post-harvest group of Zambia. A total prohibition on beach seining is firmly rejected by majorities across all the sample sets.

Measures that would place some form of restriction on lift net operations find majority support only in Zambia, amongst both categories of fisher as well as post-harvest respondents. A total prohibition on lift netting is firmly rejected by majorities of respondents lakewide.

[19] Summary review adapted from Reynolds and Hanek (1997).

Restrictions on gear -- characteristics

On the question of general restrictions on mesh size (net types unspecified), there appears to be widespread support amongst all sample groups save those of Burundi traditional fishers (opinion divided), DRC artisanal and traditional fishers (strong rejection), and DRC processors/traders (opinion divided-- Tables 7a and 7b).

When mesh size questions are posed more specifically to fisher respondents, applying in turn to gillnet, beach seine, and lift net mesh sizes, the idea of restrictions finds favour only in Zambia and amongst the two Tanzania regional groups. It is moderately to strongly rejected by both artisanals and traditionals in Burundi as well as DRC fishers (Table 7a).

Restrictions on gear -- other operations

With reference to a proposed ban on 'active' gillnetting (beating and splashing of the water to drive fish into the mesh of a pre-positioned net, or 'katuli' fishing, artisanals and traditionals alike in Burundi and the DRC express strong opposition. Fishers in Tanzania and Zambia, on the other hand, are generally supportive of the idea, with the exception of artisanal operators in Kigoma Region (Tanzania), who seem to be divided in their views (Table 7a).

Table 7a. Sample fisher group majority views on gear restrictions*

	Burundi		DRC		Tz/Kigoma		Tz/Rukwa		Zambia	
RESTRICTION PROPOSITION	**A/Fish**	**T/Fish**	**A/Fish**	**T/Fish**	**A/Fish**	**T/Fish**	**A/Fish**	**T/Fish**	**A/Fish**	**T/Fish**
1) Gear types:										
Controls on industrial gear	+2	+2	-1	-1	-1	-1	+1	+1	+3	+3
Ban on industrial gear	0	0	-1	-2	-2	-1	-1	+1	-2	-2
Controls on beach seining	-1	-2	-3	-3	-2	-2	-3	-2	+3	+3
Ban on beach seining	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
Controls on lift nets	-2	-3	-3	-3	-3	-3	-3	-2	+3	+3
Ban on lift nets	-3	-3	-3	-2	-3	-3	-3	-3	-3	-3
2) Gear characteristics:										
General min. mesh sizes	+1	0	-3	-3	+2	+3	+3	+3	+3	+3
Min. gillnet mesh size	-1	-2	-3	-2	+2	+2	+3	+3	+3	+3
Min. beach seine mesh size	-1	-2	-3	-3	+2	+2	+2	+3	+3	+3
Min. lift net mesh size	-2	-2	-3	-3	+2	+2	+2	+2	+3	+3
3) Other operations										
Ban on *katuli* fishing	-3	-3	-3	-2	0	+1	+1	+1	+3	+3

*** A/Fish =** Artisanal fisher respondents; **'T/Fish' =** Traditional fisher respondents. **Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%); 0 = Divided opinion, no absolute majority.

Table 7b. Sample post-harvest group majority views on gear restrictions*

RESTRICTION PROPOSITION	Burundi P/Hvst	DRC P/Hvst	Tz/Kigoma P/Hvst	Tz/Rukwa P/Hvst	Zambia P/Hvst
1) Gear types:					
Controls on industrial gear	**-1**	**-3**	**0**	**-1**	**-1**
Ban on industrial gear	**-1**	**0**	**-2**	**0**	**-1**
Controls on beach seining	**-2**	**-3**	**0**	**0**	**-3**
Ban on beach seining	**-3**	**-3**	**-2**	**-2**	**-3**
Controls on lift nets	**-2**	**-3**	**-1**	**0**	**-1**
Ban on lift nets	**-3**	**-3**	**-1**	**-1**	**-2**
2) Gear characteristics:					
General min. mesh sizes	**+1**	**0**	**+2**	**+2**	**+3**

*** Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%).
0 = Divided opinion, no absolute majority.

Gear restrictions and occupational problems

Although opinion varies from one proposition to another, with some sample groups definitely weighing in favour of certain measures, the general reading is one of reluctance to accept dramatic restrictions on gear. Reference to respondents' statements on the 'most serious problems' they face in their work suggests some underlying reasons for such reluctance.

Fisher respondents across all the national sample sets tend to rank input supply problems either as 'most serious' or 'second most serious' occupational obstacles. Not only are gear and/or equipment often difficult to come by at all, but there are also problems of adequate quantity and/or quality when supplies are available. Processors and traders identify 'low earnings' as a foremost concern -- a set of problems that could be brought on in part at least by poorly equipped fishing units (see national sector SEC reports for full details).

Seasonal restrictions

Amongst fisher sample groups, only those in Zambia give majority approval to the idea of instituting fishing closures during certain seasons or times in order to allow fish to breed and/or grow. Rather emphatic majorities in all the other cases reject the proposition (Table 8a).

Post-harvest operators give majority approval for possible seasonal closures in Rukwa Region (Tanzania) and in Zambia. Opinion is divided in Kigoma Region (Tanzania), but solidly opposed in Burundi and the DRC (Table 8b).

Area restrictions

Area or place closures such as for river mouths or sandy bays in order to protect breeding and growing habitats find strong majority support amongst artisanals and traditionals in Zambia. They are opposed by strong majorities of both categories of fishers in Burundi and the DRC. Fisher opinion in the two regions of Tanzania is very fragmented over this question (Table 8a).

Rukwa Region (Tanzania) processors/traders lend fairly solid support to the principle of area restriction. Post-harvest sample group views in Zambia and Kigoma Region (Tanzania) are divided. In both Burundi and the DRC, group views are strongly opposed (Table 8b).

Table 8a. Sample fisher group majority views on time and area restrictions*

RESTRICTION PROPOSITION	Burundi		DRC		Tz/Kigoma		Tz/Rukwa		Zambia	
	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish
Limit access by season	-2	-2	-3	-3	-2	-2	-1	-1	-1	-1
Provide closed areas/reserves	-2	-2	-3	-2	0	0	0	0	+3	+2

*** A/Fish =** Artisanal fisher respondents; **'T/Fish' =** Traditional fisher respondents. **Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%); 0 = Divided opinion, no absolute majority.

Table 8b. Sample post-harvest group majority views on time and area restrictions*

RESTRICTION PROPOSITION	Burundi P/Hvst	DRC P/Hvst	Tz/Kigoma P/Hvst	Tz/Rukwa P/Hvst	Zambia P/Hvst
Limit access by season	-2	-3	0	+1	+2
Provide closed areas/reserves	-2	-2	0	+1	0

*** Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%).
0 = Divided opinion, no absolute majority.

4.5.2 Options to regulate fishing: input (effort) and output (catch) controls

Indications of local opinion or predisposition towards input and output controls can be read from responses to questions relating to: a) preference for continued involvement in fisheries-related work; b) perceptions of recent catch trends and expectations for the immediate future; c) the idea of placing quotas on the total number of fishers allowed to operate on the lake; and d) the possible imposition of restrictions of one kind or another for certain fisheries.

Future occupational and residential preferences

Direct questions to fisher and post-harvest respondents on future occupational and residential preferences reveal that solid majorities in all the national sample sets would like to stay with their present line of work and remain at their present bases of operation (Tables 9a and 9b).

Commitment to continued work in the sector is not so definite amongst the sample groups when gauged according to respondents' stated investment preferences (fishing-related versus other use preferences, e.g. farming, opening a shop, etc.). Zambian fishers and post-harvest respondents remain with strong readings on this measure along with, though to a lesser extent, post-harvest interviewees in Kigoma Region (Tanzania) and Burundi (see national sector studies for full details).

Table 9a. Sample fisher group majority preferences for future occupational and residential statuses*

STATED PREFERENCE	Burundi		DRC		Tz/Kigoma		Tz/Rukwa		Zambia	
	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish
To continue in fishing	+3	+3	+2	+3	+2	+2	+3	+3	+1	+2
For staying in present location	+2	+2	+1	+3	+2	+2	+2	+3	+1	+2

*** A/Fish =** Artisanal fisher respondents; **'T/Fish' =** Traditional fisher respondents. **Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%); 0 = Divided opinion, no absolute majority.

Table 9b. Sample post-harvest group majority preferences for future occupational and residential statuses*

STATED PREFERENCE	Burundi P/Hvst	DRC P/Hvst	Tz/Kigoma P/Hvst	Tz/Rukwa P/Hvst	Zambia P/Hvst
To continue in fish business	+2	+3	+3	+3	+3
For staying in present location	+2	+3	+2	+3	+2

*** Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%).
0 = Divided opinion, no absolute majority.

Views on catch trends

Fisher and processor/trader sample groups alike are decidedly negative in their appraisals of recent catch trends in the lake (Table 10a). There is no solid body of opinion as to the reasons for decline except amongst Zambian fishers and post-harvest operators, most of whom seem convinced that over-fishing is a principal cause. A slight majority of Burundi post-harvest respondents also blame over-fishing pressure, whereas opinion amongst the remaining national sample groups is fragmented or undecided (see national sector SEC reports for full details).

