ECONOMIC ANALYSIS OF ALTERNATIVE STRATEGIES FOR THE DEVELOPMENT OF SIERRA LEONE MARINE FISHERIES

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ABSTRACT

ECONOMIC ANALYSIS OF ALTERNATIVE STRATEGIES FOR
THE DEVELOPMENT OF SIERRA LEONE MARINE FISHERIES

By

Dean Allen Linsenmeyer

Alternative sources of animal and vegetable protein have been unable to provide an adequate quantity of high-quality protein to satisfy the broad-based effective demand. Consequently, Sierra Leone remains dependent on imported frozen fish to meet domestic needs while local stocks of marine fish are under-exploited. Given the government's commitment to greater self-sufficiency in fish, this study examines alternative strategies for stimulating small-scale and large-scale fisheries industries.

This research is the first micro-economic survey of small-scale marine fisheries in Sierra Leone and one of the first fishery surveys undertaken in West Africa which combines the micro-economic operations of small-scale producers, processors, wholesalers, and retailers into an integrated fish delivery system. The objectives of the study were to: (1) describe the micro-economic operations of alternative technologies currently practiced in fish production, processing, and marketing enterprises; (2) identify major constraints on improved performance of the fisheries production-delivery system; (3) through the development and execution of a linear programming

model to examine the aggregate impacts of alternative development strategies on (a) the level of output, employment, frozen fish imports, economic profits to the fisheries subsector, the subsectoral contribution to Gross Domestic Product and on (b) the choice of small-scale technology which is most profitable to the economy.

The field research was undertaken over a 12 month period from October, 1974 through September, 1975, covering 93 fishing firms in five randomly selected small-scale landing sites located in three coastal regions of Sierra Leone. The small-scale firms were grouped into nine representative firm types based on the type of production technology used. One of the five large-scale production firms based in Freetown was also interviewed to collect basic input-output data. Fish processors and traders were surveyed covering the major wholesaling-retailing channels between the selected producers and the four largest urban centers.

Micro-economic analysis of the data was conducted through the construction of basic enterprise budgets for each of the nine small-scale production firm types and for one large-scale firm type. The various processing, wholesaling and retailing firms were also analyzed using the enterprise budget technique. A linear programming model incorporated the budgetary data of these industries into an integrated production-processing-marketing system. This model was tested for consistency with the 1974 situation and then used to evaluate the effects of the following development strategies over the 1974-1980 period: (a) varying the resources available but maintaining the 1974 policies regarding the cost of capital and import duties, (b) encouraging small-scale fishing industries, (c) encouraging large-scale fishing industries, (d) actively discouraging large-scale fishing industries, and (e) closing the economy to frozen fish imports to force self-sufficiency by 1980.

It was found that a significantly higher proportion of the national labor force were employed in the fisheries subsector than had previously been estimated. Within the small-scale production industry, a major share of labor employment and production occurs in the October through March period. However there is considerable variation in the seasonal patterns of the different technological firm types.

A major contrast was found in the amount of capital used per unit of labor between the large-scale and small-scale industries. Although a considerable range of capital-labor ratios was evident between the different technological firm types, most of the types were quite closely clustered.

All small-scale firm types were economically profitable and capable of producing fish at considerably less cost per leone of fish landed than is capable by the large-scale firms. While frozen imports were found to be strongly competitive with large-scale production, they could not actively compete with low-cost small-scale output.

A strategy which encouraged the expansion of small-scale production was found to lower the required imports by 1980 from the level which would prevail if current policies were continued. This strategy of supporting small-scale expansion also resulted in higher levels of economic profits for the subsector as well as higher levels of subsectoral contributions to Gross Domestic Product than any other strategy tested. A strategy of self-sufficiency by 1980 while producing a higher level of Gross Domestic Product and returns to the subsector was judged unrealistic in view of the substantial resource requirements. An accelerated growth in the trained labor supply, the amount of investment capital, and in the capital stock of boats were found as key factors in the expansion of the small-scale industry. Changes in pricing policy such as the cost of capital and import duties on frozen fish and fishing equipment, when implemented in isolation, had little effect on small-scale production but considerably more effect on the large-scale industry.

While some justification is possible for more fully utilizing current large-scale capacities, an expansion of large-scale productive capacities could not be supported by this study.

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By

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While the doctoral candidate's wife is traditionally acknowledged, I note most gratefully the months of tedious work which my wife, Bek, contributed in supervising the computer coding of all the survey forms as well as her understanding support and encouragement throughout my graduate program. Without her support my graduate program would not have been completed.

I wish to express my appreciation to the five field enumerators for their long hours of work under sometimes difficult conditions in obtaining the survey data and to the eight students who spent their summer holidays in preparing the forms for keypunching.

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CURRENCY AND MEASURES

$1.00 = 0.80 Le 1974/75

1 Metric Ton = 2200 lbs.

1 Fathom = 6 feet

CHAPTER 1

INTRODUCTION

1.1 The Problem Setting

The oceans, covering approximately 70 percent of the earth's surface, have long been considered a major potential source of food. Presently about 70 million metric tons of fish are captured annually or approximately one-half the world's potential harvest [Lampe et al., 1974]. Also, fish and fish products contribute a marginal 4.6 percent of the world's total protein consumption [FAO, 1968]. As population pressures mount on land-based resources, many nations and international organizations are focusing on the technical, political and economic developments necessary to improve the productivity of the sea.

Global figures, however, do not convey the varying role which regional fisheries play in the developing world. Among the ten West African coastal countries ranging from Nigeria to Senegal, estimated daily per capita protein consumption averaged only 52.5 grams, approximately 25 percent less than the recommended daily per capita requirement for this region. Estimated protein consumption in Sierra Leone was below the group average with 49.2 grams per capita per day [FAO, 1971-a]. Although such estimates may easily underestimate actual consumption as certain indigenous sources of protein are less frequently reported, the need for an improved protein supply is evident. However in this same region, fisheries supply nearly nine percent of total protein consumed which is more than double the share of world protein consumption contributed by fisheries.

