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LAKE TANGANYIKA FRAMEWORK FISHERIES MANAGEMENT PLAN: BACKGROUND, POLICY CONSIDERATIONS, AND MAIN ELEMENTS

by

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PREPARATION OF THIS DOCUMENT

This document contains the results of the work carried out by a large team of international and national scientists and technicians who worked under the supervision of the following component leaders now listed in alphabetical order: **E. Coenen** (fisheries statistics), **G. Hanek** (field coordination, fisheries management), **T. Huttula** (hydrodynamics), **L. Kuusipalo** (fisheries genetics), **O.V. Lindqvist** (scientific coordination, fisheries management), **H. Mölsä** (scientific coordination, fisheries management), **P. Mannini** (fisheries biology), **J. Parkkinen** (remote sensing), **P.-D. Plisnier** (limnology), **J.E. Reynolds** (socio-economy, fisheries management), **K. Salonen** (primary production), **J. Sarvala** (trophic structure), **J. Szczucka** (hydroacoustics) and **I. Vuorinen** (zooplankton).

PREFACE

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

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

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

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A. INTRODUCTION[1]

1. Lake Tanganyika (map, Figure 1) hosts one of the largest inland fisheries in Africa, second only to Lake Victoria in volume of production (FAO 1995a). It therefore represents a significant source of food and livelihood for millions of people dwelling within and around its basin. The lake and its environs support a wide array of subsistence and commercial activity as well as a remarkable assemblage of tropical flora and fauna, including highly diverse populations of endemic fish, all within a setting of striking scenic appeal. The conservation value of the lake is thus also of enormous importance (Beadle 1981; Coulter 1991; Hanek 1994; Hanek and Craig 1996; Quan 1996).

2. Amidst growing concerns over the environmental status, endangered biodiversity, and possible over-fishing of this unique lake, efforts have been mounted since 1992 through the FAO-executed Lake Tanganyika Research (LTR) Project (GCP/RAF/271/FIN), to investigate Tanganyika's biological production and fisheries potential, and to devise modalities for the optimal management, on a regional scale, of its fisheries resources to serve present and future human welfare and biological conservation needs (FAO 1992).

3. From 1995 another major undertaking, the Lake Tanganyika Biodiversity Project (LTBP), has complemented LTR's fisheries-related investigations. Established with funding provided through the UNDP/Global Environmental Facility (GEF), LTBP's remit is to address wider, basin-scale management problems of pollution control, conservation, and the maintenance of biodiversity (LTBP 1998).

4. This document provides an overview of LTR's Lake Tanganyika Framework Fisheries Management Plan (FFMP) and the background of its preparation. Points discussed include:

a) work of the LTR Management Group and related activities leading to the formulation of the FFMP;
b) use of the FAO *Code of Conduct for Responsible Fisheries* (CCRF) as a basic normative matrix (FAO 1995b);
c) the principal findings of LTR's Scientific Sampling Programme, socio-economic investigations, and legal-institutional studies that provide the foundation for the FFMP;
d) recommended FFMP policy options and initial management actions; and
e) further measures needed to facilitate adoption and implementation of the FFMP within the four lacustrine States.

5. This document should be reviewed in conjunction with FFMP companion studies of institutional and legal aspects of Lake

[1] Portions of this document have been drawn from a previously published article prepared with other LTR colleagues (see Mölsä *et al.* 1999), as well as an earlier LTR Technical Document (Reynolds 1998).

Tanganyika fisheries (Cacaud 1999a) and monitoring, control, and surveillance (MCS) for Lake Tanganyika fisheries (Cacaud 1999b).

B. BACKGROUND

1. The LTR Project Management Working Group, formed in late 1997, brought together a team of LTR advisors, project associates from the respective national counterpart agencies of the four lacustrine countries as well as the University of Kuopio in Finland, and FAO technical officers from the Fisheries Department (FI) and the Development Law Service (LEGN). The group was established in order to facilitate the process of collating and assessing major results of six years of LTR research on the size and structure of Lake Tanganyika's resources and the state of their exploitation (hydrodynamics, limnology, fish and zooplankton biology, remote sensing, fish genetics, and fisheries statistics), as well as the socio-economic dimensions and legal-institutional aspects of its fishery.

2. Consistent with overall LTR Project objectives, it was intended to use the resulting synthesis as a comprehensive set of reference points for developing a regional, lake-wide approach to the optimal management of Tanganyika's fishery resources.

3. The first outcome of the Group's efforts was presented in a report entitled 'Regional Framework Planning for Lake Tanganyika Fisheries Management,' an early draft of which was presented to and discussed by delegates to the Sixth Meeting of the LTR Co-ordination Committee held in June 1998.

4. In addition to giving their broad endorsement to proposals outlined in the draft framework document, which is based on principles laid out in the FAO *Code of Conduct for Responsible Fisheries*, or CCRF (FAO 1995b), delegates further agreed to a series of supportive or accompanying measures in order to facilitate management planning co-ordination and implementation between the four lacustrine States.

5. One such measure proposed by the Working Group was the organisation and conduct, later in 1998, of a lake-wide 'Community Referenda' exercise intended to:

a) inform lakeshore community residents on the outcomes of major LTR studies;
b) demonstrate how these outcomes led to the formulation of the provisional regional management framework; and, simultaneously,
c) in keeping with CCRF guidelines, obtain feedback and inputs from local groups in order to strengthen the regional framework.

6. LTR personnel successfully carried out the referenda exercise in October 1998, in collaboration with national field teams in each of the four States (Reynolds 1999).

7. Additional recommendations of the Sixth LTR Co-ordination Committee Meeting called for complementary actions to be taken with respect to further assessment of legal and institutional provisions necessary to facilitate regional management planning and co-ordination, and preparation of a detailed workplan for extension of LTR's fisheries monitoring activities as a programme to be implemented in future under national execution.

8. Preparation of a work plan for the new Monitoring Programme, including budget details, equipment and material requirements, field team Terms of Reference, data collection and reporting protocols, and administrative/financial procedures was completed in late 1998, on the basis of a field mission to each of LTR's lakeside sub-stations in order to assess staff capabilities and equipment needs (Mannini 1999).

9. With timely assistance from the FISHCODE Project (GCP/INT/648/NOR -- Interregional Programme of Assistance to Developing Countries for the Implementation of the Code of Conduct for Responsible Fisheries.), further work was conducted on legal and institutional issues. Beginning in early 1999, a detailed review and appraisal of existing fisheries legislation and monitoring, control, and surveillance (MCS) capacities within the four lacustrine States was mounted. Possible legal and institutional modalities in support of regional harmonisation of fishery resource management were explored, and a set of recommendations for actions to facilitate implementation of the proposed FFMP was prepared.

10. Further actions that resulted from the FISHCODE – LTR partnership included:

a) the organisation and execution of a series of national seminars in the four lacustrine States for key officials of the respective Ministries concerned with fisheries, environmental and other management issues on Lake Tanganyika, in order to introduce and review the principal elements of FFMP; and
b) in the context of the seminar series, meetings with key donor agency representatives in order to brief them on the progress of Lake Tanganyika management planning work and to present, for funding consideration, a set of profiles for projects that would serve as 'Accompanying Measures' to facilitate implementation of the FFMP.

C. CCRF AND LTR RESEARCH INVENTORIES OF LAKE TANGANYIKA FISHERIES

CCRF principles

1. The CCRF principles (FAO 1995b), along with the CCRF *Technical Guidelines* (see especially FAO 1996a, 1996b, and 1997), provides the overall normative context in terms of which LTR research

findings have been collated, evaluated, and used as a basis to elaborate the FFMP.

2. The CCRF statement first verifies the pressing need for a fundamental reorientation of global fisheries priorities and then elaborates a voluntary model framework through which such reorientation can be effected. The points of responsibility it highlights include, *inter alia*:

a) use of whole ecosystem perspectives on problems of resource base and environmental preservation;
b) dedication to present social welfare needs, consistent with sustainability;
c) adoption of the 'precautionary approach' in management and conservation decision-making; and
d) effective participation of stakeholder groups in the decision-making and regulatory process, with particular attention to small-scale fisher interests.

Multi-disciplinary 'readings' of fisheries characteristics and management needs

3. Recognising that the Tanganyika fisheries must be understood as a complex biological and anthropological reality (cf. Charles 1994), the LTR research programme has made use of a combination of observational and analytical tools from both the natural and social sciences. The outcomes of an intensive six-year programme of project research bearing on the lake's trophic structure and dynamics, and the socio-economic and legal-institutional dimensions of its fisheries, can be synthesised into a multi-disciplinary set of 'readings' on basic fisheries characteristics and management problems and prospects, as follows.

D. BASIC FISHERIES CHARACTERISTICS

D.1 Distribution of Catch and Effort

1. Based on data collected during aerial and parallel ground surveys in 1992 (Coenen 1995) as well as a further frame survey in 1995 (Paffen *et al.* 1997), Lake Tanganyika presently hosts 44,960 active fishers, 18,240 operational fishing craft, and 786 landing sites (Table 1). Present-day fishing operations primarily exploit six endemic species, including the two schooling clupeid 'sardines,' *Limnothrissa miodon* and *Stolothrissa tanganicae*, together with their four predator species, all centropomids of the genus *Lates* -- viz.: *L. stappersii*, *L. angustifrons*, *L. mariae*, and *L. microlepis*.

2. Of the *Lates* species, the latter three are incidental to the catch: the lake's commercial fishery is essentially based on three pelagic species -- 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 tonnes -- volumes that translate into annual earnings on the order of tens of millions of US dollars. The harvest is shared between the littoral States roughly in the order, if not

exact proportion, of each State's share of the total lake area. Thus fishers in the DRC (45% of lake area) land about 50% of the annual pelagic catch, whilst those in Tanzania (41% of lake area) land about 31%, in Burundi (8% of lake area) about 21%, and in Zambia (6% of lake area) about 7%.

3. Traditional units (gillnets, longlines, and scoop nets) are the dominant fishing type, followed by liftnets and beach seines. Together these fishing types account for more than 90% of annual fish yield.

4. The northern and southern extremities of the lake are subject to the greatest fishing pressure per unit of fishing area. In the case of the far north end, this outcome can be attributed to the high concentration of lift net units; for the far south, it results from the combined effects of industrial purse seine 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.

5. Annual recorded catches on Lake Tanganyika have shown an upward trend since the 1970's and today stand at 196,570 tonnes, as estimated via catch-per-unit-effort (CPUE) calculations based on an average of 250 fishing days per annum. Recent estimates per country indicate a yield of about 21,000 tonnes for Burundi in 1995, just before a period of civil unrest and security restrictions resulted in a drastic reduction in fishing activity. Production for Tanzania is estimated at around 55,000 tonnes during 1994-95, as compared to figures of 72,000 and 80,500 tonnes in 1992 and 1993, respectively. The 1992 total annual yield estimate for Zambia is 12,700 tonnes, comprised of 9100 tonnes from traditional/ artisanal units and 3600 tonnes from industrial purse seiners. In Congo, the estimated annual fish yield for 1995 is about 90,000 tonnes, based on extrapolated fishing effort counts (Coenen *et al.* 1998).

6. These statistics translate into an average catch range of 54 – 66 kg ha^{-1} for the whole lake. The kg ha^{-1} figures are much higher in Burundi and Zambia -- 95 and 69 kg ha^{-1}, respectively -- than elsewhere. In the Tanzanian and DRC waters, which in combination amount to 86% of the total lake area, catch figures register at 60 and 34 kg ha^{-1}, respectively. Such differences may reflect greater fishing intensity rather than actual lake productivity, however (Coenen 1995).