Expectations for catch trends in the short-term future are mixed. Traditional fishers in Rukwa Region (Tanzania) and both artisanals and traditionals in Zambia are collectively pessimistic, as are post-harvest respondents in Zambia. No group consensus on expected trends is registered for any of the other national sample sets (Table 10b).

Table 10a. Sample fisher group majority views of catch trends*

CATCH TRENDS	Burundi		DRC		Tz/Kigoma		Tz/Rukwa		Zambia	
	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish
1) Within recent past										
Increase	0	0	0	0	0	0	0	0	0	0
Decrease	+1	+1	+3	+3	+2	+3	+2	+2	+3	+3
Similar	0	0	0	0	0	0	0	0	0	0
No opinion	0	0	0	0	0	0	0	0	0	0
2) Anticipated next 5 years										
Increase	0	0	0	0	0	0	0	0	0	0
Decrease	0	0	0	0	0	0	0	+1	+2	+2
Similar	0	0	0	0	0	0	0	0	0	0
No opinion	0	0	0	0	0	0	0	0	0	0

*** A/Fish =** Artisanal fisher respondents; **'T/Fish' =** Traditional fisher respondents. **Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%); 0 = Divided opinion, no absolute majority.

Table 10b. Sample post-harvest group majority views of catch trends*

CATCH TRENDS	Burundi P/Hvst	DRC P/Hvst	Tz/Kigoma P/Hvst	Tz/Rukwa P/Hvst	Zambia P/Hvst
1) Within recent past					
Increase	**0**	**0**	**0**	**0**	**0**
Decrease	**+2**	**+3**	**+3**	**+2**	**+3**
Similar	**0**	**0**	**0**	**0**	**0**
No opinion	**0**	**0**	**0**	**0**	**0**
2) Anticipated next 5 years					
Increase	**+1**	**0**	**0**	**0**	**0**
Decrease	**0**	**0**	**0**	**0**	**+3**
Similar	**0**	**0**	**0**	**0**	**0**
No opinion	**0**	**+2**	**0**	**0**	**0**

*** Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%).
0 = Divided opinion, no absolute majority.

Imposition of fisher quotas

Substantial majorities within all the fisher sample groups voice opposition to the idea of imposing restrictions on the overall number of fishers allowed to operate on the lake (Table 11a).

Collective opinion in the processor/trader sample sets is also set against the idea of fisher quotas, though majority margins amongst Tanzanian and Zambian respondents are considerably less than those found for the Burundi and DRC post-harvest groups or any of the fisher sample groups (Table 11b).

Table 11a. Sample fisher group majority views on fisher quotas*

PREFERENCE	Burundi		DRC		Tz/Kigoma		Tz/Rukwa		Zambia	
	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish
Restrict number of fishers	**-3**	**-3**	**-3**	**-3**	**-3**	**-3**	**-3**	**-3**	**-2**	**-2**

*** A/Fish =** Artisanal fisher respondents; **'T/Fish' =** Traditional fisher respondents. **Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%); 0 = Divided opinion, no absolute majority.

Table 11b. Sample post-harvest group majority views on fisher quotas*

PREFERENCE	Burundi P/Hvst	DRC P/Hvst	Tz/Kigoma P/Hvst	Tz/Rukwa P/Hvst	Zambia P/Hvst
Restrict number of fishers	**-3**	**-3**	**-1**	**-1**	**-1**

*** Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%).
0 = Divided opinion, no absolute majority.

Controls for specific fisheries

As already indicated (section 4.5.1), respondents across the national fisher and post-harvest sample sets generally do not lend their support to controls on the beach seine or lift net fisheries. Broad support does seem to exist for controls on the industrial fishery. Since no specific forms of restriction were at issue (catch controls and/or gear specification and/or time-space limitations, etc.), the question is more one of principle than particulars.

4.5.3 Limiting access

The SEC survey dealt directly with the issue of access and its possible limitation by posing three propositions for use rights cast at different levels of abstraction, and indirectly through a question on respondents' views of resource abundance.

Unrestricted access

Fisher responses to the most abstract open access proposition ('everyone/everywhere') are mixed. Majority support for the idea is found amongst both categories of fishers in both regions of Tanzania and amongst artisanals in Burundi. There is a consensus against totally unrestricted access in the DRC. Opinion in Zambia and amongst Burundi traditionals is divided (Table 12a).

Post-harvest respondent opinion likewise is not consistent across the national sample sets. Totally unrestricted access is moderately to strongly endorsed by groups in Burundi and the two regions of Tanzania; it is firmly opposed by the Zambian sample group and even more by the DRC group (Table 12b).

National access

Fishers of both categories in all the national sample groups except the DRC would favour allowing people to fish 'outside of their own district' (i.e. across internal administrative boundaries within their respective countries). DRC artisanals by a moderate majority are also in favour of this range of access rights; their traditional counterparts are by a strong majority opposed (Table 12a).

For the post-harvest groups, considerable majorities in Burundi and both regions of Tanzania support 'outside of own district' access rights. Strong group opposition is found in the DRC and Zambia (Table 12b).

International access

On the question of allowing people to fish in waters 'outside of their own country,' strong positive response is found only amongst fishers in Burundi. Moderate to strong opposition is encountered in the DRC and Zambian fisher samples and amongst Rukwa Region (Tanzania) traditionals. Slight to modest majorities of artisanals and traditionals in Kigoma Region (Tanzania) and artisanals in Rukwa (Tanzania) support the proposition (Table 12a).

Consensus in the processor/trader sample sets is strongly in favour of access across country borders in the case of Burundi, and strongly opposed in the cases of the DRC and Zambia. Opinion in Tanzania runs slightly in favour for the Kigoma Region group, and slightly against for the Rukwa Region group (Table 12b).

Access and expectations of resource abundance

Both artisanal and traditional fishers in the DRC and Zambian sample sets tend to think that fish resources in the lake will not 'always be enough for everybody.' On the other hand, collective opinion amongst artisanals in Burundi is mildly optimistic. Respondents in the other sample sets are divided or undecided in their views (Table 12a).

Burundi processors/traders take a generally optimistic line on future resource abundance. Opinion in the DRC and Zambia tends strongly towards the negative. In Kigoma and Rukwa regions of Tanzania it is divided or undecided (Table 12b).

Table 12a. Sample fisher group majority views on access rights and future resource abundance*

PROPOSITION	Burundi		DRC		Tz/Kigoma		Tz/Rukwa		Zambia	
	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish
'Everyone fish everywhere'	+1	0	-1	-1	+2	+3	+2	+2	+1	0
'Allow fishers outside own district'	+2	+2	+1	-2	+3	+3	+3	+3	+2	+2
'Allow fishers outside own country'	+2	+2	-1	-2	+1	+1	+1	-2	-2	-2
'Will always be enough fish for everybody'	+1	0	-1	-2	0	0	0	-1	-2	-2

*** A/Fish =** Artisanal fisher respondents; **'T/Fish' =** Traditional fisher respondents. **Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%); 0 = Divided opinion, no absolute majority.

Table 12b. Sample post-harvest group majority views on access rights and future resource abundance*

PROPOSITION	Burundi P/Hvst	DRC P/Hvst	Tz/Kigoma P/Hvst	Tz/Rukwa P/Hvst	Zambia P/Hvst
'Everyone fish everywhere'	+2	-3	+2	+1	-1
'Allow fishers outside own district'	+3	-2	+3	+3	+3
'Allow fishers outside own country'	+3	-2	+1	-1	-3
'Will always be enough fish for everybody'	+1	-3	0	0	-3

*** Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%).
0 = Divided opinion, no absolute majority.

4.5.4 Management in partnership

Local attitudes towards possible co-management arrangements were probed during survey interviews through a final set of propositions dealing with the general issue of shared decision-making responsibility and questions of official enforcement and sanctioning mechanisms.

Attitudes towards co-management

Fishers in Zambia and the two regions of Tanzania tend to reject the proposition that 'fishing rules should only be decided by Government.' DRC and Burundi fishers, on the other hand, give it very solid support (Table 13a).

For the post-harvest sample sets, the proposition is rejected by a majority of respondents only in Zambia. Strong majorities in the DRC and Burundi support it, whilst respondents in both regions of Tanzania remain divided in their views (Table 13b).

Views on official enforcement mechanisms

Fishers of both categories across all the national sample groups lend majority support to suggestions that there should be more fisheries patrol boats and more fisheries scouts to help with regulation enforcement (Table 13a). The idea that there should be more direct involvement of the police in fisheries enforcement finds majority favour only in Tanzania, amongst both artisanals and traditionals in Kigoma Region and artisanals in Rukwa Region.

