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9. ABSTRACT

This report presents the results of a survey to assess the feasibility of assistance to a fishing cooperative (COOPELAZ) to increase its fish production from Lake Tanganyika, in Zaire. The survey was conducted from March 10 to April 10, 1973. Its objectives were (1) to report on the harvest, distribution, and consumption of fish in the Uvira-Fizi Zone of Zaire; (2) to analyze proposed actions for and impacts from doubling the present fish harvest; and (3) assess the capabilities of COOPELAZ to attain and handle expanded capacities from a technical, managerial, financial, and institutional standpoint. The report presents detailed information on the lake, fish, fish production and technology, consumption and demand, the marketing system, and capabilities of COOPELAZ and local agencies. It then presents a revised project proposal and additional recommendations. The proposed project involves modernizing the present COOPELAZ fishing fleet, using reconditioned industrial vessels, assuring that 40 percent of the catch is distributed to outlying regions where fish protein is needed most, providing technical assistance to develop the marketing system, and exploiting additional means of fish processing and preservation. The $702,000 proposed for the three-year project could double fish production. A loan of this amount is recommended.

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AN EVALUATION OF PROPOSED USAID PROJECT FOR IMPROVEMENT OF LAKE TANGANYIKA'S FISHERY RESOURCES IN ZAIRE

June 10, 1975

REVISED

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Typical market display of ndagala (small piles), capitaine (large fish), and other fish, Uvira, Zaire.

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1. Nationalized industrial boats (purse seines) moored unused in harbor at Uvira—trimaran beached in foreground.

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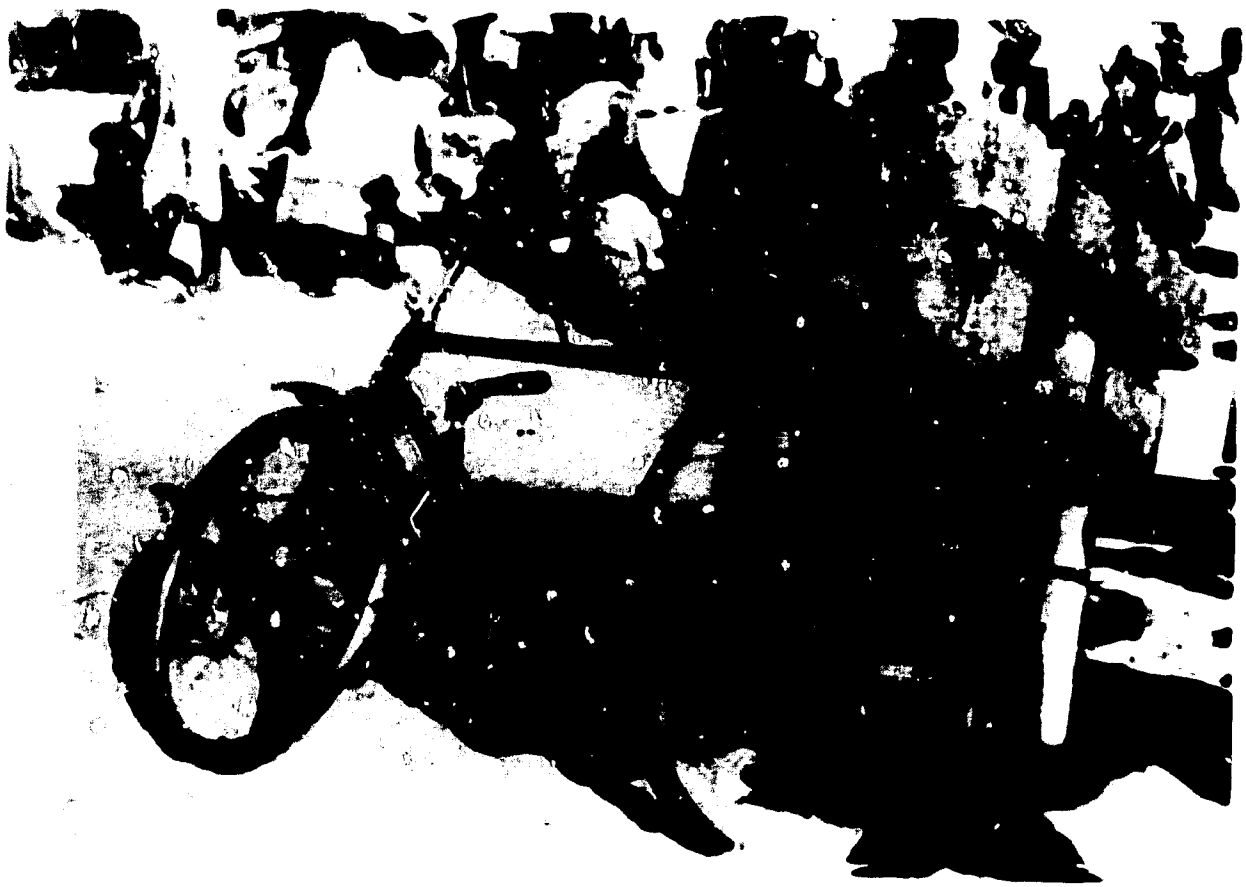
3. Typical 10-man trimaran (artisanal) fishing unit used for netting ndagala, Lake Tanganyika, Zaire.



4. Usual means of transporting fish to outlying countryside areas from Lake Tanganyika—one box holds about 40 kilos (100 pounds).

AN EVALUATION OF PROPOSED USAID PROJECT FOR IMPROVEMENT OF LAKE TANGANYIKA'S FISHERY RESOURCES IN ZAIRE

1.0 INTRODUCTION

In response to a request by USAID/Zaire through AID/W, a survey to assess the feasibility of assistance to a fishing cooperative (COOPELAZ) for increasing its fish production from Lake Tanganyika in Zaire, was conducted by this team from March 10 to April 10, 1975. The objectives were: (1) to develop information and to report on the harvest, distribution, and consumption of fish in the Uvira-Fizi Zone of Zaire; (2) analyze proposed actions to and impacts from doubling the present fish harvest; and (3) assess the capabilities of COOPELAZ to attain and handle expanded capacities from a technical, managerial, financial and institutional standpoint.

The principal sources of information used in preparing this report were:

1. Published technical reports dealing with fish catch statistics, fish stock surveys, fishing gear and methodology studies, and general biology of Lake Tanganyika's fishery resources, primarily from FAO[1] and IRSAC[2] investigations.

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[1]Food and Agricultural Organization, United Nations.

[2]Scientific Research Institute of Central Africa.

2. Interviews with FAO fisheries personnel in Rome, Italy, prior to arrival in Africa.[3]
3. Unpublished reports and data on fishery statistics, marketing and present harvest from the Lake by COOPELAZ and the Service de la Production Agricole, South Kivu Regional Office.
4. Interviews with Action Kusaidia regional development and agricultural staff in Bukavu and Uvira.
5. Interviews with the manager and assistant manager of COOPELAZ in Uvira.
6. Observations of fishing boats, nets and other pertinent equipment and actual harvest operations on Lakes Kivu (Bukavu) and Tanganyika (Uvira and Kalemie), as well as fish markets and marketing conditions in Uvira, Baraka and Kalemie.

Approximately two weeks were spent in field observations and interviews, over half of which was in the Uvira region of Lake Tanganyika, where headquarters and principal activities of COOPELAZ are located. A complete itinerary of the team survey is included in the appendix.

Significant contributions to the completion of this evaluation were made by Citoyen Sole, Comissaire Sous-Regional, Assistant, South Kivu; Mr. Charles Leister, Lt. Mbaya, and Citoyen Mikobi of Action Kusaidia; Citoyen Moakaloni, Service de la Production Agricole, South Kivu Region, Uvira; Citoyens Kahindo and Nzikani, Coopelaz; and Mr. William Garvey, USAID/Zaire, Kinshasa.

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[3]FAO personnel currently working on fisheries projects in Burundi sector of Lake Tanganyika could not be contacted for discussion of this subject.

2.0 CHARACTERISTICS OF THE LAKE AND THE FISHERY RESOURCE

2.1 Background

Lake Tanganyika is a large, deep rift lake in East Central Africa (figure 1, map). Bordered by four different countries, (Zaire, Burundi, Tanzania and Zambia) the lake has a surface area of 32,900 km^2, a maximum length of 673 km, a maximum width of 48 km and a total shoreline of 1,500 km. The second deepest lake in the world, it has a maximum depth of 1,435 m and a mean depth of 700 m. (1)[1/] Despite the great depths of water, pelagic fish stocks, which are most important in the traditional and industrial fisheries, use mostly the upper layers because benthic waters contain no oxygen and much hydrogen sulphide. Fish life is generally limited to the upper 100-150 m. (2) Zaire has the biggest share of the lake within its territorial limits, 14,800 km^2 (45% of total) and the longest coastline, which is rugged and backed up steep hills, making access to the hinterland difficult. The main ports are Kalemie on the central coast and Uvira and Baraka near the north end.

2.2 Kinds of Fish

Over 200 species of fish are known to inhabit Lake Tanganyika, of which 134 belong to the family Cichlidae. Six species make up most of the pelagic biomass, upon which Zaire's (and all the lake's) fishing industry centers. These are

1. Stolothrissa tanganicae and Limnothrissa miodon, two small Clupeids, weighing between 4 and 8 grams, locally known as ndagala or fretin.
2. Luciolates stappersit (mukeke) a predator, weighing between 100-150 grams.

[1/] Bibliographic references are numbered consecutively in the text with an Arabic numberal in brackets, i.e., (1).


Central African Republic
Sudan
Cameroon
Haut-Zaire
Equateur
Gabon
Uganda
Kivu
Rwanda
Bandundu
Kasai-Oriental
Congo
Burundi
Tanzania
Kasai-Occidental
Zaire
Angola
(Portugal)
Shaba
Zambia

3. Lates spp. (Sangala or Capitaine) three predators, average weight 3000 to 7000 grams.

Stolothrissa makes up more than 75% of the catch in all fisheries.

2.3 Biomass

With respect to the abundance of these pelagic species, primarily the two clupeids and the young of Luciolates, preliminary quantitative estimates by FAO personnel using echo sounding (sonar) equipment and techniques in October/November 1973, assessed their biomass for the entire lake at 2.8 million tons (3). This amounts to an average abundance of about 872 kg/ha, which is at least double what one would expect for a large, deep lake of this type and fertility. However, the figure compares with a range of 50 to 1600 kg/ha of potential fish production estimates for the lake by Kupperath in 1946-47 (4,5), on the basis of the concentration of critical nutrients in the epilimnion, compared to those in the hypolimnion. The bulk of the fish biomass on the recent FAO acoustic survey was mainly located in the central sector of the lake, and fish density was much less at the northern and southern ends. Fish were found to be concentrated both offshore and inshore, but large variations in abundance and in vertical distribution in both time and space were evident.