Efforts to develop inexpensive protein from alternative animal and vegetable sources have met with limited success in developing countries. Poultry and eggs are frequently noted by nutritionists as the panacea for protein deficient diets in developing countries. Modern poultry farms on the outskirts of the capital city may be found in almost any developing country. While many such firms are able to survive on the high incomes of urban consumers, the masses of the population do not have the effective demand to purchase eggs and poultry products.[1]

Cattle and other ruminant animals, while capable of utilizing material nondigestible by humans, are restricted geographically because of climate, disease, and pests. Tsetse fly and the threat of sleeping sickness have limited cattle production in Sierra Leone to the northern regions.

Cereals and legumes account for over 81 percent of the total protein intake in Sierra Leone [FAO, 1971-a]. In spite of the large variety of vegetables grown only a few such as groundnuts, cowpeas, and beans supply the vital amino acids (such as lysine) found in animal proteins [Billings, 1971].

Sierra Leone looks to the sea as a major source of animal protein. Approximately 66 percent of all animal protein consumed in

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[1]For example in reviewing commercial egg schemes established by the Regional Government of Eastern Nigeria, Billings [1971] concludes that even with subsidized inputs (₦ 5,000,000 public investment) commercial eggs have failed to become the cheap food supply originally anticipated and are incapable of solving the protein problems of the masses.

Sierra Leone is derived from fish, the highest share in any West African coastal country [FAO, 1971-a]. Based on a nationwide survey of 250 rural households in Sierra Leone, Byerlee and King [1976] found that expenditures on fish and fish products ranked second only to rice in total consumption expenditures.

Although the government of Sierra Leone has placed high priority on developing its fishing subsector, there has been little real increase in domestic production since 1965[1] [FAO, 1974-a]. Sierra Leone remains dependent on fish imports to satisfy domestic demand. Using revised estimates of domestic fish landings of approximately 50,000 metric tons [Government of Sierra Leone, 1974-a] annual imports currently account for approximately 15 percent of total domestic fish supply. Table 1.1 shows that fish imports have constituted a drain in foreign exchange earnings of over 2.4 million dollars annually since 1969 of which 75 percent was expended for fresh chilled and frozen fish caught in offshore fishing grounds.

Several international trends in the supply and demand of fish for human and fish meal consumption directly affect development policies in Sierra Leone. First, there has been a decline in fish catches in European and Western countries over the past decade. The Asian and African catch increased steadily at an average annual rate of 6.0 and 5.4 percent respectively over the past decade. The world fish catch grew at approximately 4.4 percent annually from 1964-71, peaked at 70 million metric tons in 1970-71 and has since declined at

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[1]A 67 percent increase in 1972-73 production figures over previous levels was a function of revised estimating procedures rather than increased production.

TABLE 1.1
SIERRA LEONE: QUANTITY AND VALUE OF FISH IMPORTS, 1969-74

Commodity	Weight in Metric Tons							Value in Thousand U.S. Dollars					
	1969	1970	1971	1972	1973	1974	1975	1969	1970	1971	1972	1973	1974
Fish: Preparations, tinned and preserved	1,638	710	1,242	962	n.a.	n.a.	n.a.	739	406	723	562	n.a.	n.a.
Fish: Fresh, chilled, and frozen	9,576	11,470	9,702	5,831	9,563	5,980	5,233	2,081	2,080	1,950	1,305	n.a.	n.a.
Total	11,214	12,180	10,944	6,793	n.a.	n.a.	n.a.	2,820	2,486	2,673	1,867	n.a.	n.a.

SOURCE: Prepared by author: 1969-1972 figures from [United Nations, 1974]; 1973-1975 figures are adjusted from accounts of the largest frozen fish import firm which accounted for 88 percent of all fresh and frozen imports over the 1969-1972 period.

NOTE: n.a. means not available.

approximately 3.2 percent annually over the 1971-73 period. The decline since 1970 has been primarily a function of reduced catches by both North and South American fleets [1975]. Not only did the Peruvean anchovy industry, which in recent years supplied nearly two-thirds of exports of world fish meal, experience a near collapse in the early 1970s, but catches in the North Atlantic have also declined through 1974. Major producers such as the U.K., Norway, Portugal, Japan and Canada all experienced declining catches in 1974 [FAO, 1975].

Brown and Eckholm [1974] note that as developed countries exhaust the resources of northern fisheries, they have turned increasingly to the southern areas. They see more intense international competition in such regions as the Indian Ocean and the South Atlantic as inevitable. Such predictions are borne out as one looks at recent trends in fish catches in the East-central Atlantic. The catches made by long distance foreign fleets along the Atlantic coast of Africa have been increasing faster than the catch of the African coastal countries. Although locally based fleets in the East-central Atlantic accounted for 86 percent of the total catch in this area in 1958, this percentage declined to 33 percent by 1972 [FAO, 1974-b]. Aubray [1972] observes that "there has been a spectacular increase during the decade of 1960-70 of more than 500 percent in the catch by the non-African based fleets operating mostly over and at the edge of the West African continental shelf . . . while the total African catch increased only by about 80 percent during the same period."