All the post-harvest groups give modest to firm majority support to the suggestion for more fisheries patrol boats. There is also fairly solid majority support for the idea of deploying more fisheries scouts except amongst the DRC respondents, who remain divided on the question (Table 13b). Slight to moderate majority support for more police involvement in fisheries enforcement is found within the post-harvest sample groups in Burundi and both regions of Tanzania. It meets majority opposition amongst Zambian processors/traders. Opinion is divided or undecided in the case of DRC post-harvest respondents.

Table 13a. Sample fisher group majority views on co-management issues*

PROPOSITION	Burundi		DRC		Tz/Kigoma		Tz/Rukwa		Zambia	
	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish	A/Fish	T/Fish
1) Decision responsibilities										
'Only Gov't should decide rules'	+3	+3	+3	+2	-1	-2	-1	-1	-2	-2
2) Enforcement mechanisms										
'More patrol boats'	+1	+1	+1	+1	+3	+3	+2	+2	+3	+3
'More fisheries scouts'	+3	+3	+1	+1	+2	+1	+2	+2	+3	+3
'More police involvement'	-1	0	-2	-2	+1	+2	+2	-1	-1	-1
3) Official sanctions										
'Punish offending fishers'	+2	+3	+2	+2	+3	+3	+3	+3	+3	+3
'Punish offending traders/ consumers'	+3	+3	+2	+3	+3	+3	+3	+3	+3	+3

*** A/Fish =** Artisanal fisher respondents; **'T/Fish' =** Traditional fisher respondents. **Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%); 0 = Divided opinion, no absolute majority.

Table 13b. Sample post-harvest group majority on co-management issues*

PROPOSITION	Burundi P/Hvst	DRC P/Hvst	Tz/Kigoma P/Hvst	Tz/Rukwa P/Hvst	Zambia P/Hvst
1) Decision responsibilities					
'Only Gov't should decide rules'	+3	+2	0	0	-2
2) Enforcement mechanisms					
'More patrol boats'	+1	+1	+2	+2	+2
'More fisheries scouts'	+3	0	+1	+2	+3
'More police involvement'	+1	0	+1	+1	-1
3) Official sanctions					
'Punish offending fishers'	+3	+3	+3	+3	+3
'Punish offending traders/ consumers'	+3	+3	+2	+2	+3

*** Scores:** +/-1 = Majority for/opposed (> 50%); +/-2 = Strong majority for/opposed (≥ 65%); +/-3 = Very strong majority for/opposed (≥ 80%).
0 = Divided opinion, no absolute majority.

Views on official sanctions

Extremely strong majority sentiment is measured across all the national sample sets in support of suggestions, very generally stated, that violators of fisheries regulations should receive some punishment -- either in the form of fines, gear confiscation, and/or withdrawal of fishing permit in the case of fishers, or in the form of fines, product confiscation, and/or withdrawal of trading permit in the case of traders or consumers (Tables 13a and 13b).

4.5.5 Indicators for management planning

The SEC survey findings yield a large and somewhat complicated set of management planning 'messages.' Local stakeholders are by no means united in their perceptions of fisheries problems and prospects, though important areas of agreement can be found both at a general level and in terms of national, fisher, and processor/trader sub-groupings.

SEC findings indicate a broad acceptance in principle amongst local stakeholders that some sort of formal regulation is needed for the fisheries. This can be read from the widespread concern expressed for the state of commercial stocks and the high approval ratings on propositions to enhance official enforcement capabilities. Such results presumably would not be forthcoming if it were widely perceived that current resource exploitation patterns were without problems.

At the same time, however, there is rather weak agreement lakewide vis-à-vis many of the particulars that management arrangements could entail. Where consensus is found, it tends to be of a negative sort. Moderate to heavy majorities across all the national sample groups surveyed reject the idea of imposing a prohibition on beach seining or on lift net fishing; they also reject the suggestion that an overall limit be placed on the number of fishers allowed to operate on the lake.

Opinion is divided, and sometimes heavily so, on a wide array of questions. Thus, differences of view are registered in response to suggestions that: a) some form of controls be placed on industrial gear, on beach seining, or on lift net operations; b) a total ban be imposed on the use of industrial gear; c) minimum mesh size specifications be applied generally, or specifically for gill nets, beach seines, or lift nets; d) the method of frightening fish into a stationary gillnet, known as 'katuli,' be completely prohibited; e) area and time restrictions be established, as for example to protect breeding or juvenile fish communities; f) access to the fishery be conditioned by certain criteria of residence or nationality; and g) government authorities retain exclusive responsibility for deciding on fishing rules.

The formulation of a regional framework plan for the lake's fisheries therefore faces some very considerable challenges. Not only is there divergence of fisher and post-harvest operator opinion on crucial issues between the national sector samples, but also in a number of instances between different sample groups within the same national sector. A rigidly set 'one design, size, and colour fits all' fisheries management 'uniform' would certainly on present readings be very uncomfortable for many local fisherfolk to wear, assuming they could be induced into trying it on at all. It thus seems best to tailor management approaches to suit the circumstances. This is after all more in keeping with the overall principles of the responsible fisheries 'style.' Management is conceived not as a pattern instantly and irrevocably fixed in its details, but as a process that flexibly accommodates to the acquisition and exchange of information, leading through gradual implementation to measures for ensuring continued productivity of the resource base.

In the context of Lake Tanganyika, it is obvious that a management framework will have to fashioned with a good measure of 'flexible accommodation' vis-à-vis three major and closely interrelated problem areas, namely:

- **Differing orientations towards co-management possibilities.** Many fisherfolk (especially in Tanzania and Zambia) seem to embrace the participatory approach to management, in which decision-making and enforcement responsibilities are shared between local resource user communities and official fisheries authorities. But many

others (especially in Burundi and the DRC) appear to be less enthusiastic, apparently wishing to rely instead on the more conventional 'top-down' arrangement that features a high degree of state intervention in local management affairs.

- **Community outreach.** Although community outreach is integral to responsible fisheries, it is difficult to over-emphasise its importance for the lakewide management process. Environmental education and consultation and negotiation with user groups will have to figure extensively in efforts to gain local level acceptance of measures to regulate fishing (gear use, time and space restrictions, etc.) or to condition access to fisheries resources.

- **Development options.** Management initiatives that significantly curtail existing fishing practices, harvest times or places, or conditions of access to fisheries resources will in all probability involve certain costs to local stakeholders at least in the short term. However well advised, the success of such initiatives will depend greatly on the availability of alternative technologies or other trade-offs that would be meaningful to local stakeholders in simple livelihood terms. In other words, it is quite unrealistic to expect local populations to forego usual and accustomed practices of production, trade, and consumption without any development options ready to hand.

Finally, appreciation of socio-economic realities is an ongoing process requiring continual attention. Conditions within the fisheries, landing site communities, and larger national societies are subject to multiple changes, and these are likely to influence the way local people make decisions about acts of resource use and compromise. Furthermore, as repeatedly emphasised above, effective management is clearly something that must be developed on a partnership basis with local stakeholder groups. Feedback from regular monitoring of socio-economic parameters will provide official administrators, researchers, and others who represent the wider public trust with indications of how this partnership is faring and the ways in which it might be made more durable. The need to monitor socio-economic parameters already has been alluded to in section 4.2.5, but should be specifically highlighted as part of the present management planning 'message' list. Thus,

- **Socio-economic monitoring.** Regular collection of socio-economic information should be undertaken in conjunction with the proposed lakewide long-term monitoring programme (sections 4.1 and 4.2 above), making use of personnel assigned to the fisheries statistical units of the four states. Much of the CAS/FS data will be of relevance to socio-economic investigations, as they will provide ongoing measures of the size and scope of the fisheries (craft and gear inventories, numbers of operators, etc.). But additional monitoring should be carried out to track continuities and changes in such areas as community population size and composition, landing site services/infrastructure, local perceptions and attitudes regarding the fisheries and their regulation, and cost/earning data for harvest and post-harvest activities. Field teams should be provided with extra training as appropriate for the collection of this additional information, which can be recorded in simple, standardised format. Revised versions of the data collection forms used in the original 1997 lakewide SEC survey could be prepared for this purpose.

5. PROVISIONAL FRAMEWORK FOR LAKE TANGANYIKA FISHERIES MANAGEMENT

Framework elements presented below are only outlined in brief. This is because they have largely been anticipated in the 'indicators for management planning' notes that follow each of the reviews of major project investigations and their outcomes presented in section 4 -- viz.: the SSP work related to CPUE, production dynamics and biomass estimation, and distribution and ecology of pelagic fish; the studies of institutional and legal issues; and the socio-economic survey. Cross-references to earlier background material are provided where appropriate. For each of the elements,

a short 'Assessment' sums up the basic circumstances or problems at issue, followed by a statement of 'Framework recommendation.' The sequence of presentation is the same as that described earlier (section 3.3) for the 'management process for responsible fisheries.'