D.2 Recent Developments in Artisanal and Industrial Fishing

7. During the 1950's there was a clear lakewide shift from traditional subsistence fishing units towards catamaran lift-net and industrial units. The average efficiency of a single unit has increased remarkably from 3 tonnes yr^{-1} in the early years up to an overall average of 14 tonnes in the 1990s, with annual peak averages in Burundi an Zambia ranging as high as 30 tonnes yr^{-1}. In recent years artisanal units (mostly liftnets and, beach seines) are contributing an increasingly proportion of total production at the expense of industrial purse seine units. The maximum yields within the artisanal sector in Burundi are

106 tonnes yr^{-1} for Apollo ('super' liftnet) units, and 41 tonnes yr^{-1} for regular liftnet units. In Zambia they are 62-68 tonnes yr^{-1} for kapenta (beach) seine or chiromila (boat) seine, but only 10 ton yr^{-1} for liftnet units.

8. The drastic decline in industrial fishing in northern waters is reflected in the migration or retirement of many purse seine units. Of the 13 industrial units active in Burundi in 1992, only two were enumerated as active in the 1995 Frame Survey. The remainder have either been decommissioned or have been shifted to Zambia in the south of the lake. The DRC has witnessed a similar decline in purse seining operations based in Kalemie and Moba, though this probably owes more to political instability than to adverse fishing conditions. In Tanzania the industrial fishery never developed to the same extent as elsewhere, but here too purse seining has fallen off in recent years. Of the 4 operational units enumerated in 1995, only one remains active at the present time.

9. Over the last 15 years or so there has been a seven-fold growth in purse seining effort in Zambian waters (from 3 to 23 active units since 1983), almost exclusively harvesting *Lates stappersii*, which now comprise 95% of the industrial catch. The development of the purse seine fishery from the 1950s soon resulted in a substantial reduction in the harvest of other *Lates* species, i.e. *L. mariae, L. microlepis,* and *L. angustifrons*, all of which seem to be particularly vulnerable to localised over-fishing (Coulter 1970, 1991). Today's simple composition of the pelagic stocks, with two clupeids and *L. stappersii*, is one very striking outcome of the selective pressures imposed by the mechanised large-scale fishery.

10. It is notable that *S. tanganyicae* was the dominant target species of the purse seine fishery in the Zambian waters of the lake during the 1980s. Although the *S. tanganyicae* decline coincides with the expansion of purse seining in Zambia, the stock in northern waters, at least until recently, seems to have withstood decades of high fishing pressure in fairly confined areas. This strongly suggests that environmental factors have played a role in hastening the southern stock's decline. A succession of poor recruitment periods brought on by environmental perturbations can rapidly reduce the size of short-lived clupeid stocks (Mannini 1998).

11. 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, *L. miodon* dominates catches in the highly unselective beach seine (= kapenta 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 (Mannini 1998).

12. In general, therefore, it can be said of the contemporary situation that even though the major commercial pelagic stocks are distributed throughout all sectors of Lake Tanganyika, its northern half is dominated by a clupeid-based fishery, whilst the southern areas feature a *L. stappersii*-based fishery (Mannini 1998).

D.3 Local Artisanal and Traditional Fishers

13.Results of the LTR lakewide socio-economic (SEC) survey indicate that local fishers of all categories (artisanal or traditional, unit owner or crew member): a) are almost exclusively men; b) generally fall within an age range of 18 – 50 years; c) tend to have low levels of formal education (lack a primary school certificate); d) often originate from places other than their current landing site bases; and e) generally engage in fishing as their principal job, though are commonly involved in subsistence or combined food crop/cash crop farming as secondary occupations (Reynolds 1997a, 1997b, 1997c, 1997d; Reynolds and Hanek 1997).

14.Available information suggests that artisanal unit owners earn significantly more than their crew labourers. No such disparity is evident in the traditional fishery. Average earnings within the artisanal sector (no earnings data available for DRC sample populations) are estimated to run well above per capita annual income for the working age population within the respective lacustrine countries. Traditional sector earnings typically run much lower, though are still comparable to regional working age population averages (Reynolds and Hanek 1997; World Bank 1999).

D.4 Processing and Marketing

15.LTR SEC survey observations confirm that poor infrastructure and natural barriers impose heavy constraints on fish processing and marketing possibilities (Reynolds and Hanek 1997). Steep escarpments restrict overland access to much of the shoreline. Roads link the principal towns like Kigoma, Kalemie, Moba, and Mpulungu with their hinterlands, but feeder routes between towns and their outlying areas are not effectively developed. Railway lines exist only at Kigoma, in Tanzania (with service to Tabora and Dar es Salaam), and at Kalemie, in the DRC, with connections (when operable) west and eventually to the southern Shaba mining districts. Furthermore, there are few facilities for energy-intensive techniques of fish handling and processing, e.g. chilling, freezing, or canning. The best equipped plants are found in Mpulungu and on a more limited basis in Kalemie.

16. The bulk of fish landed at most sites must of necessity be processed in some fashion in order to extend its shelf life for marketing purposes. Simple sun drying on the beach or ground is easily managed under local conditions, requiring little input 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.

17.Reliable statistics are lacking on the volume of product flow along the various marketing channels that reach beyond the lake basin. However, 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 and further afield have in recent years become important market destinations as well.

18.Constraints on commerce imposed by geographical barriers and weak marketing structures seem bound to produce contradictory effects, depending on location. On the one hand, they limit the growth of fishing pressure and the risk of over-exploitation across wide stretches of the lake. On the other hand, however, they may encourage basin inhabitants, including refugees displaced by outbreaks of civil conflict, to migrate to the more easily accessible landing sites around the lakeshore. Fish is more readily available to consumers at these places, and they further offer the possibility of fishery-related employment. In such instances the effect is to magnify localised fishing pressure and the risk of over-exploitation.

D.5 Local Processors and Traders

19.Women are well represented in the fisheries post-harvest sector around the lake, and even appear to constitute a majority of the small-scale processor/trader population in Zambia and parts of the DRC. Survey data indicate that post-harvest operators: a) are relatively younger as a group than the fisher population; c) have a low overall level of education, particularly amongst women; d) tend to originate from places other than their current landing site bases; and e) are usually involved in the fish processing or trading as a main occupation, though are typically engaged in secondary jobs either in some other fishing-related activity (e.g. gear owner) or in farming.

20.Post-harvest income levels appear to be generally lower than those of the harvest sector, and especially in comparison with levels found in the artisanal fishery. Based on survey data (Reynolds and Hanek 1997) it is estimated that average annual income for women in some cases runs well below national working age population averages (World Bank 1999).

E. FISHERIES MANAGEMENT PROBLEMS AND PROSPECTS

E. 1 Ecological Dimensions

Pelagic fish production

1. Hydrophysical, limnological, food web, stock assessment, fish biology, and related LTR studies (Sarvala *et al.* 1999) provide a basis for reassessing the pelagic trophic structure of Lake Tanganyika, which has been claimed to be unique in the proportion of fish biomass to phytoplankton biomass (Hecky 1984). Ecological studies and catch surveys have shown that production rates fall within the average range for deep tropical lakes, and are indeed not particularly high. These studies have also evaluated the vulnerability of the fish stock to increased fishing pressure and possible over-fishing.

2. Hydrophysical patterns, nutrient fluxes, and related primary production of Lake Tanganyika are highly dynamic and affected by climatic, hydrological and internal factors (Huttula 1997; Plisnier 1997; Salonen *et al*. 1999), all of which are not readily predictable and capable of dramatic fluctuation. Various hydrophysical and biological processes regulating secondary production likewise induce fluctuations in zooplankton, medusae, and shrimp abundance and distribution. These effects are seen in high seasonality, strong daily vertical migration, and patchy horizontal distribution. Some degree of areal variation is also apparent, at least between the northern and southern extremes of the lake. No consistent structural patterns are apparent along the intervening north-south axis (Vuorinen *et al.* 1999; Kurki *et al.* 1999).

3. The dominant pelagic fish species (clupeids and *L. stappersii,* as distinct from the other *Lates* spp.) display an r-selected life-history strategy typified by features of high juvenile mortality, early maturity and recruitment to fishery, relatively short life cycle, and high turn-over rate (Mannini *et al.* 1996). Such features are consistent with an adaptation towards non-predictable conditions and provide resistance to high fishing pressure (Adams 1980). High reproduction potential, multiple spawning, and migrations lead to regular recruitment and fast recovery after exposure to over-exploitation and highest actual yield and yield/ recruitment (Adams 1980; Armstrong and Shelton 1990; Fogerty *et al.* 1991).

4. Annual catch of planktivorous fish figures at about 23% of total estimated production for the whole lake, and as high as 66% in the case of Burundi waters, which are the most heavily fished. For piscivorous fish, the lakewide catch is reckoned to be some 70% of total estimated production. These figures suggest that the present fishing pressure in Lake Tanganyika is very high (Sarvala *et al.* 1999).

Variations in stocks and yields

5. Lake Tanganyika’s fish stock levels and yields are characterised by substantial year-to-year, season-to-season, and

area-to-area fluctuations, often associated with dramatic shifts in the relative abundance of clupeids and *Lates*. Such fluctuations, may be caused by variable success in fish recruitment which, in turn, is regulated in complex ways by physical, biological and fishing-related factors (Cole and McGlade 1998). LTR researchers have established that temporal and areal variations of commercial stocks are associated with the strength and timing of nutrient upwelling and related plankton succession in Lake Tanganyika. In other words, patchy and ephemeral distribution of the target pelagic species matches the patchy and ephemeral availability of their prey -- copepods for clupeids, and shrimps and clupeids for *Lates*. The strength of the fish year-classes is difficult to predict, but the lake productivity shows some correlation with long-term climatic changes (Plisnier and Coenen, 1997; Coenen *et al.* 1998; Mannini 1998).

6. Fluctuations in the relative abundance of pelagic species are also apparently linked to migrations between different sub-basins of the lake. Although not systematically studied by the LTR project, the likelihood of migration occurrence was demonstrated indirectly through catch studies (Coenen *et al.* 1998), fish biology data (Mannini 1998), and assessments of population genetic discreteness (Kuusipalo 1994, 1999; Hauser *et al*. 1998). The lack of distinct genetic population structures suggests that a significant exchange of individuals takes place between different parts of Lake Tanganyika.

7. In the case of *L. stappersii*, even though the species 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 (Mannini 1998).

8. Signs of excess fishing pressure of *S. tanganicae* stocks (high juvenile content and smaller mean length in catches) exist for the northern end of the lake, on both west and east coasts north of Karonda (Burundi coastline, about 75 km from the northern tip of the lake). Furthermore, the highly unselective beach seine fishery, mostly prosecuted in Zambia, is heavily targeting juvenile *Limnothrissa miodon* in their shallow, inshore nursery grounds. The seines are also inflicting substantial damage on the mainly cichlid coastal fish community (Mannini 1998).

9. Although total catches show an increasing trend, CPUE for industrial units (purse seiners) have been declining. Nightly CPUE of industrial units in Burundi dropped from 166 kg in 1994 to 111 kg in 1996, and in Mpulungu from 877 kg in 1994 to 535 kg in 1996. The industrial nightly CPUEs in Congo have also decreased to 433 kg from the 780-950 kg of the early 1990s (Coenen *et al.* 1998).