The estimated stock of marketable species in territorial waters of Sierra Leone seems ample to sustain expanded fish production in the future. One effort to assess the fisheries resources along the West African Coast was the Guinean Trawling Survey of 1964 [Williams, 1969]. This survey estimated a total standing stock in territorial waters of 113,000 metric tons in the 15-50 meter depths and an additional 34,000 metric tons in the 50-200 meter depths, nearly all of which are demersal (bottom) species. Because trawler equipment was used, these estimates tend to underestimate the stock of inshore pelagic (surface water) species. Other official sources estimate pelagic fish stocks at approximately 300,000 metric tons. The estimates of sustainable harvest of demersal and pelagic stocks combined range from 100 to 140 thousand metric tons annually, compared to current annual catches of approximately 50 thousand metric tons [Government of Sierra Leone, 1974-b]. In addition, Aubray [1971] points out that as long as Easterly flowing Guinea currents provide abundant larvae from unexploited populations north of Sierra Leone for local rearing grounds, high rates of fisheries exploitation can be pursued without depleting local stocks. The evidence indicates that the potential sustainable harvest of fish is approximately two to three times the present rate of harvest by Sierra Leone [Government of Sierra Leone, 1974-b].

The Government of Sierra Leone, after considering the domestic demand for fish, the cost of foreign imports, and the level of domestic fish stocks, has established ambitious goals for the fisheries sub-sector. During the current five year development plan, 1974-75 to 1978-79, government planners hope to implement investment programs and policies to expand production by an annual rate of 14.1 percent [Government of Sierra Leone, 1974-b]. Self-sufficiency in fish is expected within the planning period.

Government policy makers have a choice between several alternative strategies which could aid in achieving their production goals. The strategy of developing the large-scale fish industry and associated frozen-fish marketing channel has historically appealed to planners. It is frequently easier to obtain external financing and to administer credit and control operations in large-scale schemes than in small-scale fisheries. Small-scale fisheries development is another alternative. The stimulation of either large or small-scale fishing could be encouraged (1) through direct public investment and ownership, (2) by encouraging domestic and/or foreign private investment through direct public subsidy, or (3) through indirect public support through adjustments in import duties and quotas.

More specifically, policy makers are faced with an array of alternative technologies in small and large-scale production as well as various credit and extension programs. Present technologies range from (1) the one-man "kroo" canoe with accompanying cast net or hook and line gear to (2) the standard bonga canoe fishing for demersal species with bottom nets to (3) the large "salla" or even larger "fante" boat complete with outboard engine and ring net up to (4) the large-scale diesel powered vessels operating a bottom or midway trawl.

Credit and extension programs include (1) the present program which relies on the local trader for borrowed capital and an indigenous apprenticeship program for passing on traditional skills to (2) the possibility of allowing commercial banks to increase their discount rates to cover the added cost of loan servicing in remote areas to (3) the reestablishment of a direct publicly-subsidized credit scheme and regional extension outstations with an active program for village level extension.

Research on fisheries in West Africa has focused primarily on (a) biological-technical research which has examined isolated technological improvements and (b) historical analyses of Government programs. To date there are few if any micro-economic studies of small-scale fisheries in tropical Africa in spite of the frequent complaint of the lack of micro-economic data for policy analysis. Lawson and Kwei [1974] review Ghana's experience with developing the fisheries subsectors through (1) the Charter Party Scheme which was initiated in 1953 to break the grip of the traditional money lender over small-scale fish production and marketing and also to assist small-scale fishermen through motorized vessels and (2) establishment of the State Fishing Corporation to operate large-scale trawlers in order to eliminate the importation of fish. In their review of these two programs they provide data on the growth in aggregate output and employment. However, in the fisheries subsector they fail to detail the financial and economic costs and benefits of large-scale versus small-scale fisheries.

Kuranchie [1972] examines the smoke processing practices of Tema, Ghana based on a small sample of one-time interviews. Although his analyses do provide cost estimates of smoke processing and distribution, he examines the industry at only one point in the season, one locality, and one processing technique. His analysis of distributional costs is based on one processing-distribution channel instead of examining the entire integrated production-processing-delivery system or the seasonality of activities over the production cycle.

Other research efforts have been largely of a biological or technical nature. In Sierra Leone the United Nations Development Program undertook a series of biological and stock assessment investigations in coastal waters in the late 1960s [FAO/UNDP, 1968] [Williams, 1969]. Their findings are essential in planning fisheries investment and exploitation in the future. However, to date little economic data has been collected in Sierra Leone other than basic aggregate statistics on total fish catch.

In summary, the few economic studies on fishing in West Africa to date have been deficient both in terms of quantity of economic data generated and in terms of breadth of scope of the studies. Moreover, these studies have failed to provide policy makers with a solid microeconomic understanding of the operation of the industry and have failed to provide data on the alternative production, processing and marketing technologies and the costs and benefits of these alternative development strategies.

1.2 Objectives of the Study

In evaluating the current system and defining its inadequacies, relevant performance goals or criteria need to be clarified. The quantity and quality of fish produced and delivered is an important consideration. A system which is technologically progressive and economically efficient in its use of scarce resources is a second important governmental goal. Other important criteria are the level and distribution of income and employment for those who participate in the production-delivery process.

This thesis focuses on the issues involved in improving the production-delivery system of marine fish[1] as a source of animal protein for Sierra Leonean consumers. Fresh-water fisheries which currently contribute approximately 2 percent of the annual domestic catch will not be considered.[2]

The objectives of this research fall into several general areas:

(1) To provide a micro-economic description of the fish production, processing and marketing system in Sierra Leone;

(2) To identify the barriers to improved performance of the fisheries subsector with emphasis on the constraints in the production-delivery system;

(3) To develop an aggregate model integrating the production, processing, and marketing industries;

(4) Through the execution of their model, to examine the aggregate impact of policies affecting marine fisheries production such as (a) improved credit, (b) manpower training and extension programs, and (c) alternative import policies for capital equipment and frozen fish imports;

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[1]Marine fish are defined as those species living in the high salinity sea water as opposed to fresh-water fish which inhabit the low salinity waters of inland rivers and lakes.