The management framework overall has been kept as minimal and straightforward as possible at this preliminary stage of regional agenda setting. Thus, although LTR studies over the past six years identify a large range of possible management concerns in both the harvest and post-harvest sectors, priority attention is given to those that demand the most immediate attention in terms of implications for regional policy direction, regulation of fishing mortality, access limitation, and community participation. In regard to possible regulation of fishing, for example, attention focuses on artisanal and industrial operations rather than the traditional sector. Units of the latter are significant as a proportion of the lakewide fleet, but are far less important in terms of their contribution to overall annual catch.

This is not to suggest that the other management concerns are irrelevant or trivial. It is only to recognise that the construction of a regional management framework must start with basic elements and priorities, and then, through ongoing review and revision, gradually be elaborated or adjusted as appropriate.

5.1 Policy Reaffirmation, Clarification, and Amplification[20]

Assessment

There appears to be a general need within all four lacustrine states for a re-affirmation and clarification of fisheries policy in order to stress the mutuality of socio-economic and wise use purposes, and to foster greater public awareness of basic objectives. With regard to the shared fisheries of Lake Tanganyika specifically, there is simultaneously a need to foster policy congruence between the four states. The voluntary FAO *Code of Conduct for Responsible Fisheries* (CCRF), as the internationally recognised standard of fishery policy orientation, provides an ideal vehicle for accomplishing these tasks.

Framework recommendation

The CCRF should be adopted as the foundation for shared policy for the shared fisheries of Lake Tanganyika.

5.2 Technical Measures to Regulate Fishing

5.2.1 Gear restrictions

Assessment

Beach seining is a particularly destructive method of fishing wherever it is practised on the lake, both because it exploits inshore fish habitats and nursery areas and because of its highly unselective nature. The beach seine is an especially serious problem in the south end of the lake, where it inflicts considerable harm on the juvenile stock of *L. miodon* but is clearly the gear of choice amongst artisanal fishers. At the same time, the SEC survey data indicate that Zambian fisher views towards at least some controls on beach seining are quite positive. In Zambia as elsewhere on the lake, initiatives to restrict beach seining would require important complementary measures in the form of environmental education and the opening up of other gear and method options as viable alternatives to the practice.

There is clear evidence of overexploitation of *L. stappersii* in southern waters, owing to

[20] Policy characterisations are based on documentary and interview material collected in the course of LTR/FAO Fisheries Management and Law Advisory Programme studies of institutional and legal aspects of fisheries management within the four lacustrine states. Bonucci's study (1990) is also used as a reference.

uncontrolled growth of the industrial fishery. There are also indications of high exploitation pressure on *L. stappersii* within extreme northern waters, though in this case resulting from a concentration of artisanal liftnetting on top of a history of industrial purse seining. SEC survey results indicate that there is considerable local sentiment in favour of stricter controls on industrial fishing.

Framework recommendation

a) Management measures should aim at the total retirement/phasing out of beach seining on the lake.

b) Also, 'off-limits' areas for industrial units should be considered for both the extreme north and extreme south sub-basins (combination gear restrictions and area closure -- see below).

5.2.2 Area and time restrictions

Assessment

The assessment is the same as for section 5.2.1 above.

Framework recommendation

a) Provide for 'beach seining prohibited' areas.

b) Provide for industrial fishing off-limits areas as noted in section 5.2.1 above.

5.3 Input/Output Controls to Regulate Fishing

Assessment

Input or effort controls are indicated with respect to the industrial purse seine fisheries in the south of the lake (overexploitation risk to *L. stappersii*), and the liftnet fisheries throughout the northern end (overexploitation risk to S. *tanganicae* on both west and east coasts north of Karonda*)*.

Framework recommendation

Consider the use of licensing ceilings for both industrial units in the south and liftnet units in the north (waters north of Karonda). In the case of the purse seine fishery, effort should be reduced to levels that prevailed ten years ago. That is, licensing measures should aim at the retirement or transfer to other fishing zones of units that entered the southern fishery within the last decade.

5.4 Access Limitation

Assessment

Local attitudes towards various forms of access limitation are not uniform. On the question of allowing people to fish in waters 'outside of their own country,' for example, strong positive response is found only amongst fishers in Burundi. Moderate to strong opposition is encountered in the DRC and Zambian fisher samples and amongst Rukwa Region (Tanzania) traditionals. Slight to modest majorities of artisanals and traditionals in Kigoma Region (Tanzania) and artisanals in Rukwa (Tanzania) support the proposition. It is nevertheless the case that a 'free-for-all' or unlimited access regime will be impossible to sustain in the face of growing population pressures within the Lake Tanganyika region. Licensing mechanisms in combination with allocation of use rights by zone or water territory between individual fishing communities would seem to be the most appropriate way of countering the 'race to fish.'

Framework recommendation

Use licensing as a means to control individual entry into the fishery, and through a process of consultation and negotiation begin creating a use rights structure based on control of particular inshore zones or territories by particular communities.

5.5 Management in Partnership

Assessment

Attitudes towards co-management appear to vary by country and fisherfolk sub-groupings. For example, fishers in Zambia and the two regions of Tanzania tend to reject the proposition that 'fishing rules should only be decided by Government.' DRC and Burundi fishers, on the other hand, give it very solid support. For the post-harvest sample sets, the proposition is rejected by a majority of respondents only in Zambia. It commands strong majority support in the DRC and Burundi, but respondents in both regions of Tanzania remain divided in their views.

Co-management arrangements should thus be encouraged in a somewhat flexible manner, depending on local predispositions. Community outreach activities with a strong environmental education component will be crucial for building local awareness and acceptance of responsibility in fisheries regulation decision-making and compliance processes.

Framework recommendation

Provide for community-based management (co-management, participatory management, partnership management) structures and operational arrangements with sensitivity to local circumstances and predispositions, possibly through pilot initiatives within selected sites/shoreline segments. Use new approaches being developed in Zambia as reference experiences.

6. ACCOMPANYING MEASURES

A series of supportive or accompanying measures will be required in order to operationalise the framework plan. These measures relate to institutional and legal provisions, development initiatives, and research and monitoring follow-ups.

6.1 Institutional

LTR assessments confirm that the fisheries authorities of Burundi, DRC, Tanzania, and Zambia are all strong advocates of enhanced regional co-operation for the management of Lake Tanganyika fisheries.

Three major institutional options for facilitating such co-operation have been identified on the basis of interviews with fisheries and other government officials in the four states. The first would involve a Working Group, as some variation on the existing CIFA Sub-Committee for the lake. It could possibly develop in the form of a successor body with similar advisory and co-ordination functions. The other two options would require establishment of wholly new quadri-partite entities, either in the form of a Technical Committee with a permanent secretariat, or an intergovernmental Organization along the lines of the Lake Victoria Fisheries Organization.

Establishment of a Technical Committee or regional Organization would presumably garner the advantages of high level visibility and government support. But there are clear disadvantages as well. For example, operating costs are bound to be quite substantial, and institutional stability may come to depend almost entirely on donor funding. Moreover, very long lead times are required in order to set up such elaborate structures.

The Working Group arrangement appears the most viable option. It would provide a regional forum for information collection and exchange. Recommendations and reports could be channelled to the CIFA body at least to begin with. The Group would particularly attend to questions of:

a) conservation of fish stocks and aquatic ecosystems;
b) fisheries legislation harmonisation;
c) co-operation in fisheries monitoring and surveillance activities; and
d) collaborative research needs.

The Working Group type of institution would be broadly based, with a nesting structure of local stakeholder group members (fishers, traders, local fisheries and other authorities, etc.) combining into National Working Groups headed by National Co-ordinators. Each national group would provide representatives to the regional group. The latter would basically serve as an advisory body whose primary functions would be to strengthen co-operation among technical and local authorities directly involved in the management of fisheries resources on the Lake and to pursue the agenda set by an agreed framework plan.

Such an arrangement offers several advantages:

a) It could be developed through an existing body (the CIFA Sub-Committee).
b) Funding would be required but costs could be kept within reasonable limits.
c) It would provide a ready means of promoting community participation in fisheries management.
d) It has the potential for expansion and integration at a later stage with other institutional arrangements, either to serve expanded lake fisheries purposes or to fulfil larger cross-sectoral purposes, such as the regional environmental body envisioned by the Lake Tanganyika Biodiversity Project.

6.2 Legal

It is has been well demonstrated through LTR-associated studies and other appreciations of the situation that the legislative frameworks of the four lacustrine states as they apply to Lake Tanganyika appear to be incomplete and warrant significant review and revision.

This is therefore an obvious area of concentration for framework plan accompanying measures, and requests for further assistance have already been channelled to the Development Law Service of FAO. Technical assistance possibilities are being explored and will be confirmed by the LTR Coordinator.

6.3 Developmental

Implementation of framework plan elements will require further technical assistance with respect to fishing technology and fisheries training/educational institutions, and project profiles are now in the process of being drafted in consultation with the Fisheries Industries (FII) division of the FAO Department of Fisheries.