The average biomass figure in the 1973 survey for the Burundi-Ubwari sector, of particular interest in this current analysis of Zaire fisheries, was 794 kg/ha. This sector was surveyed twice within an interval of 14 days with quite different results in concentration of fish. Estimated biomass varied from 120,000 to 260,000 tons from the first to second survey, which gives relative abundances of 502 to 1089 kg/ha. These rapid changes in fish

distribution indicate that large annual or seasonal variations in catch may result largely from movements of fish stocks and should not be considered unusual or as cause for alarm in any one year.

Additional acoustical surveys are needed, particularly at other times of the year, to gain more reliable knowledge of total quantities and seasonal differences in fish biomass. Nevertheless, these estimates (6) are probably less biased and more indicative of true stock abundance than earlier estimates based mostly on commercial catch samples. These estimates of potential fish production suggest that Lake Tanganyika contains a rich pelagic fish resource, which in most sectors is many times greater than both the current annual harvest and the potential sustained yield.

2.4 Biology and Distribution of Pelagic Species (6) (7) (8)

Much of what is known about the biology of Stolothrissa, the principal commercial species in the ndagala group on Lake Tanganyika, comes from the work of Marlier, et. al. at the Uvira station of IRSAC before 1959. FAO personnel have begun additional biological studies on these clupeids and their larger predators, but this work is still in preliminary stages. Most FAO efforts on Lake Tanganyika has been directed toward developmental aspects of the fishery and complementary biological research of important species has not kept pace.

Stolothrissa is a plankton-feeder with a short life cycle (6-18 months). It exhibits large seasonal fluctuations in abundance, being generally low in April and May, rising to a peak in November-

December. The majority of adults collected are 60 to 90 mm in length. Two spawning periods have been identified from the percentage of mature females in the catch - June/July and February/March; the latter period is considered the main spawning season. Strong recruitment of 43-67 mm fish from this spawn occurs in July and a few of these recruits may spawn in that (summer) season. A few individuals from the summer spawn may be capable of reproducing the following winter, but the main contribution is from one-year old fish. The average egg production per female is 30,000.

Indications are that the ecology and breeding times of this species, and consequently of the predatory forms that feed on them, are linked with the main phases of plankton production in the lake (8). Tiny Limnothrissa fry may generally be found near shore and occasionally in great numbers that has generally coincided with plankton maxima. As yet, Stolothrissa fry have not been collected successfully in littoral (shoreline) regions. Growth rate and survival data indicate that most of these small sardines (ndagala) live only about one year and that adults are most abundant during the greatest plankton production period - May to November. Stomach contents of adults consist mostly of zooplankton, particularly Diaptomis, but in juveniles more phytoplankton is usually present. Bursts of relatively high phytoplankton productivity are apparently confined to the shallower regions of the lake; the deep offshore waters generally appear to be oligotrophic (infertile). Outbursts of phytoplankton are associated with two phenomena - water movements which introduce deep water to inshore areas and contribution of nutrients by runoff, particularly in the first rains (8).

The fish population of Lake Tanganyika is unequally distributed throughout the different regions of the lake and also seasonally. According to early researchers at the Uvira IRSAC Center, the diversity of fish species becomes greater as one moves from lower to higher temperature regions. Fishermen of Baraka, Uvira, Ubwari and Kalemie say there are particularly heavy concentrations in the Bay of Burton and around Kalemie.

Seasonal movements of fish in the lake are not well known, but according to fishermen, there appears to be a large-scale seasonal migration of Stolothrissa between the Bay of Burton and the northern extremity of the lake. These ndagala are much more heavily concentrated at the mouth of the Ruzizi River in the months of September-November during which they make two circuits, and in the Bay of Burton in the months of June through September, where they make four circuits. Harvest records of COOPELAZ fishermen show that, in the period April to June, there is a migration of ndagala from the Uvira area southward toward Ubwari pennisula and Kalemie, and that the harvest near Uvira at that time consists of more of the larger predators.

The small size, rapid growth rate, short spawning periods and high fecundity of Stolothrissa lead to considerable seasonal fluctuations in abundance and catch rate, which rises to a peak in August-December and subsequently declines as natural mortality predominates. Their short life history and capacity to respond rapidly to favorable environmental conditions, together with susceptibility to predators, are responsible for the high variability in abundance of this species from year to year. Mortality due to fishing, even seasonal pressure on juveniles, is at present believed

to be relatively unimportant compared to natural mortality including predators. Long-term biomass changes appear to be more closely related to predator abundance (namely Luciolates) than to the present pattern of fishery exploitation.

Both adult and juvenile Luciolates (mukeke) are widespread in the pelagic (open-water) zone, but there is high variability in the abundance of the component age-classes over time and space. Adults are more numerous in purse-seine catches during February, but definite spawning seasons for this predator have not as yet been identified; attempts to recover eggs or fry have so far been unsuccessful. Growth is rapid, sexual maturity is attained around two years of age, and fish of 300-360 mm in length reach ages of 4.5 to 8.5 years.

Luciolates less than 70 mm in length feed on planktonic crustaceans, but by 130 mm they have become almost exclusively piscivorous (fish eaters). Their main prey is Stolothrissa, but their own young and Limnothrissa are taken occasionally. The size and type of prey appear to depend simply on availability. Anatomical studies suggest that the mukeke range widely, swimming continuously and fast, and that the capture of prey depends on speed. Both juveniles and adults tend to accumulate around fishermen's lamps and the associated concentration of prey. Juvenile mukeke sometimes form a significant part of the ndagala catch.

Limnothrissa and Lates spp. are minor components of the commercial catch and they appear to have little or no effect upon the equilibrium of the Stolothrissa and Luciolates populations. The large predators of the Lates group (Sangala and Capitaine) are

characterized by a long life history (10 years or more) and a low level of abundance with little seasonality.

The high variability in abundance and length composition complicates the interpretation of data derived from relatively few samples collected haphazardly in the commercial catches. Consequently, many of the estimates of biological parameters and concepts of life histories of these species are still inadequate. Many more confirming biological studies are needed of these species in both inshore and offshore environments - the interactions between the clupeid and predator components; additional limnological studies of patterns of high plankton production and its relationships to fish production, dispersion and concentration in the lake. Since biological organisms do not respect territorial boundaries in the water and move freely over the lake, cooperative biological investigations by all neighboring countries is highly desirable. Such cooperation would be more efficient and is essential to a full understanding of many aspects of the fish stocks and lake environment.

3.0 FISH PRODUCTION (HARVEST)

3.1 Potential Yield - Maximum Sustainable

Early yield estimates for all of Lake Tanganyika, based on 20% removal rate of 10 kg/ha, were 30,000 tons in 1947; this was revised up to 100,000 tons in 1956 on the basis of echo-sounder studies that indicated fish populations in the open waters were more dense than had previously been suspected (5). By 1972, FAO estimates of maximum sustainable yields up to 300,000 tons (100 kg/ha/year) were considered reasonable. The acoustic survey of 1973 of total biomass confirmed that such yields were still quite valid.

Total fish production for the entire lake is now recorded at 80,000 tons, but the net catch is probably nearer 100,000. On the basis of present estimates of maximum sustainable yield, the present total catch could be tripled, i.e., increased by about 200,000 tons (9), but the scope for increased production varies from country to country, the greatest growth potential being in Zaire.

The potential sustainable yield in Zaire has been estimated at about 140,000 tons/year (70% of the projected allowable increase for the entire lake). If this were to be divided equally along all the coastline of Zaire, the waters from Burundi border to Burton Bay could sustain an annual catch of 20,000 tons. But since fish freely move up and down the lake and more fishermen will be concentrated in the Uvira and Baraka areas, it is reasonable that more of the potential yield will be harvested from areas nearest these ports and landing areas.

3.2 Present Annual Catch

1. For Zaire Waters of Lake Tanganyika, the annual catch was probably on the order of 22,000 tons before the Greek-owned, industrial purse-seining units in Kalemie and Uvira were nationalized early in 1974. Most of these boats did not operate in 1974. The catch from canoes (3-4 t/year average) and catamarans and trimarans (about 15-30 t/year) on the coast from the Burundi border to Burton Bay is estimated at 7,000 tons now; landings of purse-seiners (average catch 200-300 t/year) previously furnished up to 3,000 more tons, giving a total of 10,000 tons in this region. In the Katanga region, extending to the Zambian

border, annual production was estimated at 12,000 tons. Of this, nearly 5,000 tons were being landed from the purse-seining units. Without the industrial purse seine boats present annual harvest is no more than 14,000 tons for all of Zaire waters.

2. For Uvira-Fizi Zones. Estimates of present annual harvest, excluding industrial catch, were derived from three data sources: FAO, Annual Reports of the Service de l'Agriculture for the Sub-Region of South Kivu, and Progress Report for COOPELAZ by its manager dated November 1974.

   a. FAO estimates (9) of 7,000-8,000 tons were based on average annual tonnages caught by various types of fishing boats (canoes, catamarans, etc.) and "recorded" catch according to 1970/71 statistics, probably the the annual Reports of the Agriculture Department.

   b. Department of Agriculture catch statistics were obtained from estimates by agricultural personnel of boxes of fish landed each morning at the various beaches; estimates are conservative because small amounts of fish may be sold from boats before counts are made; data are compiled according to traditional, artisanal and industrial for 1973 fisheries. These records, (Table 1) show a total of 7,331 tons, of which about 2,500 tons were from the industrial fishery, and another 3,035 tons were those reported by COOPELAZ for the last six months.

These annual production data are of interest from several points

Table 1

ANNUAL FISH PRODUCTION BY TYPE OF FISHERY
IN THE UVIRA AND FIZI ZONES - 1970-1974

Year	Type of Fishery	Production in Metric Tons			
		Uvira	Fizi	Totals	Grand Totals
1970	All	946.1	564.8	1,510.9	1,510.9
1971	All	1,084.4	1,679.0	2,763.4	2,763.4
1972	Traditional	493.7	373.3	867.0	
	Artisanal	344.3	367.8	712.1	
	Industrial	638.8	0	638.8	2,217.9
1973	Traditional	763.4	131.4	894.8	
	Artisanal (COOPELAZ)	3,661.5 (3,036.0)	337.7 (0)	3,999.2 (3,036.0)	
	Industrial	2,274.6	162.8	2,437.4	7,331.4
1974	Traditional	413.1	241.7	654.8	
	Artisanal	1,269.8	981.2	2,251.2	
	Industrial	1,408.7	0	1,408.7	4,314.7

Source: Agricultural Service, Zone and Sub-Region Annual Reports.

of view. First, they provide a sense of the variability in catch from year to year. Second, they give a sense of the changing nature of the fishery, e.g., the departure of the majority of the industrial fishermen in early 1974. Finally, they indicate the growing comprehensiveness of the information being gathered by the agricultural department. (This fact was quite evident as one reviewed the annual reports. The more recent their data, the more detailed was their coverage.)

One should, however, not be lulled into a false sense of security by the apparent wealth of data. Consider, for example, the price and quantity data for dried fish sold from two areas of one zone as shown in Table 2. This information was taken from the same sources as the fish production data. Aside from a time trend in prices, there is no discernible relationship between the variables. A plot of price against quantity indicates a correlation coefficient close to zero. Recalling that, in general, production is at its peak in the period September through March, is moderate during April through June, and is nil in July and August, only the price and quantity values for September appear right.

c. COOPELAZ reports projected the catch from their 223 members in the last 6 months of 1973 to an annual catch of 22,000 tons for the artisanal and traditional fisheries alone. This was based on an average catch of 9 boxes of fish per member for 23 nights of every month and assumes all equipment was trimarans with large nets and in top operating shape. Such a catch, both rate and total, is above all reasonable estimates.