10. Progressive CPUE decline and increased duration of fishing trips in the industrial fishery in southern waters indicates a

decrease of the catchable stock and possible over-exploitation of *Lates stappersii* in southern waters, owing to uncontrolled growth of the industrial fishery (Coenen *et al.* 1998; Mannini 1998). Indications of possibly excessive exploitation pressures on *L. stappersii* have also been noted for the northern end of the lake, as a result of the effects of successive waves of heavy industrial fishing and artisanal fishing. *L. stappersii* now make up only around 20% of the commercial catch in northern waters, with juveniles accounting for most of this contribution (Mannini 1998).

E.2 Human Welfare Dimensions

11.Readings on the human welfare dimensions of Lake Tanganyika fisheries are provided by findings from two major LTR investigations – the lakewide socio-economic survey that was conducted in 1997 (Reynolds and Hanek 1997), and the community referenda exercise that was completed in late 1998 (Reynolds 1999). The latter involved a series of public meetings around the lake for the exchange of information and views between local fisheries stakeholder groups and national LTR field teams. Local community residents were briefed on major outcomes of LTR hydrobiological and socio-economic studies over the previous six years, and on how these have been integrated into a provisional framework for regional fisheries management. Each meeting involved free-ranging discussion of major management proposals followed by formal polling of participant opinion of their merits.

12.The following summary of socio-economic and community features of Tanganyika fisheries is based on aggregated survey findings and field observations, and so provides only a very broad and somewhat simplified picture of local realities.

Fisheries as livelihood

13.CCRF principles recognise that socio-economic and community welfare are crucial fishery concerns. Management aims for maintaining resource base viability must be pursued in the context of human requirements for '…food security, poverty alleviation and sustainable development' (FAO 1995b:4). Decisions related to the regulation of fishing effort, the protection of fragile stocks, and so on, are bound to carry implications for the activities and even the basic livelihood of those who participate in a fishery system as resource users.

14.The communities bordering Lake Tanganyika clearly share in the conditions that, on the basis of various 'quality of life' indices, have ranked East-Central African countries amongst the world's most poverty-stricken and underdeveloped (World Bank 1999). LTR Project socio-economic survey findings confirm a picture of weak and deteriorated physical infrastructure around the lakeshore, and of a critical scarcity in basic social services and amenities. At the same time, however, the data show that there is considerable variation of socio-economic circumstance within local and regional settings (Reynolds and Hanek 1997).

15.In some cases, estimated fishing-derived incomes in the artisanal sector rank above to well above estimated national working age population per capita annual income levels. Estimated earnings for traditional fishers, on the other hand, are substantially lower than national averages. Amongst post-harvest operators, strong gender-related discrepancy is widely apparent, with men earning at rates above national working age averages and women earning at rates well below (Mölsä *et al.* 1999).

16.In a context where the overall rural economy offers very limited opportunities for gainful employment, the attractions of fisheries work may be quite strong (cf. Skjønsberg 1982); there is the promise of moderate remuneration, depending on the job, and conditions of entry seem relatively easy (low initial requirements for skills, working capital, or investment in productive equipment and supplies). This observation is borne out by SEC survey findings related to respondents' future employment preferences. Strong majorities across all job categories in all four countries indicated a wish to continue with their respective present lines of work.

17.On the other hand, local views on the state of commercial fish stocks indicate that a degree of pessimism, or at least uncertainty, exists with regard to the ability of the lake's fisheries to sustain adequate levels of livelihood security. Fishers and post-harvest operators are very pessimistic in their appraisals of catch trends over recent years: majorities in all cases take the view that they have been on the decrease. Opinion as to whether future catches will be lower, higher, or the same tends to be divided or undetermined (i.e., responses of 'No opinion').

18.Sample respondents were also asked if they thought the lake would always provide 'enough fish for everybody.' Here too a division of opinion is apparent. DRC and Zambian fishers and post-harvest operators all take a decidedly negative view, whereas those in Tanzania are largely uncertain and those in Burundi tend towards a positive view.

Increasing demand for fish

19. The above survey findings on Tanganyika fisherfolk views of past trends and future prospects need to be appreciated in an overall regional context where demand for fish is constantly on the increase. Fish accounts for some 25% to 40% of total animal protein supply for the populations of the four Lake Tanganyika States (Gréboval *et al*. 1994), so its significance for nutritional welfare is obviously considerable. At the same time, rapid population growth within the Tanganyika basin and across East-Central Africa as a whole (World Bank 1999) fuels an ever-increasing demand for fish products, so that over the last several decades per caput supply has barely kept pace with overall fish production, despite increases in the latter (Gréboval *et al.* 1994).

20.In a region already subject to severe episodes of drought, prolonged political unrest has compounded the effects of population growth in ratcheting up demand for Lake Tanganyika fishery products. Crop and livestock production capabilities, marketing infrastructure, and the general state of food security have all been severely disrupted in Burundi, eastern DRC, and Rwanda due to hostilities and attendant population displacements and breakdown of public services.

Resource access issues

21.Tanganyika fisheries basically operate under an open access regime. Under the broad conditions associated with national territorial partitions, everyone is free to fish. This situation is clearly untenable. Open access classically leads '…to overexploited resources and declining returns for all participants' because it is '…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' (FAO 1997:52). Rising population pressures within and without the lake basin are bound to exacerbate matters.

22.At the same time, opinion seems to vary amongst local fisherfolk populations about what sorts of access rights, if any, ought to be maintained. A survey proposition suggesting that 'everyone should be allowed to fish anywhere they want in the lake,' for instance, drew mixed responses both within and across national boundaries (Reynolds and Hanek 1997). Consensus on the issue is clearly lacking, yet some form of limited access will have to be established if the fisheries are to be sustained – i.e. if the classic sequence of 'free-for-all' exploitation → race to fish → resource over-exploitation is to be avoided (FAO 1997).

Local participation in management decision-making

23.Management approaches within the four national sectors of Lake Tanganyika were established in the classic 'top-down' model, featuring a high degree of state control over all aspects of fisheries affairs from policy definition to regulation enforcement. Although existing legislation in some cases provides for consultation between administrators and local representatives of fisher interests (Cacaud 1999a), and although fisher committees are reported to exist at various landing sites (Reynolds and Hanek 1997), *de facto* local community participation in resource management decision-making and follow-up has been very minimal.

24.It is nevertheless clear that at least in some localities fisherfolk would be eager to embrace management responsibilities more directly. SEC survey findings show, for example, that majorities in all respondent categories in Zambia, and of both artisanal and traditional fisher groups in Tanzania, reject the proposition that 'fishing rules should only be decided by Government.' Further evidence of a willingness to engage in management deliberation and consultation activities with

fisheries officials was encountered during the community referenda exercise of late 1998 (Reynolds 1999).

Equity issues

25.The existence of broad patterns of differentiation between owners and crew members along various measures of personal circumstances and income potential documented during the SEC survey (Reynolds and Hanek 1997) was further verified during the 1998 community referenda exercise (Reynolds 1999). Many fishworkers related accounts of poor working conditions and arbitrary behaviour on the part of some employers. Crew members widely report harbouring a sense of powerlessness, and of feeling that their interests and problems are generally ignored.

26.A gender dimension of socio-economic inequality in local communities is expressed in terms of educational attainment and estimated income measures (Reynolds and Hanek 1997). It is apparent in other ways as well, as noted during the 1998 Community Referenda exercise (Reynolds 1999). Considering their actual level of participation in Tanganyika fisheries as workers, processors, traders, and even occasionally as boat and gear owners, women seem to have little voice in public deliberations on fisheries issues.

27.A further dimension of socio-economic inequality can be recognised in the relations between artisanal and traditional fishers on the one hand and the industrial purse seine fishery on the other. Small-scale fisher antipathy towards purse seining is fairly general around the lake, but is particularly strong in the southern end, where virtually all of the industrial fleet is now based (Reynolds and Hanek, 1997; Reynolds 1999). Purse seiners are widely blamed for declining catches in the Zambian sector, and overwhelming support exists for imposing restrictions on their operation. There is a strong sense that fishing companies are treated preferentially, at the expense of small-scale fisher interests.

E.3 Institutional and Legal Dimensions

28.An appreciation of the problems and prospects related to institutional and legal dimensions of Tanganyika fisheries can be gained from LTR studies of relevant organisational and legislative frameworks within the four lacustrine States (Hanek 1994; Maembe 1996; Cacaud 1996, 1999), monitoring and statistical data collection work carried out in collaboration with national research institutes and fisheries department offices around the lakeshore (Coenen 1994, 1995; Coenen *et al.* 1998; Paffen *et al.* 1997; Mannini 1999), and findings of the 1997 lakewide SEC survey (Reynolds and Hanek 1997) and 1998 Community Referenda exercises (Reynolds 1999).

Institutional capabilities

29.All four lacustrine States are nominally committed to fisheries policies that emphasise socio-economic welfare objectives, consistent with the need to use resources in a

sustainable, conservation-wise manner. Yet the institutional means provided for realising these objectives are woefully inadequate (Reynolds 1998; Cacaud 1999).

30.Detailed appraisals of regional institutional capabilities identify budgetary problems as the main underlying cause of organisational dysfunction within the fisheries sector (Maembe 1996; Cacaud 1996, 1999). National fisheries departments and research agencies are chronically under-funded, and in some cases disastrously so. As a consequence, research agencies are unable to maintain creditable scientific monitoring programmes in order to fulfil their role as technical advisors on sound management and conservation practices, except through dependence on outside sources of funding (cf. Coenen *et al*. 1998; Mannini 1999).

31.Furthermore, fisheries departments are simply unable to marshal, in either qualitative or quantitative ways, adequate human and material resources for effecting their basic mission tasks of monitoring, control, and surveillance (MCS) and provision of extension services. Operational paralysis and lack of motivation amongst field personnel are rife (Cacaud 1999a).

Legislative frameworks

32.Inventories of major fisheries legal framework deficiencies within the four lacustrine States reveal that existing legislation, in some cases dating back to the colonial era, is in many respects outmoded or obsolete (Cacaud 1999a). Comprehensive overhaul is needed in order to relate it both to current realities of territorial and administrative organisation, and contemporary management imperatives.

33.Also, umbrella-type legislation that establishes broad regulatory powers for state authorities to exercise on a national basis needs to be supplemented with specific regulations to fit the particular circumstances of Lake Tanganyika.

34.The lake’s ecosystem, including its pelagic stocks, exists and must be understood and managed as a unitary whole: it makes little sense to devise management approaches purely on a piecemeal, national jurisdiction-by-jurisdiction basis. Imposition of mesh size restrictions or the banning of beach seining, for example, will be of limited utility both in biological and social equity terms if the fishers or gear suppliers of an adjacent country are not subject to the same regulations.

35.Despite their participation in the CIFA Sub-Committee structure, no provision exists in existing legislation of the respective lacustrine States for participation in regional efforts to guide resource use and conservation on an internationally shared basis.

36.Enforcement and compliance assurance are other major areas of legal deficiency. Fisheries regulations in all four lake States

are widely ignored in practice, either because they are insufficiently enforced or because they are simply not enforced at all. The problem relates back to the huge financial constraints under which regional fisheries authorities must labour: it is impossible to support adequate numbers of enforcement agents in the field.

37.As this situation is unlikely to improve in any dramatic way within the foreseeable future, new and viable enforcement solutions are called for. These latter will require the full participation of local stakeholders in management decision-making and in follow-up actions to ensure regulatory compliance (Cacaud 1999a, 1999b).

Monitoring needs

38.At the beginning of the LTR project it was apparent that fisheries monitoring and information processing capabilities at some of the lakeshore stations were extremely weak. Extensive collaborative work with national administrators and researchers was conducted in order to strengthen these capabilities and to assemble the sort of information base that is a first requirement of fisheries planning and management.