Efforts to phase out the beach seine fishery need to be complemented by project work to develop, test, and replicate fishing methods that can be deployed by local operators as viable alternatives to seining. In the case of the extensive beach seine fishery in the southern part of the lake, technology needs to be developed and demonstrated to allow effective artisanal exploitation of waters further offshore.

A considerable amount of strengthening is indicated for existing fisheries training/education institutions within the region, in order that their personnel and programmes can support the implementation of CCRF approaches lakewide. In this respect, the programme that is being

developed through the TRAINFISH Network (FAO/Fishing Technology Service) should be explored.

6.4 Research and Monitoring

Accompanying measures to be considered in connection with research and monitoring include the organisation of 'community referenda' and the implementation of a lakewide monitoring programme.

The 'community referenda' exercise is envisioned as a series of briefing and consultation meetings with local stakeholder groups around the lake (see Annex 2). The object of the exercise would be to brief local stakeholder groups on the outcomes of major LTR studies and the elements of the regional management framework proposed above, and simultaneously to obtain feedback and inputs from these groups in order to strengthen the framework and foster a sense of collective participation in efforts to ensure the sustainable use of the lake's fishery resources. It should be organised as soon as possible through the LTR, according to the draft workplan now being prepared.

A lakewide monitoring programme should be put in place according to the approach already elaborated in Kapetsky and Hanek (1998), which makes provision for coverage of physical, biological, statistical, and socio-economic parameters referred to in sections 4.1.6, 4.2.5, and 4.5.5 above.

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ANNEX 1

EXAMPLE COUNTRY 'AUDITS' -- CCRF ARTICLE 7, 'FISHERIES MANAGEMENT'

Note: The following table is provided as an example format for evaluating current degrees of compliance to CCRF principles within the respective states of the Lake Tanganyika littoral and, where applicable, within the lake basin region as a whole. It is by no means intended as a complete 'audit' of the situation for any state or for the region, but should provide some indication of the kind of systematic assessment required in building towards the establishment of responsible fisheries, as proposed in the LTR Draft Framework Plan. The example deals only with provisions of Article 7 of the CCRF (Fisheries Management). Individual provisions are noted in abbreviated/paraphrased form. The official version the CCRF should be consulted for full text copy.

Status of national policy provision and implementation in relation to Code of Conduct Article 7 (Fisheries Management) -- Lake Tanganyika States

↓ *Article 7 (Fisheries Management) Provision**	(Clm 1) ZAMBIA	(Clm2) TANZANIA	(Clm 3) DEM. REPUBLIC OF CONGO	(Clm 4) BURUNDI
7.1 General				
7.1.1 'Appropriate policy legal & institutional framework & measures for long-term conservation & sustainable use of fisheries resources…measures…based on best scientific evidence available…designed to ensure long-term sustainability of fishery resources at levels which promote the objective of optimum utilization & maintain their availability for present & future generations; short-term considerations should not compromise these objectives.'	Commitment in principle. Overhaul existing legislation (Fisheries Act, No. 21 of 1974 and supplemental statutory instruments) now in progress. New draft legislation should be reviewed to confirm, strengthen CCRF orientation.	Commitment in principle. Revision existing legislation (Fisheries Act, No. 6 of 1970; Fisheries Principle Regulations of 1989, and Fisheries (General Amendment) Regulations of 1994) indicated, in order to provide more explicit CCRF orientation.	Policy weighed towards food production functions. Existing provisions based on colonial-era decrees. Draft legislation prepared 1985 never took effect. Review, update with thorough grounding in CCRF indicated.	Fisheries law based colonial-era decrees. Outdated and incomplete in many respects. Draft legislation prepared 1992 now in process of review, submission to Council of Ministers. Thorough grounding in CCRF indicated.
7.1.2 'Within areas under national jurisdiction...identify relevant domestic parties having a legitimate interest in use & management of resources…establish arrangements for consulting them to gain their collaboration in achieving responsible fisheries.'	Provision for user group participation in new draft legislation (Integrated Fisheries Management Regulations). Authority for appointment of fishing community representatives to Fisheries Management Boards and for establishment of Village Management and Zonal Committees.	No known provisions. Special attention indicated. LTR Draft Framework Plan refers.	No known provisions. Special attention indicated. LTR Draft Framework Plan refers.	No known provisions. Special attention indicated. LTR Draft Framework Plan refers.
7.1.3 'For transboundary (straddling, highly migratory, high seas) fish stocks, where exploited by two or more States, the States concerned…should cooperate to ensure effective conservation & management of resources. This should be achieved, where appropriate, through establishment of …regional fisheries organization or arrangement.'	Commitment in principle demonstrated through membership in CIFA Sub-Committee for Lake Tanganyika and participation in LTR regional project. LTR Draft Framework Plan calls for relevant initiatives.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.1.4 '[Subregional/regional] management organization/arrangement should include representatives of resource jurisdiction States as well as of States with real interest in fisheries or resources outside national jurisdictions….States should cooperate by joining such organization/ arrangement & actively participate in its work.'	Membership in CIFA Sub-committee. Question of representation of states with interest but outside national jurisdictions probably does not apply.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.1.5 'State not a member/participant [subregional/regional] management organization/arrangement should nevertheless cooperate…in conservation & management …relevant resources by giving effect to any conservation & management measures by such organization/arrangement.'	Does not apply.	Does not apply.	Does not apply.	Does not apply.
7.1.6 '...afford ...representatives from intergovernmental and non-governmental organizations ...opportunity to participate in meetings of [subregional/regional] fisheries management organizations/arrangements as observers or otherwise, as appropriate, in accordance … procedures of organization/arrangement concerned….'	Allowed under CIFA Sub-committee procedures. Should be provided for under proposed new Regional Working Group arrangement.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.

Status of national policy provision and implementation in relation to Code of Conduct Article 7 (Fisheries Management) -- Lake Tanganyika States (Cont.)

↓ *Article 7 (Fisheries Management) Provision**	(Clm 1) ZAMBIA	(Clm2) TANZANIA	(Clm 3) DEM. REPUBLIC OF CONGO	(Clm 4) BURUNDI
7.1.7 '...establish ...effective mechanisms for fisheries monitoring, surveillance, control and enforcement, to ensure compliance with conservation and management measures.'	Under consideration: new draft legislation.	Thorough review, revision existing mechanisms indicated.	Thorough review, revision existing mechanisms indicated.	Thorough review, revision existing mechanisms indicated.
7.1.8 '…take measures to prevent or eliminate excess fishing capacity & …ensure levels of fishing effort commensurate with the sustainable use of fisheries resources….'	a) Clear indications of excess fishing capacity for industrial fleet. Redistribution/retirement of excess units proposed in LTR Draft Framework Plan. b) Heavy pressure on juvenile *L. miodon* stock from uncontrolled beach seining. Ban/ area prohibition proposed in LTR Draft Framework.	High exploitation pressures on *L. stappersi* and *S. tanganicae* stocks by artisanal units in extreme northern waters. Licensing ceilings recommended in LTR Draft Framework.	High exploitation pressures on *L. stappersi* and *S. tanganicae* stocks by artisanal units in extreme northern waters. Licensing ceilings recommended in LTR Draft Framework.	High exploitation pressures on *L. stappersi* and *S. tanganicae* stocks by artisanal units in extreme northern waters. Licensing ceilings recommended in LTR Draft Framework.
7.1.9 'States & [subregional/regional] management organizations/arrangements should ensure transparency in mechanisms for management, related decision-making process.'	Area of probable deficiency in past. New draft legislation places strong emphasis on stakeholder participation. Working Group structure proposed in LTR Draft Framework should be developed with special attention to transparency issues.	Area of probable deficiency in past. Working Group structure proposed in LTR Draft Framework should be developed with special attention to transparency issues.	Area of probable deficiency in past. Working Group structure proposed in LTR Draft Framework should be developed with special attention to transparency issues.	Area of probable deficiency in past. Working Group structure proposed in LTR Draft Framework should be developed with special attention to transparency issues.
7.1.10 ''States & [subregional/regional] management organizations/arrangements should give due publicity to conservation, management measures & ensure legal rules governing their implementation effectively disseminated. Bases, purposes such measures should be explained to users…to facilitate application & gain increased support in implementation.'	Area of probable deficiency in past. Recommendations for policy enunciation, publicity within LTR Draft Framework apply.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.2 Management objectives				
7.2.1 'Recognizing ...long term sustainability ...[as overriding conservation/management] objective, States & management organizations/arrangements...should...adopt appropriate measures designed to maintain or restore stocks at levels capable of producing maximum sustainable yield, as qualified by relevant environmental and economic factors, ...special requirements of developing countries.'	Area of present deficiency. LTR Draft Framework recommendations apply.	Area of present deficiency. LTR Draft Framework recommendations apply.	Area of present deficiency. LTR Draft Framework recommendations apply.	Area of present deficiency. LTR Draft Framework recommendations apply.
7.2.2 'Such measures should provide, inter alia that: ***excess fishing capacity avoided and exploitation of the stocks remains economically viable;*** ***the economic conditions under which fishing industries operate, promote responsible fisheries;*** ***interest of fishers, including those in subsistence, small-scale & artisanal fisheries, are taken into account;*** ***biodiversity of aquatic habitats and ecosystems conserved, endangered species protected;*** ***depleted stocks allowed to recover, or actively restored where appropriate;*** ***adverse environmental impacts on ...resources from human activities are assessed and corrected; and*** ***pollution, waste, catch by lost/abandoned gear, catch of non-target species…minimized through measures including, to extent practicable, development & use of selective, environmentally safe and cost-effective fishing gear and techniques.'***	*Vide* §7.1.8 *supra.* New draft legislation provides for greater attention to interests of small-scale practitioners. Develop/pursue linkages with Lake Tanganyika Biodiversity Project (LTBP) Strategic Action Plan (SAP).	*Vide* §7.1.8 *supra.* Develop/pursue linkages with Lake Tanganyika Biodiversity Project (LTBP) Strategic Action Plan (SAP).	*Vide* §7.1.8 *supra.* Develop/pursue linkages with Lake Tanganyika Biodiversity Project (LTBP) Strategic Action Plan (SAP).	*Vide* §7.1.8 *supra.* Develop/pursue linkages with Lake Tanganyika Biodiversity Project (LTBP) Strategic Action Plan (SAP).