Table 2

DRIED FISH SOLD FROM TWO COLLECTIVITIES
IN THE FIZI ZONE - 1974

Month	Collectivity			
	Mutambala		Tanganika	
	Quantity (kgs)	Price (K/kg)	Quantity (kgs)	Price (K/kg)
January	25,110	12	-	-
February	46,440	20	37,400	25
March	8,460	22	14,550	25
April	1,620	20	4,500	25
May	32,625	30	26,105	45
June	3,825	40	28,100	45
July	11,205	50	24,750	40
August	7,740	45	90,000	60
September	89,955	22	62,000	37
October	33,210	48	15,930	50
November	46,935	40	55,340	46
December	23,750	50	62,850	50
	330,875		422,540	

Source: 1974 Annual Report, Service de l'Agriculture et de l'Elevage de Zone, Zone de Fizi, Sous Region du Sud Kivu, Region du Kivu, 3 pp. typescript. 1K = .02 U.S.

The assumed average catch per night is more than three times that expected with the best artisanal equipment; further only a portion of the members have trimarans and 100-meter nets which would permit even the probable expected catch of 3 boxes of fish per night per fishing unit. Using COOPELAZ' own catch records for the 6 months period reported in 1973, the daily catch amounts to only 2½ boxes of fish a night per member, not 9 boxes.

Much lower annual harvest by COOPELAZ members is justified by statistics for the same period by the Department of Agriculture and FAO estimates, which include industrial catches. For this report, we do not feel justified in using COOPELAZ catch statistics, because we cannot reconcile them with other available data. However, reasonable estimates of their catch can be developed using COOPELAZ own records of the current number of various type fishing boats and average expected harvest for these boats as reported by FAO. Estimated current annual production for COOPELAZ, as revised in this manner (Table 3) is 5,517 tons, which is within the same range reported by FAO and Agriculture Department for this zone when industrial catches are excluded.

To estimate potential production by COOPELAZ if all units (Table 3) were converted to trimaran operations, we assume that initially no new boats are acquired, i.e., the conversion to trimarans is made from the existing stock of pirogues. Thus, the Uvira and Mboko

Table 3

ESTIMATE OF CURRENT (1975) PRODUCTION BY COOPELAZ

I. Number of Fishing Units by Type in Uvira-Fizi Zone*

	Uvira	Mboko	Ubwari	Total Units	Equivalent Pirogues
Trimarans	38	71	-	109 x 3 =	327
Catamarans	23	42	-	65 x 2 =	130
Single Canoes	-	-	161	161 x 1 =	161
Total Units	61	113	161	335	618
Total pirogues (light boats, etc.) available for conversion	278	337	161	775	

*Source: Kahindo, Personal Communication, Uvira, March 19, 1975.

II. Assumed Production Per Fishing Unit**

Trimarans	35.0 tons per year
Catamarans	17.5 tons per year
Single Canoes	3.5 tons per year

**Source: Midpoint of ranges cited by FAO based on their experience in the northern end of the lake.

III. Estimated Current Annual Production Based on Above Operating Units (I) and Assumed Catch Rates (II)

Trimarans	109 x 35.0 T =	3,815 tons/year
Catamarans	65 x 17.5 T =	1,138 tons/year
Single Canoes	161 x 3.5 T =	564 tons/year
Total for COOPELAZ		5,517 tons/year

sections of the coop have sufficient "surplus" pirogues to convert all catamarans to trimarans. However, the Ubwari section could construct only 53 trimarans. After the conversion, the trimaran "fleet" would be as follows:

	UVIRA	MBOKO	UBWARI	TOTAL
Existing	38	71	0	109
New	23	42	53	118
				227

The 227 units should produce (227 x 35) = 7,945 tons per year.

This production level represents a 44 percent increase over the estimate of current production.

If we further assume that none of the fishing units ("existing" or "new") have adequate nets, this means that 227 100-meter lift-nets need to be made available for purchase.

3.3 Seasonal Aspects and Composition of Catch

COOPELAZ catch records (1973) for the Uvira-Fizi Zone show the highest catches (70%) for ndagala occur in the period of September through March, a smaller catch (20%) in April to June, and only 10% of the harvest in the dry period of July-August. In the Bay of Ubwari, the catch of ndagala is about the same in all seasons because there is practically no water movement. In the peak harvest period, ndagala make up 60% of the total catch by COOPELAZ members, Mjkeke 30% and Capitaine 10%; in the April to June period, the ndagala migrate from the upper end of the lake toward Ubwari and Kalemie and the catch in the northern part then is 80% mjkeke and and capitaine; and in July and August when dagala spawn, the small catch is practically all of other species. For sangals and mjkeke there is no clear pattern of peak seasons in the catch.

Zaire Department of Agriculture catch statistics, on the other hand, indicate in some years the ndagala harvest in July and August may be as good or higher than in other months. For example, in both 1972 and 1973, the July catch by traditional canoe fishermen was more than any other month; in the artisanal fisheries the catch was as good as most months, the May catch, in fact, being much lower; and the July industrial catch was higher than any previous month that year. Apparently some of the seasonal differences in catch may be related to the amount of effort put forth by fishermen. FAO records(9) show a strong seasonal pattern in the catch rate of ndagala, but the low is in May-June and high in November, although differences in timing occur from year to year.

Ndagala will remain the principal target of all three types of fisheries-traditional, aritsanal and industrial; the predators, sangala and mukeke, will be harvested mainly by industrial fishermen, but their stocks are much lower than ndagala.

3.4 Protection of Fish Stocks

The question has been raised whether some regulations of the fishing industry to protect certain species or sizes of fish are not necessary, i.e., prevention of fishing on spawning grounds, mesh-sizes of nets large enough to protect young fish so they will reach reproductive age, etc.

All of these protective kinds of regulations were in force in TVA and most other large warmwater lakes of the southern USA thirty years ago. Studies on the spawning, survival and growth of important species showed that the fish there produced so many young and grew so fast, it was not possible for fishermen, either sport or industrial, to hurt their stocks. Most protective regulations

were eliminated many years ago and fish populations have not been hurt by greater amounts of fishing. In fact, most fish there still die before they can be caught or are eaten by predators.

The same should certainly also be true of a lake the size of Tanganyika. The tremendous abundance of Stolothrissa is not likely to be depleted even by industrial fisheries. This species normally spawn twice during the year, generally in open waters, and in great numbers. They grow fast and only live 18 months at most, so many more will die than can be taken by fishermen. FAO researchers believe that the predators, Lates and Luciolates, consume as much or more tons of ndagala each year as are caught by all the industrial and artisanal fisheries.

With the present rate of harvest, and even with a doubling or tripling, restrictions on the taking of fish in any number or way are not considered necessary at this time. However, their population numbers should be monitored so that if shortages in certain kinds and numbers of fish do occur over a period of years, then appropriate regulations might be instituted. Because of the great variation likely to occur in total harvests from year to year for a number of different reasons, temporary declines in fish catch should be ignored.

Another question is whether the catching of ndagala should be forbidden to industrial fisheries, so that the artisanal fisheries may be protected. From the standpoint of available supplies of Stolothrissa, there appears to be more than enough for harvest by both groups at this time, and as pointed out above, if they are not caught, in about a year or so they will die anyway. Further, as long as industrial fisheries are permitted in Burundi and

Tanzania, there is no reason to penalize those Zaire fishermen who are able and wish to use purse-seines. One concession in this respect to the artisanal fishermen would be to require the industrial fishermen to fish farther offshore in the deeper waters where they would not be likely to interfere with the trimarans and pirogues operations. Biologically this does not appear to be necessary, but sociologically it might be helpful, and the purse-seines should do just as well farther offshore, where artisanal fishermen are not likely to be. Ndagala and their predators should be everywhere over the lake at night.

3.5 Present Technology

3.51 Gear and Methodology

Present equipment and techniques of fishermen in the Uvira-Baraka and Bay of Burton sector of Lake Tanganyika are similar to that used and developed further by FAO in Burundi (9). Virtually all fishing on the lake is nocturnal, using light attraction with scoopnets (traditional), liftnets and beach seines (artisanal) and purse seines (industrial).

The basic fishing craft is the native, wooden pirogue (dugout canoe) about 8 meters long. A few pirogues are made out of wood planks, but the fishermen in Zaire do not like planked boats - they do not last as long as dugout canoes (3-4 years compared to 10-12 years) and they have the problem of seams opening constantly, which results from poor construction and caulking. The traditional method has two men in one dugout; one rows and the other scoops up fish from the bow as they collect under the light, usually a kerosene lamp.

The artisanal fishermen employ two or three pirogues tied together with long poles to form catamarans or trimarans, also equipped with lights for fish attraction. Lift nets from 36 m^2 to 108 m^2 are deployed under the boats and operated via outriggers with pulleys. Each trimaran is accompanied by 2 to 4 single search pirogues with lights of lower candlepower. When fish are located by the search boats, the net boats are signaled and the fish school is concentrated in the area of the trimaran by reducing the brightness of the lights in the search boats and turning up the higher intensity lights on the trimaran. After the nets are deployed under the school, the search boats leave to search for other schools. The trimaran fishing unit utilizes 8-10 men depending on the number of search boats. A few steel boats with fast motors are now operating in the Uvira area.

Artisanal fishermen also use some beach seines up to 250 meters long and 14 meters deep. A boat with the net leaves the shore and deploys the net in a large semi-circle. Boats with kerosene lamps are also used to attract fish into the circle. Hauling of the net is done by hand from the beach. Nets of both nylon and cotton are used; some knotless (machine-made) nylon nets, are being used, but they are more difficult to repair than the standard knotted nets. A few trimarans are propelled by outboard motors with long shafts, but maintenance of these is a constant problem and a better system of propulsion is needed.

Two types of lamps are used - in the fishing trimarans, the lamps have large glass globes that point directly down to

the water with a circular, enamel reflector above the globe; in the search boats, the lamps are of the Coleman type with the fuel container at the bottom, which allows the light to only spread horizontally. Improvements are needed so that most of the light can be directed down at the water surface.

The industrial fishery utilizes purse seines of varying mesh from 8 to 35 mm and dimensions of 250-650 m long x 14-30 m deep. Nets were usually sewn together in such a manner that the larger meshes were on the bottom when the nets were dropped, the smaller meshes to the top. In this manner smaller fish such as the ndagala which tend to stay close to the surface are caught in the small mesh net, while larger fish which feed at greater depths might be retained in the larger mesh.

These nets are operated with larger boats (12 m or more) and diesel engines that can go farther from shore than the artisanal boats. Only one or two of the purse seine boats formerly operated by Greeks and Nationalized in 1974 are now operating in the Uvira areas; at least four others are sitting in the harbor unused - they are perhaps inoperable now. Some, but not all. of the Zairianized purse seine boats in Kalemie are back in operation.