[2]Although official estimates place output of fresh-water fisheries at about 1,000 metric tons annually, it is generally believed to be considerably more.

(5) And to provide policy makers with relevant data and alternative strategies for improving marine fisheries in Sierra Leone.

1.3 Outline of this Thesis

In examining the fisheries subsector as an integrated production-delivery system, Chapter 2 will focus on a description of fisheries in the Sierra Leone economy. The structure of the small and large-scale production industries will be described in detail in Chapter 2 followed by a review of governmental policies affecting fisheries during the colonial and post-independence periods. Chapter 3 presents the methodology used in collecting primary data. Chapter 4 will provide a micro-economic analysis of the small and large-scale production industries. Beginning with a brief description of the socio-cultural framework in which the small-scale firm operates, Chapter 4 examines in detail the use of labor, working capital and equipment capital as well as the resultant seasonal output of various small-scale production technologies. The concluding sections of Chapter 4 combine these analyses to form representative firm budgets under alternative assumptions about capital cost and equipment duty. These are compared with budgets for large-scale firms.

A descriptive analysis of the processing-marketing system will introduce Chapter 5. Budgets presenting the costs and returns to resources used in smoke processing, smoke fresh fish wholesaling as well as raw frozen fish wholesaling will also be compared in Chapter 5 identifying major items of expense and areas of high returns. Chapter 6 will develop an aggregate model, integrating the results of Chapter 4 and 5. This model will be used to examine the effects of alternative development strategies on resource use and output produced over the 1974-1980 period. The final Chapter summarizes the major findings and discusses policy implications.

CHAPTER 2

FISHERIES IN THE SIERRA LEONE ECONOMY

2.1 Economic Contributions of Fisheries

Sierra Leone has an area of 27,900 square miles and a population of about 2.7 million, of which 22 percent live in urban centers. Over 75 percent of the population are employed in agriculture which is the most important sector, contributing over 30 percent of the total Gross Domestic Product and 20 percent of domestic exports. Fisheries, one of four agricultural subsectors, contributed about one percent of the Gross Domestic Product in 1972. This relative contribution has declined from a previous peak of about 2.2 percent in 1968 [Government of Sierra Leone, 1973-a]. In terms of employment, an estimated 12,000 people or 1 percent of the national labor force derive income from fish production industries [Propesca, 1974]. An additional 12,000 are employed in ancillary industries supplying inputs, processing and delivering output to consumption centers.

2.2 Descriptive Profile of the Subsector

The fisheries subsector can be clearly divided into two structurally distinct industries: (1) the small-scale fisheries production and smoked fish marketing channels and (2) the large-scale fisheries production and associated marketing channels. For the purpose of this study, small-scale fisheries are defined as all fishing firms with less than Le20,000 invested in equipment when valued at original acquisition cost. These firms are usually owned by a single family. Currently small-scale firms operate boats of indigenous plank or dugout construction without the use of inboard (built-in) engines and are based at a marine or estuarine beach landing site. Large-scale firms include any firm having more than Le20,000 invested in the original acquisition cost of equipment. These firms are usually managed by a partnership or joint venture public corporation. They operate vessels licensed for fishing by the Government of Sierra Leone. These vessels are powered by inboard engines.

2.2.1 Large-Scale Production-Delivery System

Forty-four large-scale fishing vessels possessed valid licenses from the Ministry of Agriculture and Natural Resources for fishing in Sierra Leone territorial waters (within 200 miles from shore) during the January-June period, 1975 [Government of Sierra Leone, 1975-a]. Thirty-three of the 44 vessels were foreign owned but chartered by locally based firms which operated as servicing, cold-storage transhipment depots for the foreign vessels.[1] A portion of the chartered catch was purchased and imported by the local firm by payment in foreign currency. A total of 11 of the 44 boats were registered as "owned" rather than "chartered" by local companies.[2] Chartered vessels

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[1] Twenty chartered vessels were contracted by a single firm and were engaged in shrimp trawling only. The thirteen remaining vessels active in demersal or pelagic fishing were chartered by four firms with their relative shares being 69%, 15%, 8% and 8% respectively.

[2] These eleven vessels were owned by five companies as follows: two firms owning four vessels each and three firms owning one vessel each.

are not included in the present study. All large-scale firms were based in Freetown.

Large-scale production equipment consists primarily of vessels of steel construction and a purse seine (nylon encircling net) or a midwater or bottom trawl (conical bag net). Steel constructed trawlers vary in size from 60 to over 200 ft., although boats in the 60-80 ft. range are most popular. They are powered by inboard diesel engines. One firm is constructing two 40 foot vessels of local wood but all other vessels are imported. Each trawler has one full time skilled captain and an unskilled support staff on board and ashore of approximately 25-30 men for a 60-80 foot vessel and 40-45 men for a 100-120 foot vessel. The size of the support staff varies with the size of vessels and type of equipment on board.

Processing of the catch from large-scale vessels "owned" by local firms begins with ice chilling immediately after capture. The catch is sorted by species and size and placed in wooden boxes of 10-13 kilogram capacity interlayered with ice which has been purchased before going to sea. The catch is landed during the night and sold to wholesalers or retailers the following morning. A majority of the catch is immediately taken to Freetown markets before being gutted and sectioned for retailing. Wholesalers from nearby inland markets are known to have chartered half ton lorries and after re-icing the fish and insulating them with burlap bags, delivered them as fresh fish to markets inland. This, however, accounts for a minor fraction of the catch.

Landings from the chartered vessels are usually ungutted, packaged and frozen on board the foreign vessel in 20-30 Kg cartons.