Status of national policy provision and implementation in relation to Code of Conduct Article 7 (Fisheries Management) -- Lake Tanganyika States (Cont.)

↓ *Article 7 (Fisheries Management) Provision**	(Clm 1) ZAMBIA	(Clm2) TANZANIA	(Clm 3) DEM. REPUBLIC OF CONGO	(Clm 4) BURUNDI
7.2.3 '…assess impacts of environmental factors on target stocks & species belonging to same ecosystem…& assess relationship among populations in the ecosystem.'	High sensitivity of commercial stocks to environmental factors noted in LTR SSP studies. LTR Draft Framework recommendation for long-term Monitoring Programme refers.	*Vide* Clm 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.3 Management framework & procedures ***7.3.1 '...fisheries management...concerned with whole stock unit over...entire area...distribution & take into account previously agreed measures… all removals & biological unity, other biological characteristics of stock. The best scientific evidence available…to determine…area of distribution and migration of resource.'***	Support for long-term Monitoring Programme indicated. LTR Draft Framework recommendation refers.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.3.2 '…conservation & management measures established for [transboundary] stocks in accordance with respective competencies relevant States, [subregional/regional management organizations/arrangements] should be compatible ….'	Provision assumed in LTR Draft Framework proposal for establishment of regional Working Group.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.3.3 'Long-term management objectives should be translated into management actions, formulated as a fishery management plan or other management framework.'	Commitment demonstrated through participation in LTR Draft Framework development process. Compliance dependent upon future acceptance, implementation of framework plan.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.3.4 'States or [subregional/regional management organizations/arrangements] should foster, promote international cooperation & coordination in all matters related to fisheries, including information gathering & exchange, research, management & development.'	Commitment in principle demonstrated through participation in CIFA Sub-committee, LTR regional project. Recommendations in LTR Draft Framework pertaining to Monitoring Programme and other follow-up measures apply.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.3.5 '…action taken through non-fishery organization which may affect conservation/management measures of competent [subregional/regional management organizations/arrangements] should be taken in consultation with latter.'	Proposed regional-level Strategic Action Plan under LTBP, including institutional and implementation aspects, should be closely linked to fisheries management initiatives recommended in the LTR Draft Framework.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.

Status of national policy provision and implementation in relation to Code of Conduct Article 7 (Fisheries Management) -- Lake Tanganyika States (Cont.)

↓ *Article 7 (Fisheries Management) Provision**	(Clm 1) ZAMBIA	(Clm2) TANZANIA	(Clm 3) DEM. REPUBLIC OF CONGO	(Clm 4) BURUNDI
7.4 Data gathering & management advice				
7.4.1 'When considering …adoption… conservation & management measures, best scientific evidence available should be taken into account in order to evaluate… current state… resources & … possible impact… proposed measures….'	'Best available scientific evidence' principle reflected in underlying strategy of LTR and use of SSP, other scientific study outcomes to formulate LTR Draft Framework.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.4.2 'Research in support … conservation & management should be promoted, including research on ... resources & on …effects of climatic, environmental & socio-economic factors. [Results] … should be disseminated to interested parties.'	LTR Draft Framework recommendations for long-term Monitoring Programme apply.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.4.3 '[Promote studies to]… provide… understanding … costs, benefits & effects of alternative management options designed to rationalize fishing, in particular, … relating to excess … capacity &… fishing effort.'	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*
7.4.4 '...ensure timely, complete & reliable statistics on catch & … effort … collected & maintained in accordance … international standards, practices… in sufficient detail to allow sound … analysis…. updated regularly… verified through appropriate system. [Such data should be compiled and disseminated] in manner consistent with … applicable confidentiality requirements.	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*
7.4.5 '… to ensure sustainable management & … enable social and economic objectives to be achieved, sufficient knowledge… social, economic & institutional factors should be developed through data gathering, analysis & research.'	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*	As for §7.4.2 *supra.*
7.4.6 '… compile … scientific data relating to fish stocks covered by [subregional/regional management organizations/arrangements] in … internationally agreed format & provide … in timely manner to … organization/arrangement. [Where] …stocks … occur… more than one jurisdiction & … [where no organization/arrangement], … States concerned should agree … mechanism … cooperation to compile & exchange such data.'	LTR Draft Framework recommendations for establishment of regional Working Group and long-term Monitoring Programme apply.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.4.7 '[Subregional/regional management organizations/arrangements] should compile data & make them available … manner consistent with … applicable confidentiality requirements & in timely manner … agreed format to all members … these organizations/ other interested parties… accordance with agreed procedures.'	As for §7.4.6 *supra.*	As for §7.4.6 *supra.*	As for §7.4.6 *supra.*	As for §7.4.6 *supra.*
7.5 Precautionary approach				
7.5.1 '… apply precautionary approach widely to conservation, management & exploitation… living aquatic resources in order to protect … & preserve…. The absence of adequate scientific information should not be used as a reason for postponing/failing to take conservation & management measures.'	Area of past deficiency. Future compliance turns on acceptance and implementation of recommendations outlined in CCRF-based LTR Draft Framework.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.5.2 '…take into account… uncertainties relating to size & productivity of… stocks, reference points, stock condition in relation to … reference points, levels & distribution of fishing mortality & impact … fishing activities, including discards, on … [non-target/associated/dependent] species as well as environmental & socio-economic conditions.'	As for §7.5.1 *supra.*	As for §7.5.1 *supra.*	As for §7.5.1 *supra.*	As for §7.5.1 *supra.*

Status of national policy provision and implementation in relation to Code of Conduct Article 7 (Fisheries Management) -- Lake Tanganyika States (Cont.)

↓ *Article 7 (Fisheries Management) Provision**	(Clm2) TANZANIA	(Clm 3) DEM. REPUBLIC OF CONGO	(Clm 4) BURUNDI
(Clm 1) ZAMBIA			
7.5.3 '… on basis … best scientific evidence available, inter alia, determine: ***stock specific target reference points … & action to be taken in they are exceeded; and*** ***stock specific limit reference points … & action to be taken in they are exceeded; when … limit reference point is approached, measures should be taken to ensure that it will not be exceeded.***			
As for §7.5.1 *supra.*	As for §7.5.1 *supra.*	As for §7.5.1 *supra.*	As for §7.5.1 *supra.*
7.5.4 '[For] new or exploratory fisheries, … adopt as soon as possible cautious conservation & management measures, including, inter alia, catch & effort limits…. [Measures] should remain in force … until sufficient data… [for] assessment … long term sustainability….'			
Not applied in past when industrial and improved artisanal methods introduced. A contingency provision that should be integral to overall acceptance of CCRF guidelines in new Draft Framework Plan.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.5.5 'If a natural phenomenon has … significant adverse impact on the status of living aquatic resources, … adopt conservation & management measures on an emergency basis to ensure … fishing activity does not exacerbate … impact….[Also] adopt such measures… where fishing activity presents a serious threat to the sustainability of such resources. [Emergency measures] should be temporary & based … best scientific evidence available.'			
Possible effects of global weather pattern changes noted in LTR SSP reports to be taken into account. A contingency provision that should be integral to overall acceptance of CCRF guidelines in new Draft Framework Plan.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.6 Management measures ***7.6.1 '… ensure … level of fishing … commensurate with the state of fisheries resources.'***			
Area of past deficiency. LTR Draft Framework recommendations broadly apply.	*Vide* Clm. 1.	*Vide* Clm. 1.	*Vide* Clm. 1.
7.6.2 '… adopt measures to ensure… no vessel … allowed to fish unless so authorized, in a manner consistent with international law for the high seas or in conformity with national legislation….'			
Provision in national legislation; enforcement dubious/ not consistent.	Provision in national legislation; enforcement dubious/ not consistent.	Provision in national legislation; widely ignored in practice.	Provision in national legislation. Past compliance believed to be fairly comprehensive. Security closures of landing sites in recent years have heavily curtailed fishing activities.
7.6.3 'Where excess… capacity exists,… [establish mechanisms] to reduce capacity to levels commensurate with the sustainable use of … resources so as to ensure that fishers operate under economic conditions that promote responsible fisheries. Such mechanisms should include monitoring the capacity of fishing fleets.'			
Vide §7.1.8 *supra.*	*Vide* §7.1.8 *supra.*	*Vide* §7.1.8 *supra.*	*Vide* §7.1.8 *supra.*
7.6.4 '… performance … existing … gear, methods & practices should be examined & measures taken to ensure… [those] not consistent with responsible fishing are phased out & replaced with more acceptable alternatives. In this process, particular attention should be given to the impact … on fishing communities, including their ability to exploit the resource.'			
LTR Draft Framework recommendations on redistribution/retirement of industrial purse seining and beach seining refer. Note Framework emphasis on development measures to create alternatives to beach seining.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.