3.52 Processing

Fish are sold either fresh or dried in this zone. At the present rate of harvest, most of the fish in the Uvira area are sold fresh. Only around Baraka and Fizi are fish dried in any quantities; most of these are from the Ubwari peninsula and most dried fish are transported to and sold in Bukavu. Sun drying is accomplished directly on the sand and this is

adversely affected during the rainy season. The value of dried fish is less per unit of weight and there is some waste due to beetle infestation. Ice or cold storage is not available and as yet salted and smoked fish have not been accepted by the people in Uvira area, possibly because the price is twice as much as the fresh or dried fish. (Table 4).

4.0 ECONOMIC ANALYSIS

4.1 The Economic Base of the Area

The difficulties in characterizing the Zairian economy at the national, regional or local level are twofold. On the one hand, many of the data one might desire simply do not exist - while on the other, those that can be obtained frequently are open to question. Moreover, most of the English language sources that could be located were for use only within governmental channels or otherwise were not for distribution. In view of these limitations on the data, the economic base will be presented only in outline, and generally without citation as to source.

The economy before 1960 was based on mining and agriculture. In 1959 it is estimated that nearly 28 percent of the gross domestic product (GDP) originated in the agricultural sector while mining and mineral processing contributed approximately 15 percent. Both sectors experienced decline during the period of unrest following independence. Recovery of the economy began in 1967, with 1968-1970 being the period of greatest growth. Agriculture, however, did not share fully in that growth experience. GDP grew at an average annual rate of 9.5 percent in 1969 and 1970 (at constant 1968 prices); the growth rate for agriculture in the same period was less than 3 percent. Overall growth slowed in 1971 with

Table 4

PRICE STATISTICS FOR FRESH AND PROCESSED FISH
FOR DECEMBER 1974
ZONE OF UVIRA

Fish	Type	Unit	KG/Unit	Price (K) Per Unit	Price Converted to K/KG
Fresh	Tilapias	6 fish	0.5K6	20 K	40
Fresh	Capitaine	1 fish	4	280 K	70
Smoked	Tilapias	8 fish	0.35	40 K	114
Smoked	Capitaine	1 portion	0.4	50 K	100
Salted	Tilapias	4	0.5	75 K	150

Source: Service de l'Agriculture et de l'Elevage, "Statistiques de Prix Mois de Decembre 1974" Typescript 2 pp., Survey made 5 January 1975.

1 K = .02 U.S.

the increase in GDP (at 1968 prices) amounting to less than 5 percent; growth rate of agriculture remained on the order of 3 percent. Because agriculture's growth has not kept pace with the rest of the economy, its contribution to GDP has, of course, declined. In 1968 about 24 percent of the GDP came from agriculture and less than 20 percent in 1971.

Commercial agriculture is only slowly regaining its pre-1960 levels of production. Given the population growth that has occurred in the intervening period. there has been a pronounced decline in per capita farm output. For example, Zaire was self-sufficient in rice and maize before 1960. In recent years the country has been importing substantial quantities of both these commodities. Declining per capita production of food crops is thought to be the result of both a reduction in the acreage planted and a serious decline in yield, amounting in some instances to 50 percent.

Production data for the inland fisheries for the time period discussed above could not be located. However, estimates of the value of annual production (apparently in current prices) were obtained. The fresh water catch had an estimated value of Z122,000* in 1959. A low point of Z97,000 was reached in 1965 and the value of the catch was up to Z114,000 by 1968. The national agricultural plan for the decade of the 1970's calls for increasing total fish production by 134,000 tons from a base of 130,000 tons. To achieve this goal would require a yearly increase of 7.4 percent. (The FAO Fishery Country profile for Zaire reported total production for 1971 to be 145,800 tons).

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*1Z = $2.00 U. S.

The population of the Kivu region was estimated to be 2,261,800 in 1959. The 1970 census for the region reported 3,014,500 Zairois, and 347,400 foreign (presumably including many refugees) for a total of 3,361,900 persons. The Uvira zone, the more densly populated zone of the project area, is estimated to have a population of 160,475 living in a 3,148 km^2 area and the population continues to increase rapidly.

4.2 Consumption, Demand and Nutrition

There is protein deficiency (Kwashiokor) in the South Kivu Sub-Region. Reports of international agencies say it is so; high officials of the Zairian government tell us it is so. In villages between Uvira and Baraka we have seen the protruding bellies and we know it is so. Finally, we have observed the nightly catch of fish quickly bought up on the beaches of Uvira, with the demand far exceeding the supply at the present time.

Clearly, no one program and no single protein source will solve the problem. However, complementary efforts can help. The proposed project in support of COOPELAC is one such step.

What would be the impact of any increased fish production on nutritional needs in the project area? Much of what follows focuses on the Ruzizi Plain area, is highly impressionistic and depends heavily upon lengthy conversations with local people, including the agronomes of AKU.

If one thinks in terms of an "average" family unit of 10 persons (4 adults and 6 children), such units currently consume not more than 0.5 kilos of fish per day. If the question is posed, "How much would they consume, given greater availability and price

stability?", the response is 2-3 kilos per day.[1/] If the additional question is asked "How much can the villagers afford to pay for fish?", the reply is 40-50K per kilo.[2/]

What may be inferred from these observations? To get the needed protein into the Ruzizi area will require between 2,500 and 3,500 tons of fish per year. At 40K per kilo, a case of fish would retail for 16 Zaires. This is more than the coop received per case when it was marketing in Bukavu. Thus, it would appear that price reductions at the retail level would be possible while maintaining reasonable margins, e.g., 12-15K per kilo ex-vessel, 20K per kilo wholesale in the plain, and 30-35K per kilo retail.

Nothing has been said to this point about the population in Fizi. Latest estimates put the zone population at something over half that of Uvira zone (94,000 versus 160,475). The COOPELAZ/ Action Kusaidia nutritional survey of the two zones indicated greater availability of fish in the Fizi area than in Uvira. Baraka generally has dried fish available for shipment to Bukavu. The COOPELAZ marketing and distribution plan calls for a fish collection station at Baraka from which dried fish would be moved

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[1/] Although we are reluctant to play the numbers game with protein requirements, we cannot ignore the correspondence between this figure and one World Health Organization estimate of protein requirements (apparently WHO has a new, lower value that has not been widely accepted). Using their values, our 4 adult, 6 children unit would "require" roughly 340 grams of protein per day. If fresh fish yield 20 percent protein, this implies a daily fish requirement of 1.7 kilos for the family unit.

[2/] Marketing by weight has little meaning to the people. We observed piles (a sizeable handful) of ndagala for sale in the Uvira market for 10K. While the price remained the same, the portion becomes smaller and smaller as you go north from Uvira to the Rwanda border.

to Fizi as well as to Uvira and Bukavu. Initially, the distribution of fish to Fizi calls for the use of small dealers. Until government action is taken to improve the roadway and bridges south of Uvira, the COOPELAZ proposed scheme appears to be the most practicable one.

It is the opinion of local agricultural officials that there is a definite shortage of fish now around Uvira, but that demand had been met earlier when industrial fisheries were operating in the area. At that time many fish were being exported outside the region without complaints from local people. It appears that getting fish into the mountain area north and west of Uvira, probably to centers along the highway where they can be picked up, is one way to reduce malnutrition.

4.3 Existing Marketing System and Price Structure of the Fishery, Uvira-Fizi

When fishing boats arrive at the beaches in Uvira with the night's catch, middlemen dealers are already waiting to buy these fresh, undressed fish. These dealers must be licensed by the State, and they are of four types:

1. Those who have already made a deal with the fishermen for his night's catch by advancing him money or credit; others waiting in line may not know this deal has been made, or they may already have a deal with the first buyer for his purchase and waiting to sell to others behind them, i.e., a 40 kg "box" of fish (the standard wholesale unit for fresh fish), may be sold to 3 or 4 levels of middlemen before ever leaving the beach,

perhaps before the fishermen ever unload it, with the price rising about 2Z at each level. What the fisherman may have sold for 6Z or less a box will probably be 12Z or more before it reaches the market to be broken up and sold in small quantities-a handful of ndagala sells for 10K in the market, a kilo of fish for 40-50K, which amounts to 16 to 20Z a box.*

2. Those who come on bicycles with a platform on the rear that holds one or at most two boxes. They transport the fish up the road to the villages for sale in smaller quantities to other sellers or directly to families. This is the principal way that people in the hinterlands get any fish now, unless they walk or catch a ride to the markets in town.
3. Those who buy and sell in small quantities right at the boat landing.
4. Those who buy and take it to the market to sell.

Larger fish such as mukeke up to 20 cm are sold by lots of 5 to 8 for 50K; large sangala and capitaine are sold individually on the market, usually by bargaining for a final price. Some ndagala are dried in the Uvira area, but fresh fish is preferred here and most are sold that way. Except for what few fish reach there by bicycle or truck, the area immediately south of Uvira does not receive much fish now. Most fish reaching the port of Baraka are

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*1Z = $2.00 U.S.; 1k = .02 ÷ 100K = 1Z

dried and stored in a depot there for redistribution. About 60Z of this is trucked to Bukavu. Most of this fish comes from the Bay of Burton and around the Ubwari Peninsula. It is dried on the sand beaches and brought by boat to the Baraka depot. Because of the very poor road conditions between Baraka and Fizi, limited quantities of fish are reaching Fizi, where there is a need for more protein.

The one individual still operating an industrial purse seine operation in Uvira sells his fish locally for 8-10Z per box, but about 40Z is trucked to Bukavu for higher prices.

4.4 COOPELAZ Price and Marketing System

The cooperative membership has locked itself into a curious pricing arrangement that leaves only the small retailer happy - the fishermen and the consumer are at his mercy.

Early on the membership voted to attempt to market their own production rather than sell on the beach to the series of middlemen that operated there. In order to amass the capital for the trucks needed for marketing, the members agreed to sell to the coop for a price of 2 to 3 Zaires below the existing ex-vessel price. The coop was unable to put together sufficient funds to purchase a truck, and rental proved to be prohibitively expensive. With the collapse of their attempt at marketing, the coop still has to buy from the fishermen at 3Z per case (4 to 5Z in periods of lower catch) and sells to middlemen for Z3.20, in accordance with the powers granted by the members to the coop. The fishermen then observe the boxes of fish being resold on the beach for Z6 or more. The result, of course, is that many members withhold all or part of their catch for sale directly to the middlemen.

No clear answer was obtained to our question of what would be required to revise the price structure. Two reasons were offered as to why it had not been changed. First, it was asserted that the price increase would only be passed through to the consumer, and, second, the middlemen would "revolt" if a major price increase to fishermen was made.