Importation of these chartered landings is highly concentrated with one firm accounting for 88 percent of all fresh and frozen imports over the 1969-72 period. Frozen imports were marketed by the same firm through an exclusive chain of wholesale cold storage depots in 11 inland centers. The remaining 12 percent of fresh and frozen imports was shared by four smaller firms dealing with fresh or ice-chilled fish only.

2.2.2 Small-Scale Production-Delivery System

A base line survey conducted by the Government Fisheries Division in 1974 identified a total of 6,150 small-scale boats or approximately 5,000 firms operating from 554 marine and estuarine landing sites scattered along the 205 mile coastline [Government of Sierra Leone, 1974-a]. Each firm employs three major pieces of equipment--the boat, the net or line and the propulsion equipment--which vary with the size and type of technology used. Table 2.1 describes the types of boats currently used in small-scale production. All boats are made of indigenous hardwoods by local builders. The fante boat due to its size and type of construction is capable of traveling considerable distances at sea. The open boxed well which houses the outboard engine, protects the engine from the direct impact of waves and permits better operation in adverse weather conditions than does the salla boat. The smaller boats such as salla and especially the standard canoe are more restricted as to the distance at sea and the weather conditions under which they operate.

The geographical distribution of the various boat types is shown in Table 2.2. Figure 2.1 shows the various provinces and their

TABLE 2.1
CHARACTERISTICS OF SMALL-SCALE BOAT TECHNOLOGY IN SIERRA LEONE

Boat Type	Type of Construction	Length (ft.)	Width[a] (ft.)	Type of Propulsion Used	Type of Net Used	Crew Size
Fante	Plank	35-50	5-8	Outboard	Ring	6-8
Salla	Plank	25-40	4-6	Outboard or paddle	Ring or beach seine	4-6
Standard canoe	Dugout and plank	20-24	1.5-2.5	Sail or paddle	Ring, set or drift	1-5
Kroo canoe	Dugout	16-20	1.4	Paddle	Cast or hook and line	1-2

SOURCE: Observation by the author.

[a]Width measured as widest point of top surface.

TABLE 2.2
GEOGRAPHICAL DISTRIBUTION OF SMALL-SCALE FISHING BOATS IN SIERRA LEONE

Region	Type of Boat								
	Fante Boat			Salla Boat			Standard Canoe		
	Approximate Number of Boats	Percentage of Total Boats in Province	Percentage of Total Fante Boats in Nation	Approximate Number of Boats	Percentage of Total Boats in Province	Percentage of Total Salla Boats in Nation	Approximate Number of Boats	Percentage of Total Boats in Province	Percentage of Total Standard Canoes in Nation
Northern Province	120	5.0%	44%	384	16%	71%	1,821	75%	36%
Western Area[a]	69	4.5%	25%	138	9%	25%	1,281	83%	25%
Southern Province	86	4.0%	31%	22	1%	4%	1,995	92%	39%
Sierra Leone	275	4.5%	100%	544	9%	100%	5,097	83%	100%

Region	Kroo Canoe			Total of All Types		
	Approximate Number of Boats	Percentage of Total Boats in Province	Percentage of Total "Kroo" Canoes in Nation	Approximate Number of Boats	Percentage of Total Boats	Boats Per Mile Coastline
Northern Province	96	4.0%	40%	2,421	40%	48
Western Area[a]	62	3.5%	25%	1,550	25%	44
Southern Province	76	3.0%	35%	2,179	35%	18
Sierra Leone	234	3.5%	100%	6,150	100%	30

SOURCES: Regional totals [Government of Sierra Leone, 1974-a] and breakdown by boat type [Government of Sierra Leone, 1974-c].

[a]Breakdown by boat type for Western Area are based on national average as only total number of boats was available.