Status of national policy provision and implementation in relation to Code of Conduct Article 7 (Fisheries Management) -- Lake Tanganyika States (Cont.)

↓ *Article 7 (Fisheries Management) Provision**	(Clm 1) ZAMBIA	(Clm2) TANZANIA	(Clm 3) DEM. REPUBLIC OF CONGO	(Clm 4) BURUNDI
7.6.5 '… regulate fishing in such a way as to avoid risk of conflict among fishers using different vessels, gear and … methods.'	LTR Draft Framework recommendations apply. Inherent conflicts now exist between industrial and artisanal fisheries, and between beach seine fishery and all other fisheries.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.6.6 'When deciding on… use, conservation & management of … resources, …[give appropriate recognition, in accordance national laws & regulations] to the traditional practices, needs & interests of indigenous people & local fishing communities … highly dependent on fishery resources for their livelihood.'	Area of past deficiency, in particular as regards uncontrolled growth of industrial fishery.	Status not determined.	Status not determined.	Implicit policy of favouring local artisanal units over industrial companies, though equity questions arise in relation to ownership, control of large artisanal ('Apollo') units.
7.6.7 '….[evaluation] of alternative conservation & management measures … [should consider] their cost-effectiveness & social impact….'	Relevance for LTR Draft Framework proposals to establish closed fishing areas. Point also to be taken into account in implementation of follow-up development measures in support of Framework Plan.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.6.8 '… efficacy of conservation & management measures & their possible interactions should be kept under continuous review….[& revised/abolished] as appropriate… in light of new information.'	One expected result of long-term Monitoring Programme. LTR Draft Framework recommendations refer.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.6.9 '… take appropriate measures to minimize waste, discards, catch by lost/abandoned gear, catch of non-target species… & negative impacts on associated/dependent species…. Where appropriate, such measures may include technical measures related to fish size, mesh size or gear, discards, closed seasons &areas & zones reserved for selected fisheries, particularly artisanal fisheries. Such measures should be applied, where appropriate, to protect juveniles & spawners…. [Promote] … development & use of selective, environmentally safe & cost effective gear & techniques.'	*Vide* §7.1.8 *supra.*	*Vide* §7.1.8 *supra.*	*Vide* §7.1.8 *supra.*	*Vide* §7.1.8 *supra.*
7.6.10 '[States & subregional/regional management organizations/arrangements] … should introduce measures … to facilitate … sustained recovery of [depleted/threatened resources]…. [& make] every effort to ensure… [critical] resources & habitats… adversely affected by fishing or other human activities are restored.'	Area of past deficiency. Provision applies in relation to heavy exploitation pressures on *Lates stappersi* stocks in southernmost waters and generally to depleted stocks of *Lates angustifrons*, *L. mariae*, and *L. microlepis.* Also applies where beach seining is destroying near-shore habitat for cichlid community fishes.	Area of past deficiency. Provision applies in relation to heavy exploitation pressures on *Lates stappersi* and *S. tanganicae* stocks in northern waters and generally to depleted stocks of *Lates angustifrons*, *L. mariae*, and *L. microlepis.* Also applies where beach seining is destroying near-shore habitat for cichlid community fishes.	Area of past deficiency. Provision applies in relation to heavy exploitation pressures on *Lates stappersi* and *S. tanganicae* stocks in northern waters and generally to depleted stocks of *Lates angustifrons*, *L. mariae*, and *L. microlepis.* Also applies where beach seining is destroying near-shore habitat for cichlid community fishes.	Area of past deficiency. Provision applies in relation to heavy exploitation pressures on *Lates stappersi* and *S. tanganicae* stocks in northern waters and generally to depleted stocks of *Lates angustifrons*, *L. mariae*, and *L. microlepis.* Also applies where beach seining is destroying near-shore habitat for cichlid community fishes.

Status of national policy provision and implementation in relation to Code of Conduct Article 7 (Fisheries Management) -- Lake Tanganyika States (Cont.)

↓ *Article 7 (Fisheries Management) Provision**	(Clm 1) ZAMBIA	(Clm2) TANZANIA	(Clm 3) DEM. REPUBLIC OF CONGO	(Clm 4) BURUNDI
7.7. Implementation				
7.7.1 '... ensure … effective legal & administrative framework … established for … resource conservation & … management.'	Area of past deficiency. New draft legislation under consideration. LTR Draft Framework recommendations broadly apply.	Area of past deficiency. LTR Draft Framework recommendations broadly apply.	Area of past deficiency. LTR Draft Framework recommendations broadly apply.	Area of past deficiency. LTR Draft Framework recommendations broadly apply.
7.7.2 '…ensure… laws & regulations provide for sanctions … adequate in severity to be effective, including sanctions which allow for the refusal, withdrawal or suspension of authorization to fish ….'	Area of past deficiency. New draft legislation under consideration. Sanctions should be standardised as much as possible lakewide.	Area of past deficiency. Sanctions should be standardised as much as possible lakewide.	Area of past deficiency. Sanctions should be standardised as much as possible lakewide.	Area of past deficiency. Sanctions should be standardised as much as possible lakewide.
7.7.3 '…implement effective … monitoring, control, surveillance & law enforcement measures including, where appropriate, observer programmes, inspection schemes & vessel monitoring systems….'	Area of past deficiency. MCS and enforcement measures should be standardised as much as possible lakewide. LTR Draft Framework provides no specific recommendations in relation to this guideline, and approaches need to be elaborated through consultations between lacustrine states, ideally in context of CIFA Sub-committee and proposed Regional Working Group.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.7.4 '[States & subregional/regional management organizations/arrangements]… should agree on the means by which … activities … will be financed, bearing in mind… relative benefits derived from the fishery & differing capacities of countries to provide financial & other contributions. Where appropriate, & when possible … aim to recover the costs of … conservation, management & research.'	Current dependence on donor agencies for support of regional-level activities may be expected to continue for immediate future. Issue of long-term financial underpinning for regional Working Group not specifically addressed in LTR Draft Framework, and warrants further attention. Modalities to be planned, elaborated.	*Vide* Clm 1.	*Vide* Clm 1.	*Vide* Clm 1.
7.7.5 'States which are… [members/participants subregional/regional management organizations /arrangements] should implement internationally agreed measures adopted … [by them] & consistent with international law to deter the activities of … [non-member/non-participant flag vessels engaging in] activities which undermine the effectiveness of conservation & management measures established by such organizations or arrangements.'	Not applicable at present time.	Not applicable at present time.	Not applicable at present time.	Not applicable at present time.
7.8 Financial institutions				
7.8.1 'Without prejudice to relevant international agreements, States should encourage banks & financial institutions not to require, as a condition of a loan or mortgage, … vessels … to be flagged in a jurisdiction other than that of the State of beneficial ownership where such a requirement would have the effect of increasing the likelihood of non-compliance with international conservation and management measures.'	Not determined; but perhaps not applicable at present time. Incidence of re-registration of industrial units from other states in recent years warrants consideration.	Not determined, but perhaps not applicable at present time.	Not determined, but perhaps not applicable at present time.	Not determined, but perhaps not applicable at present time.

*** Provisions noted in abbreviated/paraphrased form only. Refer to official version of CCRF for full text.**

ANNEX 2

'COMMUNITY REFERENDA' ON LTR DRAFT FRAMEWORK PLAN: SUGGESTED PROGRAMME

1. INTRODUCTION

As noted at several points in the main part of this document, and particularly in Sections 3.1 and 4.5, a basic purpose underlying LTR management planning preparations, in accordance with CCRF guidelines, is to encourage local stakeholder involvement in fisheries management problem evaluation and review of future options. In keeping with this purpose, it is proposed to carry out a programme of village meetings or 'community referenda' related to the LTR Draft Framework Plan. The programme would constitute one of the 'accompanying measures' recommended as a follow-up to the LTR Draft Framework Plan in Section 6 of the main document, and is in fact the one that requires most immediate attention. For this reason the referenda exercise would be conducted under project auspices. However, because funds are very limited, the exercise would have to be of a rather modest scope in terms of its duration and geographical coverage. The responsibility for carrying out the exercise would rest with the LTR Consultant Development Planner working in collaboration with the LTR Project Co-ordinator.