The coop's planned marketing and distribution system, if implemented, should alleviate both concerns. The reasoning goes as follows. The coop should be able to operate on a smaller margin than now exists between the beach and the consumer in rural villages, i.e., at present there is some fat in the system. If this is so, the ex-vessel price could be increased, thus attracting a greater supply. At the same time, if the coop established sales stations in rural population centers such as villages in the plain of Ruzizi, price competition would come to such areas for the first time. The consumers would have a choice of coming down from the hills to buy in the village, or they could continue to buy from the hawker selling his one case of fish from the back of his bicycle. (The fish would be available to him at wholesale from the coop sales station.) However, the presence of retailing at the station would place real limits on his margin - his margins would fall from their present level. We doubt, however, that the small entrepreneur would "revolt". Given the limited alternatives available to him in rural economy, it is unlikely that he prefer zero return to a "reasonable" one.

5.0 PROJECT AND INSTITUTIONAL ANALYSIS

5.1 Preliminary Project Proposal

The preliminary project proposal (PPP, 11 pp., dated September

26, 1974), the feasibility of which this team was to study, is essentially one in which a fishing cooperative in the Uvira-Fizi Zone of Lake Tanganyika, Zaire (COOPELAZ) would be assisted in its expansion with U.S. AID funds for the purpose of increasing fish production and protein availability in that area. A doubling of the current annual fish production of COOPELAZ members and development of an improved marketing system are the primary objectives of this project. These would be accomplished by replacing present worn-out fishing equipment, principally nets and lamps, with new ones and developing a distribution system for fish that involves collecting boats, delivery trucks and a series of selling stations along the main road from Fizi to the Upper Ruzizi Plain, as well as drying racks, fish storage depots and coop stores with fishermen supplies.

Total project costs for the fishing and marketing equipment and construction initially was $346,000, of which COOPELAZ would furnish $28,000 for the construction supplies. An additional $65,000 was included by USAID for technical assistance, making the total U.S. costs $383,000. Details on the background, goals, for technical assistance, making the total U.S. cost $383,000. Details on the background, goals, assumptions, inputs and considered benefits from the proposed project are furnished in the PPP. Impacts, both economic and social, are discussed along with other benefits in the following team analysis of project feasibility.

5.2 Feasibility of Project - Team Reaction

After two weeks of field observations in the South Kivu area of Zaire; interviews and discussions with key personnel in national and local governmental offices, Action Kusaidia, COOPELAZ and

IRSAC; and examination of available catch statistics as well as potential catch and biomass estimates, from all sources, it is the concensus of this team that, with minor modifications, this project definitely is a feasible and worthwhile undertaking for USAID.

It is our belief that the nutritional needs of the Uvira-Fizi zone cannot be completely met with this project, or any greatly expanded one which does not include reactivation of the industrial fisheries on at least as large a scale as was in operation earlier, and many more fishing units are probabiy needed to meet the protein needs of this region. Reasons for this are that the basic premise of the proposed project was a current annual harvest by COOPELAZ of 22,000 tons. Acceptance of that figure, which is about three times the actual catch as best we can determine, makes it easy to account for a lot more benefits than will occur with this project. Doubling of that production, i.e., 44,000 MT, is not likely to occur unless all of the Zaire waters of Lake Tanganyika in Zaire are covered with a fleet of industrial purse seiners.

Three hundred COOPELAZ members all using trimarans on every fishable night of the year and catching the maximum would result in about 10,000 tons per year catch. With the assistance of fish finding equipment, this can probably be increased by another 2,500 tons. To reach the stated production of 22,000 tons would require an additional industrial fleet of over 30 vessels in full operation. We believe the current fish production by COOPELAZ can be doubled or more with the assistance of funds for this project, but the starting point is about 5,500 tons. Doubling that will make a substantial contribution to improving nutrition levels in the region. Equally as important this project will serve as a model

for further cooperative fisheries development along the central and southern shores of the lake.

5.21 COOPELAZ

We believe much of the feasibility of this project lies in the fact that COOPELAZ appears to have the capability to operate in the best interests of local fishermen; its managers appear sincere, knowledgeable and honest; its program of first modernizing its present harvest (artisanal) equipment so as to gradually increase the catch, then of developing a good marketing system, and finally gradually moving into industrial fishing, is sound and in the proper order. Attempts to develop new technology for much greater harvests, without first knowing how to market or distribute the increase would be imprudent.

COOPELAZ is, is our opinion, a viable organization, but it needs more financial assistance to get its feet on the ground and moving in the right direction. Making a success of this cooperative will have many more benefits down the road: it can be a model for the development and operation of additional fishing coops on other Zaire waters; it will benefit local fishermen with higher wages and offer employment to many more people - at least 85 - in addition to the fishermen who will work in the stores and canteens; and it will provide the means for apprentice fishermen to be trained and to acquire their own equipment and needed supplies through suitable credit arrangements. Finally, with COOPELAZ' proposed marketing system, people in the outlying areas should receive more fish and protein and at a better price than is available to them now.

COOPELAZ management wants to improve the lot of its members and certainly to make more money for them and the organization. However, from its plan to market more fish in the outlying areas that need more protein and where fish can't be sold for high prices, it obviously is also quite interested in helping fill the needs of local, under-nourished people.

Our one real concern about COOPELAZ is that it is now largely a one-man operation. Cit. Kahindo, the manager, seems extremely capable and honest, and the fishermen hold him in high esteem. If anything happened to him before the coop really got going well, it could fold. He has what seems to be a capable assistant and we understand attempts have been made to train some local fishermen in cooperative management without success, mostly for lack of interest on the part of the trainee. Since Cit. Kahindo and his assistant are on loan to COOPELAZ by UNTZA, the National Labor Organization of Zaire, it is imperative they not be pulled out until the cooperative is capable of managing itself.

Concerning the inflated estimates of their own production records for 1973 we don't suggest this was done intentionally, but that errors developed in calculating daily or monthly statistics. COOPELAZ should, however, institute a system of accurately counting (or reasonably estimating) the nightly catches from its members. If they don't have good base data, it will be difficult for them, or anyone, to measure, monitor or show increased production and related benefits. This should definitely be one of the items of short-term technical assistance.

COOPELAZ managers indicated they were willing to move gradually into industrial-type fishing. To do so in the near future requires that some of the boats not now in operation be made available to them, that they be put in operable condition, and that the coop receive some initial guidance in operation of the boats and the purse seine equipment. We feel this is an important adjunct to this project and urge that COOPELAZ be encouraged to study moving into industrial operations as soon as the artisanal fishery is essentially modernized. Greatly increased production over the present depends on active operation of the six industrial vessels in Uvira.

A final point about the feasibility of this project through the activities of COOPELAZ: The cooperative is receiving competent, dedicated management from Cit. Kahindo and his assistant. Moreover, it is clear that they are committed to training their members in the philosophy of cooperatives. It is these impressions that lead us to assert that if any increases in fish production are to be made in the near term in the project area, they must be made through COOPELAZ. No other organization exists right now to assume such a role.

5.22 Roles and Relationships of Other Local Agencies

We believe the proposed project is feasible also because the idea and goal of increased fish production in Zaire waters of Lake Tanganyika, with COOPELAZ as the primary instrument, appears to be receiving the full support and encouragement of officials of the Government of Zaire and other pertinent local agencies.

Government Officials

We discussed this proposal and its objectives with officials of the Regional Governor's Office in Bukavu, the Commissaire and Assistant Commissaire of the Region in Uvira, and the Zaire Ambassador to Burundi. All expressed deep concern about protein deficiencies in the region, indicated they would support efforts of COOPELAZ to increase fish production; and regional officials were particularly interested in reviving the industrial fishing operations out of Uvira, either through COOPELAZ, or, if necessary, reassignment of non-operating industrial boats to other proprietors.

Action Kusaidia (AKU)

This is a regional government organization involved in all aspects of rural development for the South Kivu Region. It was initially established by the Presidency in 1972 as a relief organization to welcome back refugees from Burundi and elsewhere. Since then, AKU has become involved in various developmental actions including the building or renovation of dispensaries, repair of bridges and roads, construction of schools and social centers, water supplies and a hospital. It is still funded 95% by GOZ and 5% by a number of international organizations. All AKU representatives contacted in Kinshasa, Bukavu and Uvira expressed great interest in helping the people of South Kivu to receive more fish either fresh or dried, and they support the efforts of COOPELAZ in this direction.

It is the feeling of this team that AKU has the local organization, equipment and necessary contacts to be of great assistance in designing and constructing the markets, selling stations, canteens and coop stores proposed in this project. With their organization, it is considered they will know what materials are needed, how to get them faster, and they can probably do the construction faster and cheaper than any other group. We see no advantage in COOPELAZ temporarily going into the construction business, when a capable local organization with experienced construction workers and laborers already exists. In addition, any work that AKU does on the roads and bridge south of Uvira with GOZ funds will, of course, assist greatly in improving and accelerating the distribution of fish to those areas. If a badly needed mechanics training school is funded in the Uvira area, AKU could construct it. We understand AKU already has funds for a new, enclosed fish market in Uvira. All of these activities will aid and support this project.

IRSAC (Institute of Scientific Research in Central Africa)

Workers of this renowned research groups at the Uvira station did much of the earliest work on the fish and fisheries of Lake Tanganyika. Marlier (1957) was the first to study the biology and life history of the ndagala Stolothrissa. Little more has been added to his findings by subsequent researchers in FAO programs. In 1956, Collart of IRSAC was responsible for stocking both

Limnothrissa and Stolothrissa in Lake Kivu. The latter did not reproduce, but today Limnothrissa are found in great numbers, at least in areas around Bukavu, and they are now being harvested commercially for the first time by artisanal fishermen from Uvira.

Nothing more was done on the fishes of Lake Tanganyika by IRSAC after 1959 and the Uvira station was closed soon after. Nevertheless their work in other areas of research - botany, zoology, anthropology etc.- continues at the Bukavu station. It is planned that the Uvira station will reopen soon with Cit. Luyeye of this team as its Director and emphasis will be on fishery biology and research. This development should proceed as soon as possible.

A program of both basic and applied research at the Uvira IRSAC center can be of great assistance in the further development and improved production of fish from Lake Tanganyika. Much more information is needed about the habits, especially seasonal movements and concentrations, of species important to the artisanal fishery better estimates of their biomass, relative abundance and potential production are needed; and annual fluctuations need to be monitored so that overfishing of certain stocks does not occur and that under exploitation, if it continues to occur in spite of greatly increased fishery effort, is well known, also.

IRSAC workers can be particularly helpful to Lake Tanganyika fishermen with sonar (fish finding) equipment

by identifying the presence of fish and their concentrations in different locations during specific months and even days. Such an operation would permit fishermen to head for areas where the probability of finding fish is high, thereby increasing their catch and the overall production.

Finally, IRSAC can assist fishermen on Lake Kivu to locate concentrations of ndagala, first by mapping and showing fishermen where the deeper waters are (more ndagala can be expected to be in these locations in this much shallower lake) and secondly by helping to locate fish concentrations with sonar equipment. Any increase in the catch of ndagala on Lake Kivu will lessen the need to import fish to that city from Lake Tanganyika and make more fish available in the Ruzizi and Uvira regions where there is a shortage at this time.