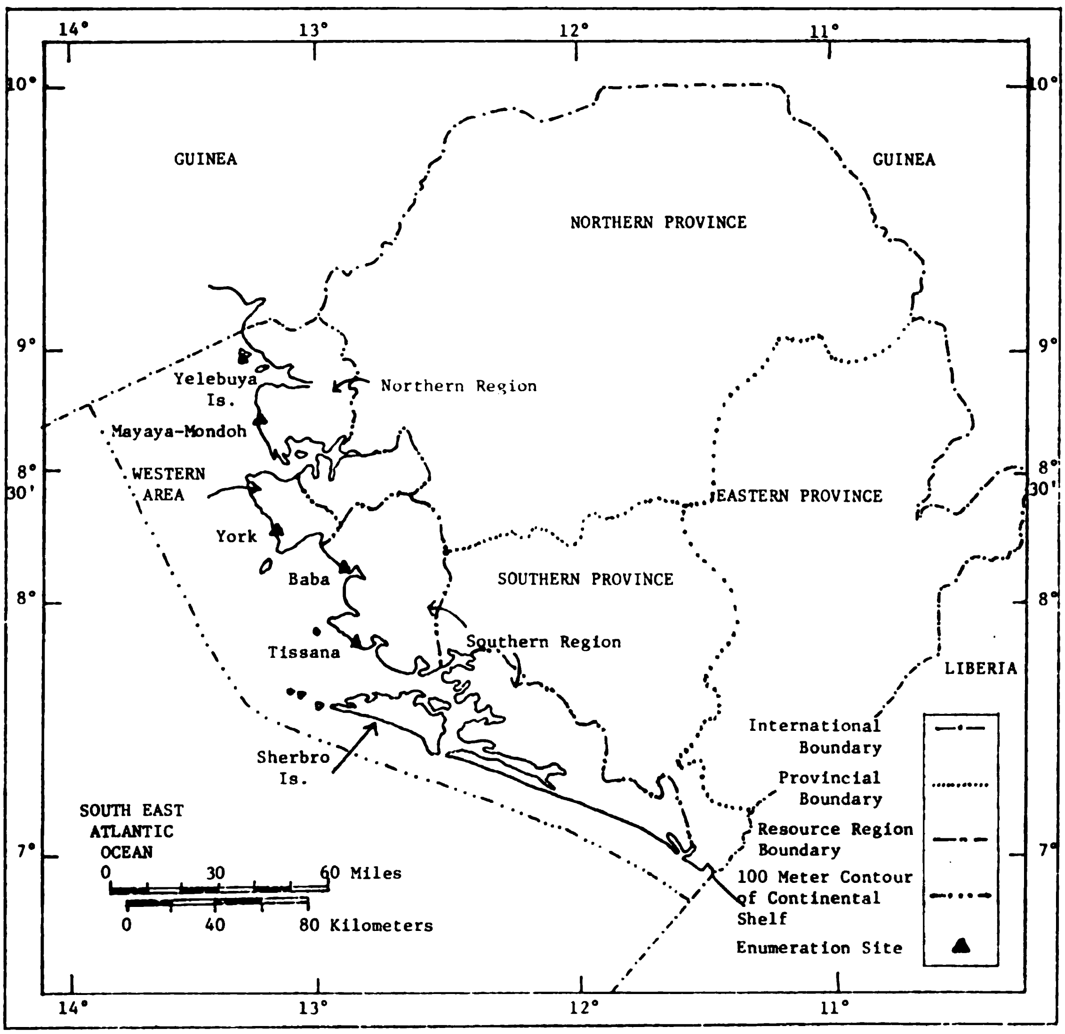

FIGURE 2.1
SIERRA LEONE MARINE FISHERIES PRODUCTION ENUMERATION SITES

associated regions of continental shelf. The standard canoe is by far the most popular boat accounting for 83 percent of all boats. Northern Province contains a larger share of the more modern, plank-built salla and fante boats than either of the other regions. The absence of the snapper boat which was popular 30 years ago [Stevens, 1945] is striking.[1] This boat which stayed at sea for a five to seven day period before landing was capable of carrying a crew of four to six men plus fuel for smoke processing the catch. It was propelled by paddle and sail. Apparently it has largely been replaced by longer, narrower motorized boats capable of quickly delivering the raw catch ashore.

The Northern Province and Western Area both benefit from a wide area of continental shelf within the 100 meter depth contour as shown in Figure 2.1. This explains why Northern Province and Western Area have the highest concentration of producing units per mile of coastline, more than double that of Southern Province.

Table 2.3 describes the various types of nets. The ring, set, drift and cast nets capture the fish by entangling the fish in the net as it attempts to pass through. However, the beach seine guides fish along two outstretched wings toward a central conical bag. The beach seine is pulled ashore by two groups of eighteen to twenty men on the beach.

Propulsion equipment for small-scale fisheries includes the outboard engine, sail or paddle. A boat usually carries several sets

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[1]Western Area, for which detailed data on boat type was not available, might have contained some snapper boats. In the random sample of 110 boats described in Chapter 3 only one snapper boat was identified.

TABLE 2.3
DESCRIPTION OF SMALL-SCALE NET TECHNOLOGY

Net Type	Position in Water	Mobility in Water	Method of Capture	Length (Fathoms)[a]	Width (Fathoms)[a]	Approximate Mesh Size (Inches)
Ring net	Surface	Free floating	Encirclement	200-600	3-12	1.5
Set net	Bottom	Anchored	Straight line perpendicular to current	150-600	1-4	3.5-5.0
Drift net	Surface	Free floating	Straight line perpendicular to current	150-600	1-4	1.5
Beach seine	Surface	Drawn from shore	Encircles in semi-circle	100 fathoms per wing	4-8	2.0 in wings/ 1.0 in central bag
Cast net	Surface	Sinking	Thrown over from above	Conical of 24-30 feet diameter	Conical of 24-30 feet diameter	1.0
Hook and line	Varied	Anchored to fish-erman or buoy	Hooked with bait	--	--	1-4 inch hooks

[a]Fathom equals approximately six feet.

of wooden paddles as a precautionary measure although other types of propulsion may be used. Outboard engines vary from six to twenty-five horsepower. Although many different brands (i.e., Mercury, Johnson, Chrysler, etc.) are sold, Japanese brands dominate the market. Because of the non-interchangeability of parts, each brand is serviced by its own franchised retailer. Sails are usually sewn by local tailors from flour sacks or imported tarpaulin. Wooden paddles are approximately six to eight inches in width with a two to three foot handle. They are carved locally by fishermen or carpenters.

Processing of the fish catch for the small-scale industry usually consists of hot-smoking the fish immediately after landing for a period of four to six hours. If the processor (usually the producer's wife) is not assured of an immediate sale to a wholesaler, the fish are turned and smoked for an additional two to three hours before storing. Smoking is done on a raised platform (banda) about two to three feet above the ground and usually covered with a heavy wire mesh. The platform size varies from twenty-four square feet to several hundred square feet depending on the size of the fishing operation, estimated yield, and availability of labor to do the processing.

Wholesalers from inland markets develop informal buying relationships with fish producers and processors. If no wholesaler is available, the processor may undertake the wholesaling activity. A detailed description of the wholesaling-retailing industry will follow in Chapter 5.

2.3 Trends in Domestic Supply and Demand for Fish

2.3.1 Supply Conditions

A degree of caution is advisable in interpreting domestic catch statistics as secondary data on fish production are weak and fraught with inconsistencies. Estimated trends in fish catch are shown in Table 2.4. The sharp reduction in the small-scale marine catch in 1968 and its gradual recovery in 1969-70 was due to the expulsion of some 1,700 Ghanian fishermen in early 1968 and their gradual replacement by local entrepreneurs. At the same time the number of trawlers based in Freetown declined and as a result the harvest of the large-scale industry fell.