39.Planning and management efforts will be impossible to pursue in future unless a regular lakewide monitoring programme is kept in place. Although monitoring activities of the same scope and intensity as achieved under LTR would clearly be impractical, any future programme would need to provide some degree of coverage over the same basic set of parameters -- physical, biological, statistical, and socio-economic – as those investigated under the project (Coenen *et al.* 1998; Mannini 1999).

Local views on possible options to regulate fishing

40.Respondents interviewed during the 1997 lakewide SEC survey were asked for their opinions on a range of propositions relating to the regulation of fishing effort, including seasonal and area closures, quotas on number of fishers allowed to operate on the lake, mesh size restrictions, and various restrictions on fishing techniques (purse seining, beach seining, and lift-netting). A further set of questions pertaining to regulation enforcement and compliance mechanisms was also administered (Reynolds and Hanek 1997).

41.Findings (Table 2) 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 high approval ratings on propositions to enhance official enforcement capabilities and to apply sanctions against regulation violators. (It is also suggested by the widespread concern expressed by Tanganyika fisherfolk over the state of commercial stocks – see para. On the other hand, local views on the state of commercial fish stocks indicate that a degree of pessimism, or at least uncertainty, exists with regard to the ability of the lake’s fisheries to sustain adequate levels of livelihood

security. Fishers and post-harvest operators are very pessimistic in their appraisals of catch trends over recent years: majorities in all cases take the view that they have been on the decrease. Opinion as to whether future catches will be lower, higher, or the same tends to be divided or undetermined (i.e., responses of 'No opinion')..)

42.At the same time, however, there is rather weak agreement lakewide vis-à-vis many of the particulars that management arrangements could entail. Where strong 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 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.

43.These attitudinal findings suggest that the task of fashioning a regulatory framework for fisheries around the lakeshore will be a complicated one. Significant divergence of fisher and post-harvest operator opinion over management measures occurs not only between the four national sectors, but within them as well.

44.Polling conducted in the course of the LTR Community Referenda exercise on core proposals contained in the provisional management framework yielded broadly similar outcomes (Reynolds 1999). Community groups were asked about their reactions, 'in principle,' to the following possible management actions: 1) limitations on fishing in one form or another; 2) local community participation in fisheries management; 3) the formation of management advisory groups running from local to regional level; 4) licensing to control the number of fishers and boats allowed to operate within given areas; 5) prohibition of industrial fishing in certain parts of the lake; and 6) prohibition of beach seine fishing along certain areas of shoreline.

45.Whilst these basic management propositions largely meet with local approval, and thus may continue to be regarded as legitimate reference points for elaborating management strategy and tactics on a lakewide basis, there is by no means a universal consensus on any of them. Local stakeholder opinion appears to be especially divided on the issue of operator and craft licensing as a means to control entry to the fishery. Of the above six propositions presented to participants in the community referenda meetings, this proved to be the one case that yielded an indeterminate outcome.

F. LAKE TANGANYIKA FFMP: POLICY CONSIDERATIONS

Management policy challenges

1. Assessment of the current state of Lake Tanganyika fisheries across its multiple dimensions -- ecological, socio-economic, legal, and institutional – indicates that management policy needs to be formulated to cope with broad problems inherent to conditions of lacustrine resource system uncertainty and

complexity, plural stakeholder interests, and interactions between fishing and other sectors of the wider regional economy.

2. The CCRF provides a framework of basic policy orientation through which these requirements may accommodated in an integrated fashion. Use of this policy framework requires simultaneous attention to what might be called the 'five principal Ps' of responsible fisheries -- namely:

a) **Process** (understanding management as dynamic and adaptive in the face of complex and changing circumstances);
b) **Precaution** (conservative, least-risk exploitation and development strategies in the face of system uncertainty);
c) **Partnership** (reliance on co-management approaches involving shared management responsibilities between State fisheries authorities and local stakeholders);
d) **Proprietorship** (recognition of limitations on rights of resource access and use); and
e) **Policing** (monitoring, control, and surveillance and enforcement activities to secure the regulation of fishing mortality).

3. Figure 2 depicts an idealised representation of how the different components of the responsible fisheries management approach are integrated into an overall process. It is important to note 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' (FAO 1997:7-8).

4. 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. Whatever the specifics of the circumstances and the programme of actions elaborated to secure the identified objectives, management transactions must be based on the fundamental recognition that fishing mortality will have to be regulated in some fashion or another. It is a question of maintaining sustainability. As observed in the CCRF *Technical Guidelines*,

> ...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 [FAO 1997:45].

5. With these basic reference points in mind, the following directions for policy are recommended in order to build toward responsible fisheries management on Lake Tanganyika.

F.1 Process (1): Adaptive Management

6. Management approaches must be capable of adjustment to meet particular episodes of stock fluctuation and attendant changes in fishery circumstances (cf. Hilborn and Sibert 1988).

7. Inter-annual, seasonal, and areal variations in yields within Lake Tanganyika may be linked to the complex relationships between fish stock fluctuations and migrations and the incidence of nutrient upwelling and related plankton succession. Yet such knowledge, even when coupled with findings from the wider set of hydrophysical, limnological, and related studies that have been conducted through LTR and other scientific investigations, by no means allows for close 'when, where, and how much' predictions of ecosystem fluctuation.

8. In the face of multilevel uncertainties, a good deal of flexibility will be required to accommodate sometimes rapidly changing circumstances. Static maximum sustainable yield (MSY) modelling and lake-wide total allowable catch (TAC) assessment are completely unequal to such a task (Lindqvist and Mikkola 1989). 'Adaptive' or 'interactive' management practices that allow for adjustments in fishing pressure in the short-term will also allow for fishery system sustainability in the long-term (cf. Charles 1994).

9. A policy of adaptive management is appropriate to Lake Tanganyika circumstances in other ways as well. Even though pelagic stocks seem to be distributed randomly throughout the lake, with no apparent sub-populations, the difference in target species concentration between the clupeid-based fishery of the northern areas and the *L. stappersii*-based fishery to the south might require management treatments that are somewhat distinct and separate.

10. The same holds true with respect to the composition of national fleets and fishing units. The fisheries of the DRC and Tanzania, which respectively account for the greatest and second greatest annual take of pelagic species from the lake, are comprised mostly of traditional and artisanal units operating from landing sites distributed along vast stretches of coastline. The fisheries of Burundi and Zambia, in contrast, are limited to much more confined areas. They also feature fairly high concentrations of relatively more efficient artisanal gear – liftnet and Apollo units in the case of Burundi and kapenta seines in the case of Zambia. A very high density of industrial units further distinguishes the Zambian sector.

F.2 Precaution: Uncertainty, Complication, and Multi-disciplinary Perspectives

11. From a sustainability point of view, the effectiveness of management decision-making directly depends on the use of multi-

disciplinary approaches. This is particularly true in the case of the Tanganyika pelagic fishery. It is a fishery of complicated and interacting 'multiples': multiple species, subject to multiple fluctuations of abundance, are harvested and utilised by multiple interest groups deploying multiple varieties of gear and technology.

12. Accordingly, in its bid to chart out some of the key patterns, processes, and inter-linkages of this complex system, LTR made use of a mix of observational and analytical tools from both the natural and social sciences. Plans for the immediate future call for the continuation of the regional monitoring activities started under the project's Scientific Sampling Programme, on a much reduced scale, under the responsibility of national teams using a standardised set of procedures.

13. The extended monitoring programme will have to be capable of generating information on complex fisheries interactions involving both natural and human agencies. Provision has thus been made in for collection and collation of basic data in five key indicator areas (Mannini 1999). These include:

a) 'early alarms' signalled by changes in hydrodynamic patterns;
b) density and distribution patterns in the meso- and macro-zooplankton communities that provide prey for planktivorous fish;
c) CPUE and fish biology data for main target species;
d) continuity and change in fishing communities (size, composition, and infrastructure) and the socio-economic circumstances of local harvest and post-harvest operators; and
e) continuity and change in local views on trends in, problems with, and regulation of the fishery sector.

14. Of over-riding concern for future monitoring activities on Lake Tanganyika is their practicality, given current conditions of budget, staff, and equipment limitations. Design of the extended programme accordingly has attempted to meet criteria of:

a) feasibility (procedures commensurate with available resources);
b) simplicity (use of uncomplicated equipment with minimum maintenance needs); and
c) sustainability (high likelihood for regular data collection over the long run).

15. A basic requirement for monitoring is that it be sufficiently robust to allow for the achievement of management aims in the face of statistical uncertainty and incomplete knowledge (cf. FAO 1996a; Charles 1985).

16. Robustness may be enhanced by combining information from 'non-scientific' knowledge systems into the store of multi-disciplinary data that is generated through conventional 'scientific' approaches. Such a whole system approach would

entail collaboration between all concerned parties to a fishery -- scientific and managerial 'experts' on the one hand and local 'experts' on the other (cf. de la Mare 1998; Mackinson and Nøttestad 1998).

F.3 Partnership: Co-management

17. Variously known as 'co-management,' 'management in partnership,' 'participatory management,' or 'community-based management,' policies to increase local involvement in resource use decision-making and regulation are based on recognition of the inherent weaknesses of 'top-down' or 'command and control' management regimes.

18. The latter, in addition to undervaluing the potential contributions of local knowledge systems and actors to the management process just noted above, often feature a heavy measure of state intervention. This may often result in an 'us versus them' response of disassociation amongst local fisherfolk, expressed in widespread indifference and even the deliberate violation of official regulations (Reynolds 1998; cf. Charles 1994).

19. In CCRF language, '...the efficiency and implementability of...management measures are often highly dependent on the support gained from the interested parties' (FAO 1997:55). Such support is most likely to exist where resource users can identify with specific measures because they have they have helped to craft them.

20. Because it offers such obvious long-term advantages, management partnership warrants strong emphasis in regional policy for Tanganyika fisheries. At the same time, the scope and pace with which partnership arrangements are implemented will depend on specific circumstances.

21. Views on co-management appear to vary to some extent between countries and localities, and there are clear differences in fisheries and environmental circumstances, as well as attitudes towards specific regulatory measures (e.g. licensing, gear and space-time restrictions, etc.), that will have to be accommodated.

22. Community outreach activities obviously must figure strongly as part of management partnership strategy, in order to build levels of environmental consciousness and receptivity to measures for the regulation of resource access and exploitation.

F.4 Proprietorship: Resource Access and Use Rights

23. Local control of fisheries resources is also mediated through the allocation of property rights. As noted earlier, open access regimes or regimes that, as in the case of the Tanganyika fisheries, essentially function in an open access mode under broad conditions of state resource ownership and regulation, virtually guarantee a situation of resource over-exploitation. Fish harvesters, even where limited by quota and/or effort

restrictions, will each race to garner as much of the resource as they can, with the ultimate result of declining returns for all (FAO 1997).

24.Limited access arrangements in small-scale artisanal fisheries may be particularly effective when constituted as fishing rights allocated at the group or community level. Incentives are thereby created to use resources (i.e. group 'property') in a sustainable fashion through the application of local catch and access controls and the use of local enforcement mechanisms (Charles 1994).

25.The future sustainability of Tanganyika fisheries requires a transformation of the present rather loose 'open-access-within-national-jurisdictions' regime into one that allocates fishing rights to local communities and their respective territories. But here again a gradual policy move is indicated.

26.Attitudes and circumstances that bear on access issues vary at both district or country levels, and need to be addressed on a zone-by-zone basis through careful consultation and negotiation with local stakeholder groups.