To assist these needed supporting activities of IRSAC, it is suggested that sufficient funds be included in the proposal to provide the reopened Uvira fishery research center with a high speed, fiberglass boat, fully equipped with powerful search and signalling lights, marine radio and combination depth and fish finding equipment. Possibly the fiberglass boat now beached adjacent to AKU headquarters in Uvira can be acquired and reconditioned for the purposes of scientific investigations and fish finding operations. In addition, IRSAC should be encouraged to staff this station with at least three technicians and furnish other needed scientific equipment

so that those investigations can be effectively and efficiently initiated and accomplished.

5.23 Training Needs and Technical Assistance

Several types of training and technical assistance are needed and should accompany the development of this project and expansion of COOPELAZ activities:

a. COOPELAZ itself should cooperate closely with the development of an apprentice training program of young fishermen in the more modern fishing methods so they can be ready to take over the fishing operations (see b. below). Present membership of COOPELAZ now consists largely of older fishermen. COOPELAZ management should also hasten the training and indoctrination of several of its most intelligent young men in the management and operation of this fishing cooperative.

COOPELAZ management indicated it probably has the capability already to train fishermen to operate the industrial boats and the purse seines, if the equipment should be made available to it. To us this seems unduly optimistic and perhaps unwise. To be certain that COOPELAZ is fully capable of handling purse seine equipment and operations, the project should include an initial period of technical guidance in that respect - they may know how to run the boats but not necessarily the most efficient and effective way of operating the purse seines.

b. A training program under UNICEF auspices for young fishermen of the Uvira region is in the process of being implemented. It is considered an extremely important

element of the fisheries development program on Lake Tanganyika and envisages actions entirely complementary to achievement of the objectives of the project. The UNICEF project proposes to:

1. establish 10 artisanal fisheries units in the UVIRA region, each staffed by 12 young fishermen under the guidance of an experienced fisherman.
2. Teach these young fishermen their craft through on-the-job training and formal instruction.
3. integrate these young fishermen with their equipment into COOPELAZ on the completion of their training program.
4. establish a fisheries repair and maintenance facility and train selected young men in equipment and boat repair and maintenance techniques.

The A.I.D. Mission is exploring with UNICEF the best manner in which to implement such a training program and the COOPELAZ fisheries program to assure that all training needs are covered and to avoid areas of project duplication.

c. Other technical assistance we consider needed by COOPELAZ in this project would be a marketing expert for about a month to show its management how to work with and develop a suitable pricing system - one that sufficiently allows for all transportation and other costs and that provides acceptable profit margins. It appears to us that COOPELAZ has proposed the outline of a good fish

distribution system but it should be reviewed by a marketing expert who could advise, for instance, on simple ticket systems to keep trace of boxes of fish between the landing area and final distribution point. The expert could also help initiate the training of market and store managers and processors in improved methods of handling, processing and distribution of fish, or waste and spoilage will continue.

COOPELAZ also needs guidance in the development of a system for recording and tabulating catch statistics. The right kind of marketing expert might be able to assist in this aspect as well, or it may require some additional very short term statistical assistance. U.S. A.I.D. agricultural economists or statisticians might be able to assist in this. Although not perfect, it appeared to us that the method of obtaining catch statistics at fish landings by the Agriculture Service in Uvira is better and more accurate than the estimates now being made by COOPELAZ.

Finally, technical assistance should include a gear development specialist for construction of demonstration trimaran fishing units, with which he, or someone from COOPELAZ, could tour all the artisanal fishing beaches to visually show and convince fishermen of the advantages of innovative ideas and more efficient and easier ways to operate equipment. The unit can be used to teach apprentice fishermen modern techniques and equipment and provide opportunities to try out new ideas and

improvements in fishing gear and methods. The technical gear expert could initiate and oversee the construction of the demonstration unit; instruct appropriate individuals in COOPELAZ how to demonstrate to traditional and artisanal fishermen ways to facilitate their work while increasing their catch and how and where such equipment could be built or bought on credit. A revisit to the area by the technical expert should be planned for a couple of weeks once a year to check on whether the unit is functioning and being utilized as it should and to add new ideas to the demonstration.

6.0 REVISED PROJECT PROPOSAL

The following are the team's suggestions for modifying the preliminary proposal with some specific, incremental courses of action. The modified proposal incorporates most of the ideas of the earlier one, but includes some additional ones considered necessary to meet the objectives of increased production, and suggests changes in priorities, in materials acquisition, time frames and project funding. The proposed project would cover a period of three years and be accomplished in three stages as follows:

6.1 First Stage

Modernize the present COOPELAZ fishing fleet to the highest level of artisanal technology as quickly as possible, by converting all present catamarans and available fishing pirogues of the right lengths into trimarans and equipping them with the appropriate nets and lamps. Acquisition of new boats would not be included at this stage; rather the existing stock of pirogues is utilized. Enough are available to add 118 more trimarans to the COOPELAZ

fleet of 109 now existing (see earlier discussion and table on current and potential production by COOPELAZ pp. 16-18). Funds would be provided only for acquisition of approximately 200, new 100-meter nets and the same number of both large and small lamps. This would allow for a considerable number of spares in stock since the present supply of nets and lamps is still useable to some extent.

Construct the proposed selling stations starting first with those along the road from Uvira north through the Upper Ruzizi Plains; begin construction of drying racks and storage depots, starting in the Baraka and Fizi areas where 90% of the fish are dried. (Note: Where construction is involved, it is recommended that it be done through AKU and that all funds allocated for this be used for purchase of needed materials and supplies.

Arrange for COOPELAZ to acquire at least two of the inactive industrial vessels and fishing equipment in Uvira for a three-year probationary period and begin reconditioning as necessary.

Acquire and make available to IRSAC a fiberglass research boat with a fast motor and fully-equipped with ship-to-shore radio, appropriate depthfinding and fish location equipment - with some reconditioning, the one beached near AKU headquarters in Uvira might be utilized for this purpose.

Acquire one large truck, of 2.5 to 5 tons for delivery of fish to stations in upper Ruzizi area.

All of the above should be accomplished in the first year at a maximum cost of $278,000. In addition, it is considered some technical assistance with development of a better system for collecting and recording catch statistics should be provided early in the project life. Some increase in catch should be evident as soon

as the additional trimarans are operating, thus, their conversion, plus acquisition of new lamps and nets, has highest priority.

6.2 Second Stage

After a reasonable training period begin purse seine operations with two reconditioned industrial vessels, and as soon as they begin catching fish, start reconditioning of two more industrial boats for use by COOPELAZ. One desirable restriction by the government, during the probationary period that COOPELAZ is allowed to operate these boats would be that at least 40% of the catch should be distributed to the outlying regions where fish (protein) is needed most, rather than all to Bukavu, where the highest price might be obtained.

With the increased catch from improvement of the artisanal fisheries and re-introduction of industrial fisheries, remaining components of the COOPELAZ marketing and distribution system should be completed, i.e., the remaining selling stations, drying racks, canteens, etc., should be constructed; and the other trucks and the collecting boats and motors should be acquired. All of this should be done by the end of the second year with costs in this phase of about $203,600.

Technical assistance in the second stage should include guidance and training from a marketing expert early in the year before development of the marketing system is completed, and instruction in the operation of purse seine boats and equipment. At the end of the second phase a considerably increased catch should be evident and more fish should be reaching out to the villages beyond the beach markets. A doubling by then of the previously estimated production of 5,500 tons is possible, but will depend on the full

operation of all four industrial vessels.

6.3 Third Stage

After two years of experimentation and study by IRSAC researchers, it should be possible to initiate a fish locator system by which fishermen are guided to the concentrations of fish. This should definitely increase production to at least double that at the start.

If the first four industrial units are all catching fish, then consideration might be given to acquiring and renovating two more units, possibly from Kalemie, if those are not all in operation. Also, FAO has plans for smaller purse seine units which might be more appropriate and less expensive. Funds should be included for this contingency.

Acquisition and gradual replacement of some of the older trimarans with metal ones and purchase of motors could be initiated in this period. This would permit fishermen to cover a greater area in a shorter period of time, and, with the assistance of fish-locator equipment, should increase the catch even more. Current costs of metal boats are not available to us, but since they are in use in Burundi waters, costs should be available from FAO.

From this point on, further increases in catch will depend on new technology. Trawlers or large purse seiners operating in the deeper waters with sophisticated fish location equipment, in daytime as well as at night, are the best possibility; however, this will require preliminary investigations of species and stocks and experimental fishing over a considerable period of time. Also, the several governments will mutually have to agree that this is a permissable means of harvesting fish on Lake Tanganyika. Hopefully

FAO and other international groups will continue experiments with better fishery technology on this lake and make their findings of improvements known to all countries.

This last period should also be one in which other means of fish processing and preservation should be exploited. Smoking and salting are possibilities, if local populations will accept them; the feasibility of freezing of fish might also be studied in this stage. Experiences of FAO in Burundi and Tanzania in this respect should be reviewed, and successful methods tested for acceptance of product and cost. The third stage is essentially one of allowing time for the programs and modifications initiated in the first two years to work. Some developments might take longer than anticipated because of delays in getting started, in construction, in training and in acquisition of equipment. Furthermore, it would be unusual if everything jelled so that increased production occurred right away. If the production is doubled and the marketing system fully integrated and working after two years, then this project will be more than a success. If it takes three years or even a little longer, then it is still a worthwhile undertaking for U.S. funds.

6.4 Suggested Budget

Following is the budget breakdown for the modified, three-stage proposal outlined above. Funding for the first two phases in the amounts shown is considered essential to the success of this project and should be the minimum budgeted; additional items suggested for the third phase are not critical, but they would help insure a continued increase in fish production and provide more stability and incentive for further improvement in COOPELAZ'

(Zaire's) program for fishery development on Lake Tanganyika. They are included as possible, desirable expansion of the basic development and assistance project.

It is still assumed,as indicated in the PPP,that COOPELAZ will assume salary costs for all workers in their expanded activities resulting from this project and that AKU will assume administrative costs, other than materials, for any construction activities assigned to it in this project. In addition perhaps COOPELAZ, or the Republic of Zaire, would share more of the proposed costs, particularly those in the third phase.

With respect to financial arrangements the team supports the suggestion by Citoyen Kahindo and others that financing to the cooperative should be made in the form of a loan, to be repaid following stipulated conditions. The funds would then be available for reuse in further expansion of these activities or in other cooperative fisheries projects as mutually agreed upon by the Government of Zaire and USAID authorities.

6.5 Proposed Material, Equipment and Assistance Requirements by Stages and Estimated Costs

First Stage - Year 1 - Equipment

No.	Item	Dollar Equivalent
200	100 meter nets at 2Z per meter	$80,000
200	Lamps (16,000 CP)	30,000
200	Lamps (500 CP)	12,000
1	Welding Torch	300
1	Large truck for fish distribution markets and selling stations in Upper Ruzizi Plain	20,000
1	Fiberglass research boat (25')[1/] for IRSAC Uvira Station, equipped with large engine, marine radio, depth locator and fish finding (sonar) equipment	15,000
	Construction Materials for Half the Markets, Stores, Depots and Drying Racks[2/]	
	12 Selling Stations in Upper Ruzizi Area	2,500
	14 Drying Racks mostly in Baraka & Ubwari peninsula	10,000
	2 Storage Depots for dried fish	2,000
	2 Coop Stores for fishermen supplies	1,500
	Reconditioning of 2 Industrial Purse Seine Boats[3/]	100,000(up to)
	Technical Assistance Re-Catch Statistics System	5,000
	Sub-Total: First Stage	$278,300 (Maximum)

1/ Acquisition and reconditioning of Army boat beached near AKU Headquarters in Uvira would reduce costs by 1/3 or more.