Pelagic (surface feeding) species comprise about 65 percent of the total marine catch while demersal (bottom feeding) species account for the remaining 35 percent [Shorunkeh-Sawyer, 1975]. Table 2.5 shows the relative importance of major species. For a detailed description of major species and their respective average weights, see Appendix 1. The geographical origin of the domestic catch appears to be highly concentrated in the Northern Region due to (1) the wide continental shelf along the coast and the (2) relatively dense fish stocks.

TABLE 2.4
ESTIMATED SIERRA LEONE FISH CATCH
FROM FRESH-WATER AND MARINE SOURCES, 1965-1973
(IN THOUSAND METRIC TONS)

Source	Year								
	1965	1966	1967	1968	1969	1970	1971	1972	1973
I Fresh-water fisheries	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
II Marine fisheries									
Small-scale marine	29.8	29.0	30.7	20.8	21.5	26.8	27.3	46.8[a]	47.4
Large-scale marine	1.8	2.2	1.9	1.7	3.0	2.8	2.3	3.2	2.9
Total domestic catch	32.6	32.2	33.6	23.5	25.5	30.6	30.6	51.0	51.3

SOURCES: Fresh-water and small-scale marine fisheries: [Government of Sierra Leone, 1974-b]. Large-scale marine fisheries: years 1965-1968 [FAO, 1976]; years 1969-1973 [Government of Sierra Leone, 1975-b]. Total domestic catch: [FAO, 1974-a].

[a]The sharp increase in 1972-1973 production figures was due to revised estimating procedures by the Government of Sierra Leone.

TABLE 2.5
ESTIMATED COMPOSITION OF FISH CATCH BY SPECIES

Species	Type	Percentage of Total Domestic Marine Catch
Bonga	pelagic	52
Herring	pelagic	10
Ladyfish	demersal	7
Butterfish	demersal	6
Shinenose	demersal	6
Sheephead	demersal	5
Gwangua	demersal	2
Other		12
Total		100

SOURCES: Pelagic Species [Government of Sierra Leone, 1975-b], Demersal Species [Williams, 1965].

Table 2.6 reveals a total area of continental shelf about one third the size of the national land mass or 8,500 square miles which is within the reach of most trawl, purse, and ring net technologies. Eighty-two percent of the continental shelf area is concentrated along the northern coastal front.

Perhaps the most detailed assessment of fisheries resources along the West African coast was the Guinean Trawling Survey of 1964 by FAO/UNDP [Williams, 1969]. Based on one-hour trawls at eight depths ranging from 15 to 600 meters deep outward from the coast at sites forty miles apart along the coast, the estimated live weight of fish per mile of coastal front is shown in Table 2.7. Because trawl nets were used, these estimates tend to underestimate the stock of inshore

TABLE 2.6
APPROXIMATE AREA OF CONTINENTAL SHELF AT VARIOUS DEPTHS
WITHIN SIERRA LEONE TERRITORIAL WATERS

Geographical Region	Depth			
	15-50 Meter		50-200 Meter	
	Nautical Square Miles Per Mile Coastal Front	Total Nautical Square Miles Per Region	Nautical Square Miles Per Mile Coastal Front	Total Nautical Square Miles Per Region
Sherbo north to Guinea border	46.5	5,441	12.9	1,509
Sherbo south to Liberian border	6.2	546	11.0	968
Average	29.2	5,987	12.1	2,477

SOURCE: Adapted from [Williams, 1969].

TABLE 2.7
SIERRA LEONEAN COAST: ESTIMATED WEIGHT OF STANDING CROP (TOTAL LIVE WEIGHT OF FISH) IN METRIC TONS AT VARIOUS DEPTHS PER MILE OF COASTAL FRONT

Geographical Region	Depth	
	15-50 meters	50-200 meters
Sherbro Island to Guinea	900 m. ton (82% demersal species)	191 m.t. (93% demersal)
Sherbro Island to Liberia	10 m. ton (44% demersal species)	135 m.t. (85% demersal)

SOURCE: Calculated from data presented by Williams [1969].

pelagic species. Eighty-three percent of the total standing crop is estimated to be found in the northern area between Sherbro Island and the Guinean border.

2.3.2 Demand Conditions

Annual per capita consumption estimates range from 24.3 lbs. in 1971 [Government of Sierra Leone, 1973] to 38.1 for the same year [FAO, 1971-b] reflecting the uncertain estimates of domestic catch and population statistics. Based on revised 1973 production figures of 51,300 m. tons [FAO, 1974-a], plus fish imports of 5,980 m. tons (Table 1.1), and an average population growth rate of 2.3 percent annually since the 1964 census, per capita consumption in 1974 was calculated as approximately 46.17 lbs. This agrees closely with a 1974 per capita total of 54,659 metric tons accounted for out of a total supply estimate (domestic catch plus import) of about 57,280 metric tons. This is reasonably close if one assumes a one percent spoilage rate by weight of raw marine catch before it enters the market and that much of the fresh water inland catch is consumed directly without entering the market.

Effective demand for fish varies between different geographical regions in the country and between rural and urban populations in the same region depending on income level, availability of substitute goods, taste, etc. as shown in Table 2.8.

It is evident from Table 2.8 that per capita consumption in Western Area is approximately six times the average per capita consumption in the three provinces. This appears reasonable since the Western Area has more direct access to the sea, a higher average income per capita and has a greater distance from the supply regions of other substitute goods, particularly beef, than have most of the provinces. However subsistence consumption which was not included in Table 2.8 would tend to be slightly higher in the rural areas of the provinces than in Western Area.

Urban per capita fish consumption is significantly higher than rural consumption because per capita incomes are higher in the urban centers and rural consumers rely to a greater extent on subsistence production of bush meat and fresh-water fish than on purchased fish products.