27.Also, in the case of the southern waters particularly, the process of fishing rights reallocation will need to accommodate the interests of industrial fishing firms, possibly as stewards of special 'offshore commercial use territories' or directly as component parts of local community zones.

F.5 Policing: Community Involvement in MCS

28.CCRF guidelines characterise monitoring, control, and surveillance (MCS) activities as indispensable to effective management. Thus,

> …the widespread failure of fisheries management on a global scale has, in large part, been a result of the inability of …authorities to enforce successfully or otherwise ensure compliance with their management regulations and to monitor accurately the behaviour and performance of the fishers. Responsible fishing requires effective …[MCS], which is dependent on the collection, collation and analysis of accurate and relevant data and information [FAO 1997:39].

29.As shown by LTR legal-institutional studies, regional fisheries administrations labour under financial, staffing, and operational shortcomings that severely limit their ability to provide adequate MCS services. The studies offer the further reminder that such shortcomings are not likely to be resolved in any meaningful way over the near-term. In this connection, greater use of co-management arrangements in relation to MCS activities may offer substantial advantages in terms of cost-reduction and efficiency gains.

30.If local stakeholders could be encouraged to assume a greater share of responsibility, it is conceivable that local fisheries authorities could accomplish monitoring and enforcement purposes

on a ‘more-for-less’ basis. In some circumstances, it may be possible to use existing local-level authority structures and customary practices to facilitate self-policing and shared responsibility for MCS activities.

F.6 Process (2): Holistic Management

Process and larger systems

31.The first of the ‘principal P’ themes of responsible fisheries, that of ‘process,’ should be understood not only in relation to the need to accommodate particular conditions of change and fluctuation through the use of adaptive or interactive management approaches (section F.1 above). As a basic reference point for policy orientation, ‘process’ also refers to events of continuity and change understood very broadly, in overall system dimensions.

32.Such holistic perspectives are realised in fisheries management strategies that recognise the basic *inter-relatedness* of hydrophysical, biological, and anthropogenic events of cause and effect linked to the fishery. This point also bears on the theme of precaution and the need to cope with uncertainty and complication through the use of multi-disciplinary approaches, including those that mobilise both ‘scientific’ and ‘non-scientific’ knowledge bases (see section F.2 above).

33.In the Tanganyika case, as in other fisheries contexts that involve straddling stocks, management strategy must also have ‘whole system’ capability because the commercial pelagic species are randomly distributed throughout the lake. Fish that inhabit the shared waters of Tanganyika and the other African Great Lakes, as it is often humorously observed, do not carry passports. To be meaningful, therefore, management approaches must be calibrated at the scale of the entire lacustrine ecosystem (see paras. Fluctuations in the relative abundance of pelagic species are also apparently linked to migrations between different sub-basins of the lake. Although not systematically studied by the LTR project, the likelihood of migration occurrence was demonstrated indirectly through catch studies (Coenen *et al.* 1998), fish biology data (Mannini 1998), and assessments of population genetic discreteness (Kuusipalo 1994, 1999; Hauser *et al.* 1998). The lack of distinct genetic population structures suggests that a significant exchange of individuals takes place between different parts of Lake Tanganyika. and The lake’s ecosystem, including its pelagic stocks, exists and must be understood and managed as a unitary whole: it makes little sense to devise management approaches purely on a piecemeal, national jurisdiction-by-jurisdiction basis. Imposition of mesh size restrictions or the banning of beach seining, for example, will be of limited utility both in biological and social equity terms if the fishers or gear suppliers of an adjacent country are not subject to the same regulations.

34.Despite their participation in the CIFA Sub-Committee structure, no provision exists in existing legislation of the

respective lacustrine States for participation in regional efforts to guide resource use and conservation on an internationally shared basis. above).

35.Finally, The ‘pursuit of responsible fisheries’ as a basic policy objective cannot ignore the processes operating across the larger socio-economic environment within which a local fishing industry must be prosecuted, managed, and developed.

Fishing and non-fishing sector interactions

36. From an ‘inside-out’ perspective, the weak performance of a poorly managed fishery will have ramifications far beyond the sector, affecting a range of local, national, or even regional welfare interests. Conversely, if there is strong internal coherence in terms of responsible fishing practices, then optimal benefits are generated not only for sector user groups but also for the larger society of which they form a part (FAO 1995b; cf. Charles 1994).

37.From an ‘outside-in’ perspective, the play of various factors and externalities in other, non-fishing sectors, whether at the immediate local scale or across broader national, regional, and even international arenas may exert far-reaching influence on the fisheries.

38.At local ‘micro-levels’ these typically include impacts arising directly from competing demands for use of the aquatic resource base (e.g., fishing versus wildlife conservation/tourism use), or indirectly from externalities generated by non-fishing activities (e.g. fishing versus sewage disposal).

39.At national and regional ‘macro-levels,’ impacts might arise, for instance, from declines in agricultural production, industrial stagnation, altered terms of international trade, widespread unemployment, or shifting consumer preferences.

40. The Tanganyika situation involves a complex of fishing and non-fishing sector interactions, at both micro- and macro-levels of socio-economic integration, that appear quite problematical.

Micro-level interactions

41.A variety of conflicts, existing and nascent, can be documented between fishing and other user interests around the lakeshore (LTBP 1998). Pollution impacts from waste discharge exist around urban areas like Bujumbura, Kigoma, and Mpulungu, for example. Other conflicts arise in connection with the wildlife conservation areas and development of tourism in the cases of Nsumbu National Park in Zambia, and Mahale National Park and Gombe Stream Reserve in Tanzania.

42.On a wider and, at present, far more serious scale is the environmental degradation and associated threats to biodiversity within the aquatic resource base linked with the activities of a

rapidly expanding population of smallholder farmers. The situation is particularly acute where settlement densities are high. Shortage of farm land for family food production leads people to cultivate on steep hillsides, leading in turn to progressive deforestation, soil erosion, and siltation of nearshore waters (Coulter and Mubamba 1993; Cohen *et al*. 1993).

43. Resolution or mediation of conflicts arising from multiple use demands and the interaction of sectoral externalities will not come about if regional fisheries management policy remains pre-occupied with 'internal' sector affairs. The reality of fishing and non-fishing sector interactions should be duly recognised. This once again highlights the importance of multi-disciplinary approaches for the discovery and understanding of pattern and process in fisheries systems and their wider contexts (cf. Charles 1994; FAO 1995b).

Coastal area management

44. What is also indicated is the importance of policy support for integrated development approaches, as are often associated with the 'Coastal Area Management' model (FAO 1995b, 1996b). The latter calls for, *inter alia*:

a) establishment of conflict resolution mechanisms to settle differences arising between fisheries resources users and other users of a coastal area;
b) promotion of public awareness of coastal resource conservation and management needs and of public participation by affected parties in the management process;
c) assessment of the economic, social, and cultural values that attach to different coastal resources; and
d) use of multi-disciplinary approaches to monitor the coastal environment.

45. With regard to Tanganyika fisheries, the development of coastal area management approaches in the immediate future might best be pursued in conjunction with the work of the GEF Biodiversity Project (LTBP 1998).

Macro-level interactions

46. Of particular note in connection with fishing and non-fishing sector interactions at the macro-level is the role of Lake Tanganyika as a major supplier of fish protein in a regional context marked by widespread civil turmoil, population displacements, episodes of drought, and crippled or degraded capacity in other food producing sectors.

47. These larger events, compounded by the a constantly increasing load of human inhabitants within the lake basin and across East-Central Africa generally, have not only contributed to conditions of food insecurity and placed increasing pressure on the lake's fisheries resources; they have also helped to create conditions of employment insecurity.

48. Considering the attitudinal and income data collected during LTR's 1997 SEC survey, the Tanganyika fisheries are perceived and used by basin residents as a significant source of employment as well as of food. In the face of limited alternative gainful employment opportunities, and with what seem to be relatively reasonable earnings at stake, the fisheries have probably been functioning as a strong labour magnet for rural dwellers over recent decades.

49. Taken in conjunction with LTR evidence pointing to the development of over-fishing on certain stocks in certain localities in Lake Tanganyika, the effect of such a development would only be to worsen sustainability prospects for the fisheries in the short-term. Within the wider context of national and regional development policy, therefore, a strong push for economic diversification should be encouraged. The aim should be to make fishing relatively less attractive in comparison with other employment possibilities (cf. Charles 1994).

50. Failure to promote diversification at the macro-level, given current trends in the lake fisheries, could easily result in a huge inflation of the social costs of fisheries for the wider region, as economically marginalised people are displaced from the sector and begin casting about *en masse* for rare or non-existent alternative sources of livelihood (cf. Lindqvist and Mölsä, 1992).

G. LAKE TANGANYIKA FFMP: INITIAL MANAGEMENT ACTIONS

1. Although LTR studies over the past six years identify a large range of possible management actions for both the harvest and post-harvest sectors, the FFMP has not been formulated as an ambitious 'total package' approach that pretends to deal with all of them here and now. The intent is rather to develop a programme that is as minimal and straightforward as possible at this preliminary stage of regional agenda setting. Once a basic framework for a responsible fisheries management is properly established, it would be elaborated, adjusted, and reviewed as part of an ongoing process (see para. Figure 2 depicts an idealised representation of how the different components of the responsible fisheries management approach are integrated into an overall process. It is important to note 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' (FAO 1997:7-8). and Figure 2).

2. FFMP main elements relate to those policy initiatives and practical actions that:

a) are needed to help set the overall management stage (prerequisites for other actions); or

b) concern problems demanding immediate attention because of potentially serious sustainability impacts.

3. As described below and also further summarised in Table 3, such elements have been identified under seven broad headings -- namely: overall policy matrix; partnership and resource access; institutional modalities; legal modalities; MCS; possible technical measures to regulate fishing; and possible input controls to regulate fishing.

G.1 Adoption of CCRF Policy Matrix

4. First, in order to ensure that the four lacustrine States act with a common set of development objectives in mind, it is recommended that the CCRF be implemented by their respective competent authorities as the policy matrix for the shared fisheries of Lake Tanganyika.

5. It is further and more specifically recommended that the respective competent authorities of the four States, in light of reasons outlined above, adopt and pursue management policy directions in support of:

a) adaptive or interactive management practices that allow for adjustments in fishing pressure, and also allow for flexible application of management treatments appropriate to different circumstances encountered around the lakeshore;
b) multi-disciplinary monitoring capability for measurement of continuity and change across a range of bio-physical and socio-economic parameters, as appropriate to the complexities of ecosystem – human system interactions, and also as appropriate to the establishment and maintenance of 'non-scientific' and 'scientific' knowledge coalitions;
c) partnerships with local stakeholder groups in management decision-making and in fashioning modalities of enforcement and compliance;
d) allocation of access and fishing rights at local community levels; and
e) use of integrated development strategies and coastal area management models at the local level, in order to accommodate complex interactions and possible conflicts between fishing and non-fishing activities, and, at national and regional 'macro-levels,' moves to foster economic diversification to reduce pressure on the fishery resource base.

G.2 Partnership Arrangements and Local Control of Resource Access

6. Co-management (community-based management, participatory management, partnership management) structures and operational arrangements should be encouraged around the lakeshore.

7. Because attitudes towards co-management appear to vary by country and even to some extent by fisherfolk sub-groupings, co-management arrangements should be encouraged in a somewhat

flexible manner, depending on local pre-dispositions. 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 assurance processes.

8. Local attitudes towards various forms of access limitation are not uniform. 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.

9. 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.'