2/ Costs of these and other materials might be borne by COOPELAZ and/or GOZ.

3/ These might require entirely new engines, winches, lights and seining equipment; we did not have time to inspect these boats to make such a determination. If boats can be put in operation, surplus can be carried over till second year for reconstructing of additional vessels; totals can be revised following inspection by competent marine engineer or receipt of estimate from boat yard.

Second Stage - Year 2 - Equipment

No.	Item	Dollar Equivalent
2	Large trucks (5-ton max.) for fish delivery to markets around the lake & bringing dried fish from Baraka and points south of Uvira	$ 40,000
1	Pickup truck for delivering supplies	7,000
5	Boats for collecting dried fish & delivery to storage depots	6,000
8	'Penta' 50 HP outboard motors for above boats, including spares	9,600
	Construction Materials for Remainder of Depots, Drying Racks, Stores, and Selling Stations (see footnote 2)	
12	Selling Stations - Uvira to Fizi	2,500
14	Drying Racks	10,000
2	Storage Depots for Dried Fish	2,000
2	Coop Stores for Fishing Supplies	1,500
	Reconditioning of Two Additional Purse Seine Boats	100,000 (up to)
	Technical Assistance: Marketing Expert; Guidance in Purse Seine Boat and Equipment Operation	25,000
	Sub-Total: Second Stage	$203,600 (up to)

Third Stage - Year 3 - Equipment

No.	Item	$ Equivalent
4	Additional fish locator equipment (sonar) for larger industrial boats	$ 12,000
2	Newer, smaller purse seine boats (FAO design); costs not available now but estimated at max of $25,000 each	50,000
45	Metal canoes for construction of 15 metal trimaran fishing units; costs not available, estimated at $2,500 ea. from FAO publications	110,000
15	New motors for above units	18,000
	Technical Assistance - Gear Development Sepecialist	
	For guidance and training in development of demonstration fishing unit for promotion of new fishing techniques; training in new processing methods.	30,000[4/]
	Sub-Total: Third Stage	$220,000
	Three-Year: Total: All Phases	$702,000

[4/] Include cost of acquiring or constructing demonstration unit.

7.0 OTHER EXPECTED BENEFITS AND IMPACTS OF PROJECT

7.1 Benefits to Fishermen

In addition to increasing fish production by the order of magnitude suggested and improving the protein supply in the region, the project, if funded, should establish COOPELAZ as an effective, fully viable organization, adequately serving the needs of a large percentage of the artisanal and industrial fishermen in the Uvira-Fizi region of the Lake. Local fishermen will receive many benefits including:

1. Coop stores, where supplies not readily available now, can be purchased at reasonable prices;
2. Availability of long-term credit for purchase of large items such as boats, motors and nets, as well as short-term supplies as kerosene, mantles, etc.;
3. Training in the use of improved fishing and processing techniques;
4. Better and higher quality fishing equipment;
5. Availability of more attractive markets;
6. Services of trained mechanics for repair of engines.
7. Emergency loan or rental of equipment for short periods;
8. Assistance with location of fish concentrations;
9. Guaranteed minimum prices for fish;
10. Profit-sharing.

7.2 Economic Impact of Proposed Project

To assess the impact of the project we must first identify the types of people affected and the nature of the impact upon them. In some instances it should be possible to quantify the impact

while in others we must be content with deducing the sign (positive or negative) of the impact. In all instances we shall confine ourselves to assessing primary impacts and will ignore secondary and later round effects.

Three groups of individuals can be identified as affected by the project. Obviously the members of COOPELAZ must be evaluated in terms of impacts on their income; next the impact upon the consumer in terms of the nutritional requirements must be analyzed; and finally, the impact of the project on local employment needs to be considered.

In the case of the cooperative members we can estimate their gross revenues and net incomes before and after the conversion to improved boats and gear and a revised ex-vessel price structure. Given an assumed catch rate for each type of boat and a price of 3 Zaires per case, the fleet would generate monthly revenues of Z.33,225. Crew shares would amount to half of this or Z.16,612. Thus the 242 coop members would average monthly gross incomes of Z.68. If overhead costs run as high as the 60% suggested in the PPP, this implies a net monthly income per member of Z.27. (per man crew shares, assuming 9 crewmen per trimaran, 5 per catamaran and 1 per canoe, would be Z.11 per month).

With full conversion to trimarans and a price of Z.5 per case, total monthly revenues would be Z.78,315. Crew shares would be Z.39,157 or Z.14.20 per crewman for a work force that has increased from 1,467 to 2,043. Coop members gross income has risen to Z.162 or a net of Z.65.

If the project achieves any success in its marketing and distribution efforts, the people in rural population centers and

surrounding areas will have more fish to eat at prices no worse than at present and perhaps lower. Without attempting to quantify the result of improved nutrition, it seems safe to assume that the impacts are positive.

One of the most interesting (and unexpected) benefits of the project is in the area of new employment. We had recognized that the coop planned on hiring approximately 85 middle and low income level workers to operate its various facilities. Only belatedly did we realize that the conversion to an all-trimaran fleet would necessitate approximately 580 additional crewmen, while crew shares per man increased 29 percent. If an apprenticeship program and low cost loans are made available to the more promising young crewmen as planned in the UNICEF apprentice program, both the coop and the fishery will be assured of a well-trained supply of fishermen for the future.

7.3 Other Impacts

7.31 Small Commercants or Middlemen Buyers

When the marketing and distribution system proposed by COOPELAZ is fully integrated and operable, many of the small dealers will be put out of business or forced to compete at lower prices and profit margins. In many instances this will be an improvement, since the poor consumer is often forced to pay higher prices only because the fish passes through a series of middleman dealers, each making their profit. Many of the small bicycle dealers will still be needed for local distribution of fish off the main roads. Some of the middlemen dealers will be able to find other employment either within COOPELAZ operations or in the expended fishing fleet, if

they are interested.

7.32 Other Fishermen - Not Members of COOPELAZ

There should be no great impact here since most of these will be traditional, single pirogue fishermen using dip and scoop nets. They will be the older fishermen who are not interested in changing their fishing techniques and who will be satisfied with smaller amounts of fish for family use or market trade. On the other hand, many others should be encouraged to join COOPELAZ when they see the benefits and services available to members in which they are not sharing.

It is entirely possible that if COOPELAZ gets too big i.e., acquires too many members to service them efficiently, that smaller branch or sub-coops of COOPELAZ might need to be established in other towns or lake regions to better serve specific groups of members. With COOPELAZ training, experience and guidance, it should be easier to do this than it was getting the larger (parent) group functioning.

Likewise, the one or two other industrial fishermen in the area should not be impacted by COOPELAZ activities, except possibly to benefit if COOPELAZ gets into industrial operations.

7.33 International Impacts

It is doubtful that a project of this magnitude and scope will have any major international implications. The best estimates of sustained annual potential yield for Zaire waters of Lake Tanganyika is 140,000 tons. At maximum efficiency and operation of all suggested artisanal and industrial boats, the greatest expected annual harvest after three years is only about 20,000 tons. Thus, there is no likely danger of depletion

of fish stocks in Lake Tanganyika from this project.

On the other hand, these are international waters involving three countries (in the north end of the lake) and fish move freely across territorial boundaries. Any necessary management or regulation of stocks and harvest should be based on cooperative studies and recommendations of expert fishing staffs or consultants in all three countries. More accurate determination and continuous monitoring of fish stocks (species, biomass and relative abundance) should be done by joint efforts. IRSAC should take the lead for Zaire in this and participate fully in any multi-national efforts in this regard. Fishery researchers of FAO in Burundi and Tanzania and of IRSAC should have free access to each other for exchange of technical information, exploration of ideas, periodic discussions of progress and assistance in planning and conducting needed and mutually beneficial investigations.

8.0 ADDITIONAL RECOMMENDATIONS

The following suggestions are related to the fishery, fishing conditions and technological aspects for Lake Tanganyika. They are not a critical or essential part of the project, but their implementation could generally help to further improve fish production and provide more efficient operations. We became aware of them as problems or conditions or situations that should receive someone's further attention, as we conducted this study and prepared this report. We leave them for whatever use they might be to USAID, COOPELAZ or AKU.

1. Someone - COOPELAZ or IRSAC - might look into the possibility of trying to catch ndagala in July-August--supposedly the poorest

fishing season--in the Bay of Burton where concentrations of fish are known to occur and circulate during this same period.

2. Since better methods of obtaining more accurate catch statistics are needed, why not use the new market place to be built by AKU on the main landing beach in Uvira? The building could be completely fenced with a large covered, open area and a small enclosed entrance room with platform scales, where boxes of fish would be taken first from the boats and weighed; after that they could be taken into the outer section for wholesale or retail sales, or loaded directly on trucks for delivery selling stations along the highways. To make such a system work requires the cooperation and support of GOZ, COOPELAZ, and the individual fishermen. Fishermen could be required by the government to have their fish weighed officially--probably by Agriculture Service employees--before they can be sold. Similar weighing stations can be developed at other principal landing areas.

3. The program of road repair and construction and bridge repair south of Uvira should be accelerated. A newer, much improved, all weather road is badly needed from Baraka to Fizi.

4. Spare parts for trucks and motors are badly needed and hard to get. AKU or COOPELAZ should build a retail store in Uvira, managed by local entrepreneurs or salaried individuals trained in ordering, stocking and selling of needed parts. If the UNICEF-sponsored mechanics school ever materializes here, this is the next logical step. If not this, then COOPELAZ at least should provide basic spare parts for engines and a mechanic as a service to its members.

5. A possible alternative method of fish collection and distribution

involves use of a Hovercraft, which travels 60 km/hour, has a standard V-8 Chrysler engine and a capacity of one metric ton. This could be used in place of fish pickup boats on the lake and one large delivery truck. Cost in a Kinshasa is 75,000Z.

6. For improved efficiency and costs, equipment of widespread use should be standardized as much as possible, e.g., lamps, fuel, outboard motors, net sizes, boat lengths, so that they and individual parts are interchangeable, and maintenance and reorder problems minimized. Other suggested equipment modifications are:

   1. Lamps need to be redesigned so that most of the light is directed downwards toward the water and aluminum or stainless steel reflectors will give increased light intensity over present porcelain ones.
   2. Beach seines should be lengthened by adding wing sections of larger mesh to minimize increased pulling force necessary to haul net; this should increase the catch by sweeping larger volumes of water.
   3. Wooden rollers should be added along the gunwhales of pirogues where nets are pulled in, to increase net life and reduce pulling effort.
   4. Lamp mounting on trimarans should be redesigned so that lamps can be turned out of the way during lifting of net.
   5. Pickup boats should have insulated holds; fish boxes should also be insulated for better and longer fish preservation.