As described earlier, the referenda exercise would have a dual objective. It would serve 'to brief local stakeholder groups on the outcomes of major LTR studies and the elements of the regional management framework…, and simultaneously to obtain feedback and inputs from these groups in order to strengthen the framework and foster collective participation in efforts to ensure the sustainable use of the lake's fishery resources.'

2. ACTIVITIES AND TIMING

It is suggested that fieldwork aspects of the programme be carried out over an approximately thirty-day period beginning late September/early October 1998. The overall programme would involve the following sequence of activities.

Table A2.1. Sequence of proposed LTR Community Referenda activities

	Proposed activity	Timing
a)	Designation of national field teams within each of the four lacustrine states.	Sept. 98
b)	Preparation of community meeting agenda, briefing materials, and group interview protocols. (LTR HQ – Bujumbura)	Sept. 98
c)	Organisation and implementation of short planning and training sessions for each of the national teams (Burundi, DRC, Tanzania, Zambia), in order to review and test the data collection methodology and to finalise field itineraries. (Field stations)	↓ Oct. 98
d)	Conduct of fieldwork by each national team.	(ca. 1 week per country)
e)	Field validation of community meeting results to ensure completeness of detail.	↑
f)	Compilation and evaluation of information collected by the teams and revision of the draft framework as appropriate, with a view to finalising it as the Fisheries Management Framework Plan for Lake Tanganyika. (LTR HQ – Bujumbura)	Early Nov. 98: ca. 1 week.
g)	Submission of the completed Framework Plan for deliberation at the Seventh Joint Meeting of the LTR Scientific and Coordination Committees and the Eighth Session of the CIFA Sub-Committee for Lake Tanganyika, tentatively scheduled for May 1999.	May 1999 (Tentative)

3. COMMUNITY BRIEFING MEETINGS: VENUES AND PROCEDURE

3.1 Venue Selection

As only limited project resources will be available for carrying out the referenda exercise, it will not be possible to cover a wide selection of local communities or landing sites. It is proposed therefore that two locations within each country be designated as venues for community briefing and public comment meetings. Locations should be selected on the basis of the likelihood of drawing the maximum number of local fishery stakeholders (fishers, traders, fisheries sector service providers, local fisheries and other authorities, etc.). They should therefore be central to regions where fisheries-related activities are most concentrated. On this basis, and with reference to LTR data on landing site sizes and fishing unit densities, the following locations are proposed as meeting venues within the four states.

Table A2.2 Proposed venues for community briefing meetings

Burundi	DRC	Tanzania	Zambia
1) Gitaza	1) Kivovo (nr. Uvira)	1) Luanza (nr. Kigoma)	1) Chisanza (East Coast)
2) Karonda	1) Athenée (nr. Kalemie)	2) Kipili	1) Chisanse (West coast)

3.2 Procedures and Agenda

Each community briefing and public comment meeting should be organised and conducted according to standard procedures and agenda, as outlined in the tables below. At the conclusion of each meeting, a very brief survey of participants will be conducted, in order to ascertain their reactions to basic proposals set forth in the LTR Draft Regional Framework Plan. The data collected through the survey forms together with the public questions and comments recorded during the meeting together will constitute the information base for building the overall assessment of the referenda exercise.

Table A2.3 Proposed procedures for national field team planning/training activities

a) The LTR Project Co-ordinator and Development Planner should confirm exact dates and venues for each meeting co-ordination with the respective national field team leaders (to be designated) at each of the fisheries research institutes/LTR field stations (Bujumbura, Uvira, Kigoma, and Mpulungu).

b) At the same time, composition of the respective national teams should be verified (3-4 members each, drawn from lakeside research institute/ local fisheries authority staff).

c) National team leaders should then ensure that local authorities and fisheries staff publicise the time and place of the meetings scheduled for their respective regions, and invite all members of the public involved with fisheries-related activities to attend. Announcements over the national radio networks can be used where possible.

d) In co-ordination with the LTR Project Co-ordinator and Development Planner, team leaders should also organise logistical details for the field team planning/training sessions and community meetings to be held in their respective institutes and regions (planning/training session conference rooms, office supplies as appropriate, selection of actual meeting grounds, etc.).

e) The national field teams should be assembled for one-day planning and training sessions at the respective LTR field stations, to be held on dates just prior to scheduled field activities within the respective countries.

f) During each planning/training session, team members should be introduced to the briefing materials prepared for use at the community meetings. These should include a set of large posters and printed handouts (English, French, and Kiswahili translations) outlining, through a combination of basic textual and graphical summaries, the major results of the LTR Socio-economic survey of local fisherfolk views on fisheries issues and management problems. They should also outline the principle elements of the Draft Regional Framework Fisheries Management Plan, as presented to and endorsed by delegates attending the recent Sixth Meeting of the LTR Co-ordination Committee (Lusaka, 22-23.06.98).

g) Field team members should also plan out and practice amongst themselves the best way of presenting briefing materials at the community meetings, and also familiarise themselves with procedures for recording public questions and comment on the Draft Framework proposals.

Table A2.4 Proposed procedures and agenda for national community briefing meetings

a)	Each community meeting will be opened by a representative of the national fishery authority and chaired by the national field team leader, who will assume primary responsibility for introducing the purpose of the meeting, presenting the public briefing materials, and moderating the question and discussion session that will follow.
b)	The remaining members of the team will be responsible for recording all questions and comments raised during this session.
c)	Each meeting should run for no more than about two hours' duration, and proceedings should be conducted at an orderly pace with a minimum of delay, so as not to impose inordinate demands of time on participants needing to attend to their normal daily affairs.
d)	Towards the end of each meeting, fisher and trader participants will be requested to complete (either on their own or with the assistance of national field team members) a simple survey form indicating their preferences ('Agree' -- 'Disagree' -- 'No opinion') for the main measures being proposed under the Draft Framework.
e)	If warranted by very large turnouts (>120) of local fisherfolk for any particular meeting, either public counts (i.e. non-confidential 'how many agree, disagree, have no opinion' voting by show of hand) or an elementary sampling scheme could be employed in lieu of the above approach. For sampling, representative proportions of meeting participants could easily be drawn on the spot. [Division of participants into fisher versus post-harvest groups -- Distribution of discreetly numbered tags to each participant -- Random 'out of the hat' drawing of duplicate tags to achieve a sample quota of approximately 40 fisher craft/gear owners, 40 crew/labourers, and 40 post-harvest operators, with total enumeration of any sub-group numbering less than 40.]
f)	Survey results along with the notes made by national field team members should be entered on computerised data sheets immediately the survey forms have been completed.

The survey form should be designed for speedy completion/administration and processing. It is proposed as consisting simply of a respondent identifier section and a series of six basic questions pertaining to LTR Framework Plan proposals. A sample layout is shown in the following table.

Table A2.5 Proposed survey form for measuring community response to Draft Framework proposals

Section A. Site/Respondent I.D.

Site Name: _____ **Resp. No.** _____ **Resp. Gender:** **Male** **Female**

Resp. Main Fisheries Activity/Interest: **Fishing unit Owner/Part Owner** **Crew Member/Labourer** **Processor/Trader** **Other (Specify):** _____

Section B. Views on Management Proposals

Proposition:	**Agree**	**Disagree**	**No Opinion**
1) Fishing and conservation. [**Text**: 'People around the lake who want to fish should be allowed to do so, but within limits, because their children and grandchildren should always be able to catch enough of all the kinds of fish that we have now.']			
2) Local community participation in fisheries management. [**Text**: 'Fishers, traders, and other residents of local communities involved in the fisheries-related activities should be able to take part along with government officials in deciding on fisheries rules and in making sure that they are followed in their community areas.']			
3) Fisheries management groups. [**Text**: 'There should be a system of fisheries advisory groups made up of members elected from lakeside communities as well as fisheries officials, running from the local landing beach level to one covering the entire lake (local, region/province, national, lakewide). At each level, group members would monitor or keep watch on the fisheries activities within their areas of responsibility, and give advice and recommendations on how they should be controlled or improved.']			
4) Licensing and control of access to fishing. [**Text**: 'In order to help conserve fish stocks, there should be a system of licenses for individuals and fishing boats, to control the number of fishers and boats allowed to operate along each section of the shoreline.'			
5) Restriction on purse seine units. [**Text**: 'In order to help conserve fish stocks, there should be areas of the lake where purse seine units are not allowed to operate at all.']			
6) Restriction on beach seining. [**Text**: 'In order to help conserve fish stocks, there should be places along the shoreline of the lake where no beach seining is allowed at all.']			