10. Industrial fishing firms should be accommodated within a new use rights scheme either as stewards of special 'offshore commercial use territories' or as participating stakeholders within designated community zones.

G.3 Institutional Modalities

11. It is has been shown through LTR-associated studies and other appreciations of the situation that existing institutional arrangements frameworks of the four lacustrine States are deficient on a variety of counts. Significant review and revision is warranted, as detailed more fully in the FFMP companion study on institutional and legal aspects of Tanganyika fisheries (Cacaud 1999a).

12. Principal deficiencies common to institutional frameworks were identified and can be summarised as follows:

a) inadequate budgetary allocation to fisheries sectors by central governments.
b) inadequate funding for research.
c) lack of human resources and equipment.
d) poor to non-existent enforcement of fisheries regulations.
e) insufficient linkage between central administration and field agents at local level.

13. There is an obvious need for the respective central governments to increase their level of budget allocations to fisheries research and administrative agencies.

14. Increased involvement of local stakeholders in management decision-making and enforcement activities is also indicated as this would improve the overall level of compliance with regulatory measures and thus help to reduce the costs of fisheries administration.

Modification of CIFA Sub-Committee Terms of Reference

15. In order for the CIFA Sub-Committee for Lake Tanganyika to function more effectively as a mechanism to facilitate co-ordination of regional fisheries-related matters, it is recommended that its Terms of Reference be revised to better reflect the themes and approaches proposed in the FFMP.

16. The new Terms of Reference might thus specify that the functions of the CIFA Sub-Committee for Lake Tanganyika include the following:

a) facilitate discussions for all related fisheries matters, including coastal zone management, environment and water quality;
b) promote the exchange and dissemination of fisheries information;
c) develop and recommend conservation and management measures;
d) facilitate periodic elaboration and implementation of a regional fisheries management plan and its components;
e) harmonise national measures for the sustainable utilization of the living resources of the Lake;
f) advise on the direct or indirect effects of introduction of non-indigenous aquatic animals and plants into the waters of Lake Tanganyika and all the waters connected therewith consistent with the FAO Code of Conduct for Responsible Fisheries and the United Nations Convention on Biological Diversity and any other relevant international instruments;
g) facilitate periodic elaboration and implementation of a regional monitoring programme and its components;
h) facilitate the harmonisation of fisheries regulations for Lake Tanganyika;
i) establish *ad hoc* subsidiary committees to perform such of its functions and subject to such conditions, as the CIFA Sub-Committee for Lake Tanganyika may determine;
j) continue to explore ways and means of establishing an autonomous intergovernmental organisation or arrangement;
k) seek international financial assistance to support fisheries development and management programmes;
l) facilitate, recommend and co-ordinate training and extension activities in all aspects of fisheries;
m) report to CIFA at each session on its activities during the preceding inter-sessional period.

G.4 Legal Modalities

17. It has also been well demonstrated that existing legislative frameworks of the four lacustrine States as they pertain to Lake Tanganyika are incomplete and warrant significant revision, as detailed more fully in the FFMP companion study on institutional and legal aspects of Tanganyika fisheries (Cacaud 1999a).

General provisions

18. Basic fisheries legislation in all four lacustrine States generally provide sufficient legal basis for the implementation of most of the measures proposed in the FFMP, as they vest broad regulatory powers to competent authorities enabling them to regulate virtually all aspects of inland fisheries.

19. Actions that can be immediately undertaken in all four lacustrine States on the basis of existing legal framework to facilitate the measures proposed in the FFMP include:

a) implementation of the FAO Code of Conduct for Responsible Fisheries;
b) use of existing traditional institutional arrangements and customary fishing rights, where appropriate, for enhancing local control of fisheries resource access;
c) organisation and conduct of an awareness campaign designed to inform local fishers of FFMP objectives and enlist their support for its implementation.

Zambia and Tanzania

20. In Zambia and Tanzania, where fishing operations in Lake Tanganyika remain virtually unregulated, it is recommended to draft a comprehensive set of regulations applicable to Lake Tanganyika fisheries, which should address the following tasks:

a) devise various classes of fishing units or categories of fishing operations;
b) determine which classes of fishing units are required to carry a fishing license;
c) determine the number of fishing licenses that can be issued for industrial fishing units;
d) determine prohibited or authorised methods of fishing and restrictions on certain methods of fishing (e.g. banning or gradual phasing out of beach seining in Zambia[2]);
e) establish prohibited fishing areas (for all purposes/for the protection of spawning grounds/in respect of any fishing method or any species of fish);
f) establish and demarcate prohibited industrial fishing areas and beach seining areas;
g) establish closed times and/or closed seasons for fishing;
h) set gear specifications (mesh sizes, height and length of nets and other fishing implements); and
i) ban the introduction of non-native species of fish and aquatic plants.

[2] Tanzania has put a prohibition of beach seines in place under the Fisheries (Amendments) Regulations of 1997. This is a provision that applies at the national level, and is not specific to Lake Tanganyika.

Democratic Republic of Congo and Burundi

21. In the Democratic Republic of Congo and Burundi, it was recommended to review fisheries regulations applicable to Lake Tanganyika in light of the findings and conclusions of the FFMP.

22. In the Democratic Republic of Congo, fisheries regulations applicable to Lake Tanganyika should include provisions for:

a) banning the introduction of any non-native species of fish and aquatic plants;
b) limiting the number of industrial fishing licenses that can be issued;
c) banning beach seining throughout Lake Tanganyika waters falling under the Democratic Republic of Congo jurisdiction; and
d) reviewing the classification of fishing units with a view to harmonising fisheries regulations.

23. In Burundi, fisheries regulations applicable to Lake Tanganyika should include the following provisions:

a) banning beach seining throughout Lake Tanganyika waters placed under Burundi jurisdiction;
b) modifying, if necessary, the limit imposed on the number of industrial fishing licenses that can be issued in the Burundi portion of Lake Tanganyika; and
c) reviewing the classification of fishing units with a view to harmonising fisheries regulations.

Harmonisation of fisheries regulations

24. It is reiterated that harmonisation of fisheries regulations is a key element of co-operation in the lake area that would greatly facilitate the implementation of a regional fisheries management plan. In particular, emphasis should be placed on three specific measures:

a) elaboration of a common classification of fishing units or categorisation of fishing operations;
b) development of mechanisms of management in partnership; and
c) improvement of enforcement of fisheries legislation.

G.5 Monitoring, Control and Surveillance (MCS)

25. The extended monitoring programme designed under LTR auspices (Mannini 1999) should proceed according to the workplan already in place, bearing in mind the additional recommendations detailed more fully in the FFMP companion review of MCS for Tanganyika fisheries (Cacaud 1999b).

Lake Tanganyika Monitoring Programme (LTMP)

26. The Lake Tanganyika Monitoring Programme (LTMP) generally conforms to CCRF guidelines with respect to considerations of cost, feasibility, and relevance to local circumstances.

a) The cost of implementing the LTMP, which will require an estimated US$ 10,000 per country and per calendar year and another US$ 10,000 to be made available to the Regional Co-ordinator to carry out his or her functions, has clearly been kept to a minimum.
b) Feasibility considerations are taken into account, as proposed monitoring measures have been thoroughly tailored to the availability of both human and equipment resources in each research station around the lake.
c) The characteristics of local fisheries have been reflected in the LTMP, insofar as all major commercial fishing types are covered. Specific provision is made for data collection and monitoring of the important industrial fisheries in Zambia.

27. Further measures are likely to be needed to ensure LTMP's sustainability in the long term, however. In particular, a time frame and financial scheme be incorporated in the LTMP, bearing in mind that current funding for the LTMP is of limited duration.

Promoting compliance

28. In order to ensure the proper implementation of the LTMP and, more generally, to encourage compliance with measures proposed in the FFMP, the following recommendations apply.

a) The conduct of periodic frame surveys, designed to assess the state of the fishing industry, should be required by fisheries legislation in each of the lacustrine countries.
b) Steps should be taken to ensure that consultation with fishers and other stakeholders takes place prior to revising old or devising new fisheries regulations in all four lacustrine States.
c) Participatory mechanisms should be provided for in the fisheries legislation of both Burundi and Tanzania.
d) The use of technical and other measures to regulate fishing should to be supported by alternative enforcement schemes that provide for close involvement of fishers and local communities in surveillance and control activities.
e) Where gear restrictions figure as management measures, consideration should be given to using input supply and marketing networks to discourage the availability of illegal gear and, conversely, encourage the availability of approved gear.
f) The regime of sanctions provided for in fisheries legislation of all four lacustrine States should be subjected to thorough review and revision in consultation with local fishers and other stakeholders.
g) The implementation of licensing ceilings for both industrial fishing units in the south and lift net units

in the north should be accompanied by specific provisions encouraging the negotiation and conclusion of access agreements between lacustrine States, in order to facilitate the redeployment of fishing units that would no longer be authorised to operate in their usual fishing grounds.

h) In view of the fact that licensing systems have never been enforced in the Lake Tanganyika area, and noting also that there is widespread local opposition to the idea of imposing any restriction on individual access, a strong educational campaign should accompany the introduction of measures involving licensing as a means to control individual entry into the fishery.

G.6 Possible Technical Measures to Regulate Fishing

29. Approaches to the regulation of fishing mortality include technical measures that restrict gear use and gear specifications, and that impose various types of time-space restrictions on fishing operations.

30. Important examples of possible technical measures to apply in the Lake Tanganyika context are gear type restrictions and area restrictions pertaining to beach seining and industrial purse seining.

Beach seine restrictions

31. 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 at the same time clearly the gear of choice amongst artisanal fishers.

32. Management measures should aim at the total retirement/phasing out of beach seining on the lake. As a step towards this objective, ‘beach seining prohibited’ areas should be identified and established.

33. 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. With regard to the latter, strategic use could be made of input supply networks to encourage adoption of alternative gear kits.

Purse seine restrictions

34. Progressive CPUE decline in the industrial fishery in southern waters indicates a decrease of the catchable stock and possible over-exploitation of *L. stappersii* in southern waters, owing to 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.

35. For this reason, 'off-limits' areas for industrial units should be considered for both the extreme north and extreme south sub-basins.

G.7 Possible Input Controls to Regulate Fishing

36. 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.

37. Principal examples of input controls relevant to the Lake Tanganyika situation are licensing ceilings for both the artisanal liftnet fishery and the industrial purse seine fishery.

Effort control on liftnet and purse seine fisheries

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

39. It is thus recommended that licensing ceilings be established 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 gradual retirement or transfer to other fishing zones of units that entered the southern fishery within the last decade.

H. SUGGESTED FFMP IMPLEMENTATION PROGRAMME

1. Effective adoption and implementation of the FFMP will require a variety of follow-on or accompanying measures. The programme outlined below has been more fully developed as a separate set of component project profiles (Reynolds and Hanek 1999). It is ordered with general reference to the structure of the FAO Interregional Programme of Assistance to Developing Countries for the Implementation of the Code of Conduct for Responsible Fisheries (FAO 1996c), which involves a series of Sub-programmes that may be funded by:

a) contributions to a common fund to finance sub-programme activities;
b) cost-sharing by donors to meet one or more of the sub-programme objectives;
c) single donor support to meet one or more of the objectives of sub-programmes; or
d) direct financing and execution by one or more donors to meet one or more of the objectives of the sub-programmes.