The wooden pirogues should be covered with a thin layer of

fiberglass; this will strengthen and extend life of wooden planked boats, and make them 100 percent watertight; due to shortage of trees and wood in area, the fiberglass-covered planked boats will be a suitable substitute for the traditional dugout pirogue. Further instructions with respect to use and preparation of fiberglass for covering boats is given in Appendix C.

8. In response to a suggestion in the original PPP, ferro-cement boats are not recommended due to the low ratio of the buoyancy to hull weight. A ferro-cement pirogue will weigh about three times as much as an equivalent boat constructed of wood--specific gravity 2.6:0.9--also, a ferro-cement boat will ride at deeper draft, making it more difficult to row or propel, necessary reinforcing material is expensive; and construction is a skilled to semiskilled operation.

9. The Republic of Zaire should consider the creation of a qualified and effective Government Fishing Service, with trained biologists, technologists, aquaculturists, statisticians, marine engineers, marketing and processing experts to provide assistance, training, and guidance in fishing development and management programs in all Zaire waters, river lakes, and ponds. In addition, IRSAC should be staffed with additional fishing research biologists and fish technicians as well as some fish development specialists.

10. A small net-making industry might be established in Uvira; nets are now imported into Bukavu from Tanzania and elsewhere. The factory could (1) use machines to make knotless webbing and hire women to complete finished nets and purse and beach seines of needed dimensions, or (2) purchase webbing from outside sources and complete nets locally as above. If knotted webbing is used, complete nets can be made from scratch.

9.0 LITERATURE CITED

(1) Welcome, R. L., 1972. The Inland Waters of Africa. CIFA Technical Paper No. 1, FAO, 117 pp.

(2) Coulter, G. W., 1968. Hydrological Processes and Primary Production in Lake Tanganyika. Proc. 11th Conf. Great Lakes Res., International Association Great Lakes Research, pp. 609-626.

(3) Johanneson, K. A., 1974. Preliminary Quantitative Estimates of Pelagic Fish Stocks in Lake Tanganyika, by use of Echo Integration Methods. EIFAC/74/1/Symp. - 54. 16 pp.

(4) Mann, M. J., 1974. Catch Sampling Methods and Results in Burundi, EIFAC/74/1/Symp. - 51, 27 pp.

(5) Mann, M. J. and N. Ngomirakiza, 1972. Evaluations of the Pelagic Resources in the Burundi Waters of Lake Tanganyika and the Evolution of the Fisheries. African J. of Trop. Hydro. and Fish. Special Issue II, pp. 135-141.

(6) FAO Interim Report, Burundi Fishery Survey and Development Project, 1974. FI:DP/BDI/70/508, Rome, Italy, 40 pp.

(7) Marlier, G., 1957. Le Ndakala, Poisson pelagique du Lac Tanganyika, Bull. Agricole du Congo, Belge Vol. 48, (2), pp. 409-422.

(8) Kristjonsson, H., 1974. A study of Needs and Opportunities for a Regional Approach to Development of Artisanal/Small-scale Fisheries on Lake Tanganyika, Report to SIDA, FAO, Rome, 73 pp.

(9) Haling, L. J. J., 1974. Improved Artisanal Fishing Techniques on Lake Tanganyika, Burundi, FAO FI/DP/BDI/70/508/4, 13 pp.

10.0 BIBLIOGRAPHY ON GEAR, BOATS & TECHNOLOGY

Fishing Boat Design: 1, Flat Bottom Boats; FAO Fisheries Technical Paper, No. 117, Rev. 1.

Fishing Boat Design: 2, V-Bottom Boats; FAO Fisheries Technical Paper, No. 134.

Lake Victoria Fisheries Research; FAO Technical Report 1, FI:DP/RAF/71/242.

How to Plan and Cut Nets:
URI*Marine Bulletin Series No. 8

Cutting Web Tapers;
URI Marine Leaflet, Series No. 1

The Dynamics of European Wing Trawls;
URI Marine Leaflet, Series No. 3.

Computing Horsepower Used in Trawling;
URI Marine Leaflet, Series No. 2.

Pair Trawling for Herring in New England;
URI Marine Bulletin, Series No. 9.

Fisheries Cooperatives;
URI Marine Memorandum 30.

Rhode Island's Floating Fish Trap Fishery;
URI Marine Bulletin, Series No. 14.

FAO Reports Dealing with Fisheries on Lake Tanganyika;
Suggest IRSAC contact FAO home directly.

*URI = University of Rhode Island

11.0 APPENDIX

11.1 Itinerary

March 9, 1975, arrived Rome, Italy.

March 10, conferred with FAO Fisheries Personnel for African Lake Projects, especially Lake Tanganyika.

March 11, traveled to Kinshasa and Bukavu, Zaire.

March 12-13, conferred with Action Kusaidia, IRSAC and Republic of Zaire officials and staff; observed fishery equipment and operations on Lake Kivu.

March 14, traveled to Uvira, Zaire.

March 15-20, conferred with officials and staff of Kusaidia, COOPELAZ, Agriculture Department in Uvira; observed fishing equipment, harvest operations and marketing conditions in Uvira, Baraka and Kalemie.

March 19, traveled to and from Bujumbura, Burundi in unsuccessful attempt to see FAO fishery researchers; permission not received from Burundi Government to talk with them; visited Zairian Ambassador to Burundi in Bujumbura regarding fisheries theme.

March 21, traveled to Bukavu.

March 22, conferred with Kusaidia personnel.

March 23, traveled to Kinshasa, Zaire.

March 24-April 5, conferred with USAID, Kusaidia, Republic of Zaire, and UNTZA officials and staff; and preparation of report.

11.2 Trip to Kalemie: March 17, 1975

Personnel: T. Kowalski, L. Sokolua

Duration: Three hours

Visited: Commercial fishery operation on a beach in Kalemie and talked to two operators. One was a private individual, the second a commercial company, PEZALAC.

The equipment and operating methods are similar and are based on operating units consisting of: 1 trawler, 1 boat carrying the

nets, and 4 boats with lamps.

All boats are made of steel and seem to be in good repair. The equipment, however, is not in such a good condition.

Fishing method - purse seining is used with nets made up in three horizontal strips:

top strip - small mesh for catching;

middle strip - large mesh for large fish;

bottom strip - small mesh.

The size of the net is 400 meters by 35 to 40 meters deep. The lamp boats are deployed at 200 meters distance and the netboat pays out the net and the trawler pulls the net and forms a closed circle in a standard fashion.

We were told that mid-water trawling is not allowed on Lake Tanganyika.

The fish finding is based on the experience of the fishermen and consists in spotting frothing of water on the surface, sounding the depth of water to determine what species of fish are likely to be present and ordinary trial and error search. Depth sounding is done by weighted line near the shores and serves also as a precaution against snagging of nets.

The Pezalac is operating seven fishing units for 20 to 24 days each month. The crew rests 7 to 10 days while maintenance is performed on the boats by trained personnel.

Catch Rates and Prices: The average catch rate of all the types of fish is 20-25 tons per month per trawler.

The gross prices at the time of the visit were:

Ndakala, fresh, 10 Makuta/Kg. (1 Makuta = .02 U.S.)

Ndakala, dried, 46 Makuta/Kg.

Sangala, 18 Makuta/Kg.

During times of oversupply of fish, the prices can drop to as much as 1/5th of the above prices.

Fish Distribution: Fish is sold from a central market run by the fishing operators. Dried fish are shipped by train to Lubumbashi, Kanonga, Kamina, Bujemy, Kindu, Kongolo, or to Mwene Ditu. Frozen fish fillets are shipped by air to Kinshasa and Lubumbashi.

Problems: Trained, responsible and dedicated crews, mechanics and administrators are of prime importance. There is a shortage of such personnel.

Great difficulties are being experienced regarding spare parts for engines and equipment. The repair facilities are very crude. The boats have to be beached for work on the underwater parts of the hull. Presently, there is a shortage of paint. Two companies (CFL and Filtizaf) have been repairing boats, but Filtizaf has changed its policy on the matter.

Fishing Cooperative, COOPEKA: Only office visit was made as the location of the base of operation is about 40 kilometers away.

The cooperative has 65 members. Members were given:

46 planked pirogues, about 5 meters long;

100 lamps, Coleman;

58 hand lift-nets;

5 large lift-nets;

6 purse seine nets;

1 large boat, 12 meters, outboard motor (presently broken).

The above equipment was purchased with funds provided by the labor union. The members are expected to pay back for the equipment

from the fishing profits. (This is to make them work hard.)

Fishing Methods: Are different from the Uvira area. There are no lamp boats and the fishing boats carry the lamps themselves. Two boats are braced together to form a catamaran and two catamarans are braced one behind the other forming approximately a square unit. Nets used have only 3.5 x 3.5 meter opening and are made both out of knotless and standard netting.

Catch rates vary from 100 kg/unit up to 200 kg/unit (four pirogues) per night.

Fishermen sell fresh fish, mainly Ndakala themselves. Any excess they dry and bring to the cooperative. The Coopeka gives them money right away if they have it, or pays later after selling the dried fish.

The price quoted was 6.50Z/20 kilos.

Observation: The commercial fishing is much better organized and run in Kalemie, but the artisanal fishing seems to lag behind the Uvira region operations.

It seems that the artisanal fishermen need to make contact with COOPELAZ and learn the more efficient fishing methods from the Uvira fishermen.

11.3 Recommendations for use of Fiberglas in Covering Boats

Adds little extra weight. Fiberglas' specific gravity is approximately 1.6. To cover one pirogue will take approximately 300 ft^2 of fiberglas cloth which will add about 150 lbs. to the weight of the boat.

It is very easy to apply since the boat acts like a form. The procedure consists of:

1. Turn the boat upside down on low trestles. Lay the

fiberglas cloth on the outside of the boat and cut sections so that the cloth covers the entire hull without crinkles or folds. Overlap joints by approximately 2 inches. Cut another scrip of fiberglas cloth to cover the flat portion of the hull bottom. This will provide a double layer of fiberglas to reinforce the bottom.

2. Sand the wooden surfaces to be covered and apply the premixed resin with a roller or a brush. Small area at a time should be worked because the resin will dry quickly in hot climate. Put the cloth over the wet surface and apply the resin again over the cloth. The cloth could also be saturated with resin beforehand. Make sure the cloth is smooth over the surface by smoothing it with a roller. It is most important to follow manufacturers instructions for mixing the resin and catalyst and applying the resin to fiberglas.
3. Manufacturer's recommendations regarding curing must be followed exactly.

The cost of fiberglas, resin and catalyst in the U.S.A. in small quantities to cover one pirogue, is at the present time (January 1975):

300 ft^2 of 20 ox. fiberglas	$ 40.00
8 gallons resin	$ 80.00
20 oz. catalyst	$ 10.00
	$130.00

The above prices are for small quantities bought. On large orders directly from the manufacturer the prices can be substantially lower. Caution: shelf life of resin may be problem in hot climates.

The whole fiberglassing method can be learned very easily by following the instructions printed on resin containers and experimenting with a small peice of fiberglas.