2. Five major components comprise the proposed Lake Tanganyika FFMP Implementation Programme -- namely:

a) Component 1: Fisheries Policy, Planning, and Management ('FFMP/FishPlan');
b) Component 2: Fisheries Statistics and Information Systems ('FFMP/FishStat');
c) Component 3: Monitoring, Control, and Surveillance ('FFMP/FishMCS');
d) Component 4: Promotion of Responsible Fishing Operations and Fishing Fleet Restructuring ('FFMP/FishFleetOps'); and
e) Component 5: Post Harvest Practices and Trade ('FFMP/FishTrade').

H.1 Component 1: FFMP/FishPlan

3. The overall objective of this component is to enhance fisheries policy, planning, and management capacities within the administrative and research agencies directly involved with the fisheries of Lake Tanganyika in the respective lacustrine States. (Table 3, FFMP Initial Action Areas A, B, and C refer).

4. Activities under this component project will focus in particular on the development and implementation, on a regional basis, of training and capacity-building approaches in order to:

a) increase awareness and appreciation of responsible fishing practices and environmental issues amongst local fisherfolk and other Tanganyika fisheries stakeholders;
b) promote decentralised management structures;
c) promote integrated development through the Coastal Area Management approach; and
d) promote networking amongst administrative and research units and staff concerned with Tanganyika fisheries policy, planning, and management.

5. It is envisioned that the FFMP/FishPlan component will co-ordinate closely with the global FAO TRAINFISH Project (FAO 1998), which highlights the use of modularised standard training packages and participatory approaches to the development and delivery of training at national and local levels. Close co-ordination will also be maintained with the FAO Fisheries Policy and Planning Division in carrying out the above activities.

H.2 Component 2: FFMP/FishStat

6. The FishStat component project is intended to build on LTMP (Lake Tanganyika Monitoring Programme) activities initiated under the LTR Project, particularly as related to the collection of catch and effort data and catch assessment and socio-economic survey data. (Table 3, FFMP Initial Action Areas A, C, and E refer).

7. Activities under the FishStat component will focus in particular on the development and implementation, on a regional basis, of training and capacity-building within the

administrative and research units directly involved with Tanganyika fisheries in order to:

a) strengthen and consolidate national facilities, procedures, and staff capabilities in order to create a regionally standardised and integrated fisheries statistical and information system that will be self-sustaining and cost-effective over the long-term;
b) provide, on a regularly updated basis, the respective national fisheries administrations, community-based monitoring and management groups, and the regional CIFA Sub-Committee for Lake Tanganyika with the essential statistical and informational tools for effective fisheries management and planning; and
c) set up a regional reporting systems that will allow rapid transfer of data between the respective lacustrine countries, and between the countries and: a) the CIFA Sub-Committee and any of its working groups; and b) FAO/ Fishery Information, Data and Statistics Unit (FIDI) for the further dissemination of the aggregated data.

8. It is envisioned that the FFMP/FishStat component will co-ordinate closely with FAO/FIDI in arranging details of computer training and hardware and software installation and support. FIDI's suite of statistical approaches and computer software for the harmonisation of fishery statistical monitoring techniques, known as ARTFISH, can serve as a basis for the Tanganyika regional statistics and information system.

H.3 Component 3: FFMP/FishMCS

9. There is a general need to translate the measures proposed in the Tanganyika FFMP into national fisheries regulations and to ensure that fisheries legislation pertaining to Lake Tanganyika is harmonised across the four lacustrine States. The FishMCS component project is intended to facilitate these objectives. (Table 3, FFMP Initial Action Areas B, C, D, and E refer).

10. Specifically, FishMCS will address the following activities:

a) elaborate legal provisions for co-management mechanisms or structures with a view to facilitating the implementation of the management measures proposed under the FFMP;
b) review the sanction regimes provided for in existing fisheries legislation to ensure their adequacy to carry out effectively the objectives of the FFMP;
c) develop a comprehensive set of regulations on monitoring (type, frequency and format of required information);
d) elaborate a model set of regulations applicable to all countries that accommodates the management measures proposed under the FFMP (including harmonisation of licensing systems); and
e) facilitate the formulation of such regulations at the national level (draft regulations).

11. It is envisioned that the FFMP/FishMCS component will co-ordinate closely with the FAO Development Law Service in carrying out the above activities.

H.4 Component 4: FFMP/FishFleetOps

12. This component project is intended as a pilot undertaking and will focus primarily on the amelioration of problems associated with destructive fishing practices, marketing constraints, and stakeholder group conflicts. (Table 3, FFMP Initial Action Areas F and G refer).

13. FishFleet Ops will involve the following outputs and associated activities.

a) socio-economic assessment of the existing artisanal beach seine and industrial purse seine fisheries, with particular attention to the distribution of employment and other human welfare benefits or costs associated with each fishery and the advantages and disadvantages that a fleet restructuring programme might entail;
b) technology assessment to determine design requirements for safe and efficient liftnet units that could serve as suitable alternatives to the beach seine, particularly under the rougher wind and sea conditions that prevail in the southern waters of the lake.
c) fabrication and testing of prototypes of the above liftnet units;
d) pilot operations for the retirement of existing purse seine units from direct fishing operations and their redeployment as support and catch collection vessels for the artisanal fishing fleet; and
e) awareness programmes for responsible fishing operations and protection of the aquatic environment, including:
   - the preparation of audio-visual material for presentation to local audiences of fisheries officers, fishers, and fishing community residents.
   - consultation and educational workshops involving local fisher groups and industrial company executives and staff.

14. It is envisioned that the FFMP/FishFleetOps component will co-ordinate closely with the FAO Fisheries Industries Division in carrying out the above activities.

H.5 Component 5: FFMP/FishTrade

15. The FishTrade component project is intended to improve performance in the Tanganyika fisheries post-harvest sector in accordance with principles and approaches outlined in the CCRF (Table 3, FFMP Initial Action Areas A and B refer; see also sections D.4, D.5, and E.2 above).

16. FishTrade will involve the following outputs and associated activities.

a) preparation of a regional overview of present status of fisheries post-harvest practices and trade for the Lake Tanganyika basin, including an assessment of product flow and the constraints that need to be overcome or ameliorated in order to apply the principles of the CCRF pertaining to the post-harvest sector;
b) preparation of an industry consultation and training programme to build awareness at regional, country, and local levels for quality assurance practices in fish handling, processing, and marketing in order to minimise economic losses, environmental impacts, and health risks; and
c) preparation of a complementary technical assistance programme to build capacity at regional, country, and local levels for the implementation of the above practices.

17. It is envisioned that the FFMP/FishTrade component will co-ordinate closely with the FAO Fisheries Industries Division in carrying out these activities.

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K. TABLES AND FIGURES

Table 1. Number of fishing units by type on Lake Tanganyika in 1995 (Paffen *et al.* 1997)

Active fishers	44.957
Landing sites total	786
Vessels total	19.356
Vessels operational	18.243
- fishing vessels	13.192
- lamp carriers/ helpers	2.256
- transport boats	532
- motorised vessels	1.264
-fishing lamps	20.379
Traditional gear	
-lines	20.744
- gill nets	6.300
- lusenga (scoop nets)	316
- traps	13
Artisanal gear	
-liftnets	2.976
-beach seine (day)	1.143
-kapenta beach seine (night)	154
-apollo liftnets	128
-chiromila seines	16
Industrial gear	
-purse seiner units total	52
-purse seiner units operational	28
-Zambia	16
-Congo	6
-Tanzania	4
-Burundi	2

Table 2a. Tanganyika sample fisher group majority views on fishing restrictions and enforcement/compliance measures (Reynolds & Hanek, 1997)*

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
A. RESTRICTIONS										
1) Seasonal closures	-2	-2	-3	-3	-2	-2	-1	-1	-1	-1
2) Area closures	-2	-2	-3	-2	0	0	0	0	+3	+2
3) Fisher quotas	-3	-3	-3	-3	-3	-3	-3	-3	-2	-2
4) General min. mesh sizes	+1	0	-3	-3	+2	+3	+3	+3	+3	+3
5) Controls on industrial gear	+2	+2	-1	-1	-1	-1	+1	+1	+3	+3
6) Ban on industrial gear	0	0	-1	-2	-2	-1	-1	+1	-2	-2
7) Controls on beach seining	-1	-2	-3	-3	-2	-2	-3	-2	+3	+3
8) Ban on beach seining	-3	-3	-3	-3	-3	-3	-3	-3	-3	-3
9) Controls on lift nets	-2	-3	-3	-3	-3	-3	-3	-2	+3	+3
10) Ban on lift nets	-3	-3	-3	-2	-3	-3	-3	-3	-3	-3
B. ENFORCEMENT										
1) 'More patrol boats'	+1	+1	+1	+1	+3	+3	+2	+2	+3	+3
2) 'More fisheries scouts'	+3	+3	+1	+1	+2	+1	+2	+2	+3	+3
3) 'More police involvement'	-1	0	-2	-2	+1	+2	+2	-1	-1	-1
4) 'Punish offending fishers'	+2	+3	+2	+2	+3	+3	+3	+3	+3	+3
5) '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 2b. Tanganyika sample post-harvest group majority views on fishing restrictions and enforcement/compliance measures (Reynolds & Hanek, 1997)*

PROPOSITION	BURUNDI P/Hvst	DRC P/Hvst	TZ/KIGOMA P/Hvst	TZ/RUKWA P/Hvst	ZAMBIA P/Hvst
A. RESTRICTIONS					
1) Seasonal closures	**-2**	**-3**	**0**	**+1**	**+2**
2) Area closures	**-2**	**-2**	**0**	**+1**	**0**
3) Fisher quotas	**-3**	**-3**	**-1**	**-1**	**-1**
4) General min. mesh sizes	**+1**	**0**	**+2**	**+2**	**+3**
5) Controls on industrial gear	**-1**	**-3**	**0**	**-1**	**-1**
6) Ban on industrial gear	**-1**	**0**	**-2**	**0**	**-1**
7) Controls on beach seining	**-2**	**-3**	**0**	**0**	**-3**
8) Ban on beach seining	**-3**	**-3**	**-2**	**-2**	**-3**
9) Controls on lift nets	**-2**	**-3**	**-1**	**0**	**-1**
10) Ban on lift nets	**-3**	**-3**	**-1**	**-1**	**-2**
B. ENFORCEMENT	**+1**	**+1**	**+2**	**+2**	**+2**
1) 'More patrol boats'					
2) 'More fisheries scouts'	**+3**	**0**	**+1**	**+2**	**+3**
3) 'More police involvement'	**+1**	**0**	**+1**	**+1**	**-1**
4) 'Punish offending fishers'	**+3**	**+3**	**+3**	**+3**	**+3**
5) '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.

Table 3. Lake Tanganyika Framework Fisheries Management Plan: Main elements

INITIAL ACTION AREAS (Text Para. Ref. No.)	**CCRF 'PRINCIPAL P' REFERENCE POINT**	**FFMP RECOMMENDED ACTION**
A. Overall policy matrix (Para. First, in order to ensure that the four lacustrine States act with a common set of development objectives in mind, it is recommended that the CCRF be implemented by their respective competent authorities as the policy matrix for the shared fisheries of Lake Tanganyika.f)	***Process, Precaution, Partnership,Proprietorship, Policing---***·	1) **Implementation of CCRF** by competent authorities of respective States as the policy matrix for the shared fisheries of Lake Tanganyika.
	Process---·	2) Further adopt and pursue **management policy directions** in support of: a) **Adaptive or interactive management** practices;
	Process, Precaution----·	b) **Multi-disciplinary monitoring** capability for measurement of continuity and change across bio-physical and socio-economic dimensions;
	Partnership, Policing---·	c) **Partnerships with local stakeholder groups** in management decision-making and in fashioning modalities of enforcement and compliance;
	Proprietorship, Partnership, Policing---·	d) **Allocation of access and fishing rights** at local community levels; and
	Process, Precaution---·	e) Use of **integrated development strategies** and coastal area management models.
B. Partnership and Resource Access (Para. Co-management (community-based management,	*Partnership*---· *Process, Precaution, Partnership*---· ***Proprietorship,***	1) **Facilitate community-based management** (co-management) structures and operational arrangements. 2) Provide for **community outreach activities** with a strong environmental education

participatory management, partnership management) structures and operational arrangements should be encouraged around the lakeshore.f)	***Policing---***	component. 3) **Allocate control of access** through community-based arrangements.
C. Institutional Modalities (Para. It is has been shown through LTR-associated studies and other appreciations of the situation that existing institutional arrangements frameworks of the four lacustrine States are deficient on a variety of counts. Significant review and revision is warranted, as detailed more fully in the FFMP companion study on institutional and legal aspects of Tanganyika fisheries (Cacaud 1999a).f)	***Partnership,Policing---*** ***Partnership, Policing---*** ***Process---***	4) **Increase government budget allocations** to fisheries research and administrative agencies. 5) **Encourage local community involvement** in fisheries management decision-making and enforcement activities. 6) **Modify Terms of Reference for CIFA Sub-Committee** for Lake Tanganyika.
D. Legal Modalities (Para. It has also been well demonstrated that existing legislative frameworks of the four lacustrine	***Process, Precaution, Partnership,Proprietorship, Policing---***	**Follow up** comprehensive programme for **modification of existing and draft fisheries legislation**, in order to correct current situation with respect to: a) Generally outdated state of existing legislation; b) Inadequate/ non-existent regulations applying

States as they pertain to Lake Tanganyika are incomplete and warrant significant revision, as detailed more fully in the FFMP companion study on institutional and legal aspects of Tanganyika fisheries (Cacaud 1999a).f)		specifically to Lake Tanganyika; and c) Poor enforcement.
E. Monitoring, Control, and Surveillance (MCS) (Para. The extended monitoring programme designed under LTR auspices (Mannini 1999) should proceed according to the workplan already in place, bearing in mind the additional recommendations detailed more fully in the FFMP companion review of MCS for Tanganyika fisheries (Cacaud 1999b).f)	*Process, Precaution, Partnership---* ***Process, Precaution, Partnership, Policing---***	1) **Implement LTMP** according to workplan already defined. 2) **Promote compliance with FFMP** measures, *inter alia*, through legislative provisions for periodic frame surveys, participatory arrangements, alternative enforcement mechanisms, access agreements between States.
F. Possible Technical Measures to Regulate Fishing (Para. Approaches to the regulation of fishing mortality include	*Process, Precaution, Policing---* ***Policing---*** ***Process, Precaution, Policing---*** ***Policing---***	3) **Beach seining.** Initiate gradual process leading to **total retirement/phasing out** of beach seining on the lake. 4) As a step towards this objective, establish and enforce **'beach seining prohibited' areas**. 5) For **purse seine fishery**, encourage **gradual reduction of effort** to levels that prevailed

technical measures that restrict gear use and gear specifications, and that impose various types of time-space restrictions on fishing operations.f)		ten years ago, either through unit retirement or transfer to other fishing zones. 6) As a step towards this objective, establish and enforce **'off-limits' areas for industrial units** should be considered for both the extreme north and extreme south sub-basins.
G. Possible Input Controls to Regulate Fishing (Para. 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.f)	***Process, Precaution, Policing---***	Establish and enforce **licensing ceilings** for both industrial units in the south and liftnet units in the north (waters north of Karonda).

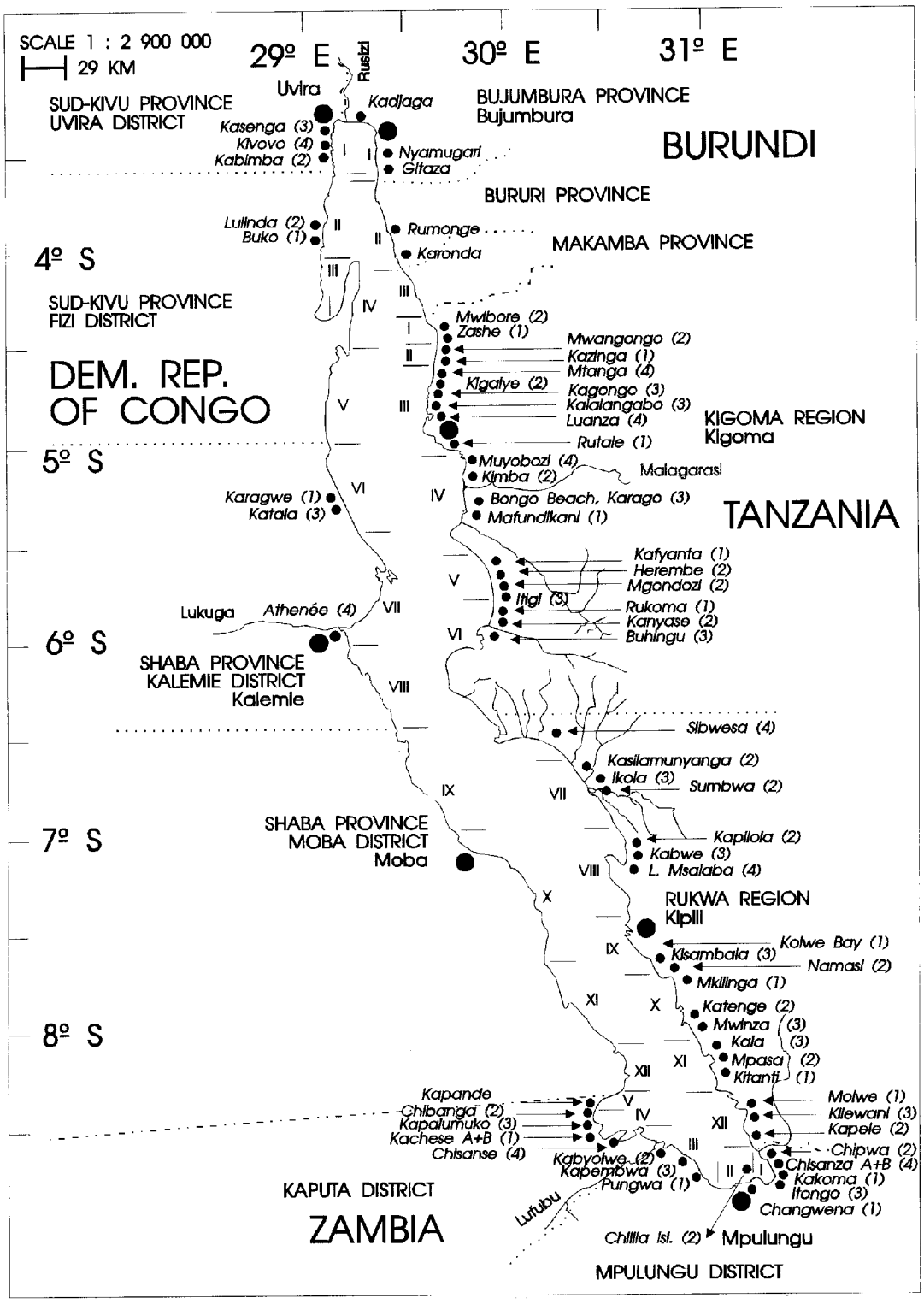
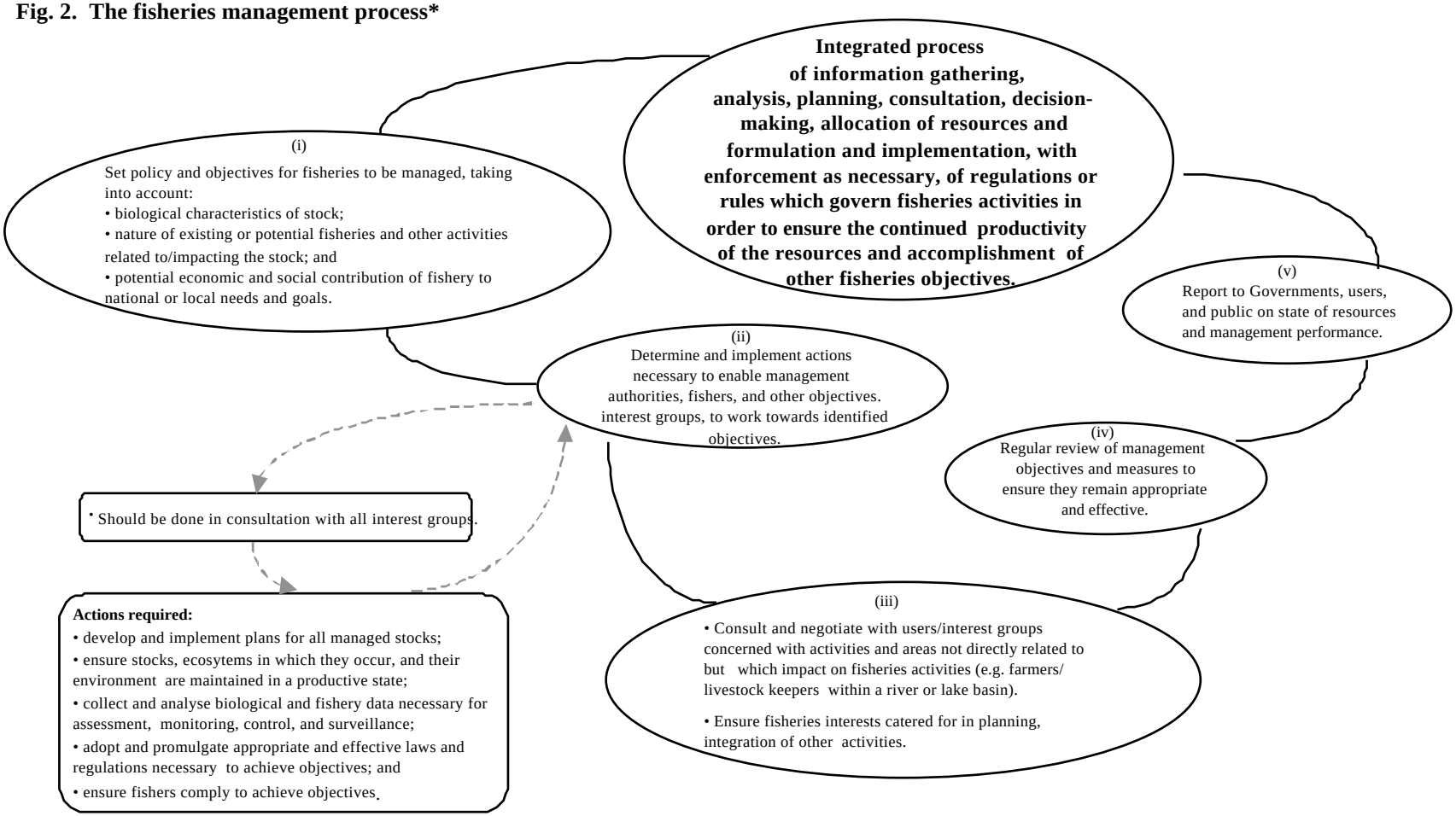


Fig. 1. Lake Tanganyika. Map showing relative locations of 1997 SEC survey sample landing sites lakewide. Geographical strata areas are indicated by Roman numerals within each national sector. Landing site size class codes appear in parentheses behind site names.

Fig. 2. The fisheries management process*



* Source: Reynolds (1998), adaptation of text from FAO (1997: 7-8).