The domestic demand for fish is estimated by the current Five Year Plan to grow at a rate of 5.9 percent per annum over the 1974-79 planning period, assuming (a) a population growth rate of 2.6 percent per annum, (b) increases in per capita income of 3.6 percent,[1] and

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[1]The 3.6 percent rate of growth in per capita income appears to be optimistic considering the historical rate of 2.1 percent over the past decade.

TABLE 2.8

ESTIMATED MARINE FISH CONSUMPTION IN SIERRA LEONE, 1974

Region	Urban			Rural			Total			Total Per Capita Consumption Index
	Pounds Per Capita	Estimated Population ('000)	Total Metric Tons	Pounds Per Capita	Estimated Population ('000)	Total Metric Tons	Pounds Per Capita	Estimated Population ('000)	Total Metric Tons	
Northern Province	47.09	126.2	2,701	25.36	1,102.2	12,704	27.59	1,228.4	15,405	1.00[b]
Southern Province	45.97	92.8	1,939	30.38	473.6	6,541	32.94	566.4	8,480	1.19
Eastern Province	43.14	204.1	4,002	21.23	466.2	4,498	27.90	670.3	8,500	1.01
Western Area	165.24	274.0	20,580	93.17[a]	40.0	1,694	156.06	314.0	22,274	5.66
Sierra Leone	92.24	697.0	29,222	27.16	2,082.0	26,748	43.26	2,779.1	54,659	--

[a]Rural Western Area per capita consumption computed as 56% of urban Western Area per capita consumption based on the average rural-urban difference in per capita consumption in other Provinces

[b]Base figure for Total Per Capita Consumption Index is 27.59 pounds per capita as shown for Northern Province

SOURCES: Urban consumption adapted from [Government of Sierra Leone, 1968] and [Government of Sierra Leone, 1971]; rural consumption adapted from[Byerlee and King, 1976].

(c) an income elasticity of demand for all fish of .9 during the period [Government of Sierra Leone, 1974-b]. This appears to be overestimated in light of income elasticities of .80 and .83 respectively in urban and rural Mauritius [Simons and Poleman, 1974] or .77 and .79 respectively in urban and rural Ghana [Lawson and Kwei, 1974]. Based on a 12 month national survey of consumption purchases in 250 randomly selected rural households in Sierra Leone, Byerlee and King [1976] found an expenditure elasticity of .74. This closely agrees with Snyder's estimate of an expenditure elasticity for fish in Freetown of .71 [Snyder, 1971]. Byerlee and King also found that fish purchases comprise approximately 11.8 percent of total cash expenditures in rural Sierra Leone.

Taking these findings into account, a more realistic estimate of growth in domestic demand for fish is about 5.0 percent per annum, based on a (a) population growth rate of 2.3 percent per annum, (b) increase in per capita income of 3.6 percent,[1] and (c) an income elasticity of demand for fish of about .74. This would underline the need to expand domestic production at least by five percent per year in order to prevent higher fish prices or increased dependence on foreign imports.

2.4 Role of Government in Fisheries Development

Public agencies have a long history of attempts to stimulate and direct fisheries development in Sierra Leone. Hornell [1928] undertook the first recorded survey of fisheries resources in Sierra

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[1]If growth in per capita incomes remains at its historical level of 2.1 percent, growth in domestic demand for fish would fall to about 4.0 percent per annum.

Leone coastal waters and being impressed with the fisheries development potential made specific recommendations to the Governor of Sierra Leone.

The disruption of trade during World War II reduced the availability of fish imports causing the colonial government to purchase, fit and operate the "Maid Honor," a 70 foot wooden ship designed to supply ice chilled fresh fish to the Freetown markets [Stevens, 1945]. In 1942 steam powered naval ships were detached from West African naval duties several days per month to operate trawls to relieve the shortage of wartime fish supplies in Freetown. This emphasis on promoting large-scale fishing schemes continued through much of the colonial period. Cotton twine and hooks were sold by permit only to bona fide fishermen through the Colonial Fisheries Development Officer, in a marginal attempt to stimulate small-scale production.

Following independence in 1961, the government launched a Fisheries Loan and Credit Scheme to facilitate increased small-scale production. One hundred and fourteen loans at four percent interest were made to individual fishermen for the purchase of outboard motors and fishing gear. By 1968 out of total disbursements of Le 102,527 only 14 percent had been repaid [Aubray, 1971].

A fisheries extension service was begun in the mid 1960s. Starting with one officer in 1967, the trained extension staff grew to seven officers in 1973. Also, a total of twenty-four staff members spent time abroad studying marine engineering, marine biology and marine mechanics [Government of Sierra Leone, 1975-b]. However, the limited extension capacity of Fisheries Division remains a major constraint on small-scale development. For example, an engine repair scheme was halted due to "extreme difficulty in obtaining spare parts" [Government of Sierra Leone, 1975-b]. An extension outstation in Southern Province was closed due to insufficient extension staff and development of the Shenge outstation was slowed down due to lack of materials and supplies. The failure of an attempt to introduce improved smoke processing at Shenge was attributed to the fishermen's preference to continue using the traditional system.

Even though the past record of developmental and extension activities of public agencies in fisheries have clearly had limited success in Sierra Leone and other West African coastal countries [Lawson and Kwei, 1974], frustrations with the current fish marketing system have led some to advocate replacing the current system with another quasi-public bureaucracy performing the required functions [Shorunkeh-Sawyer, 1975].

In 1968 some 1700 Ghanian small-scale fishermen who had settled in Sierra Leone in the mid 1950s were expelled. These skilled fishermen had introduced the ali-ring net, synthetic nylon cord, and outboard engines as well as the improved Ghanian-type fante boat. Local entrepreneurs quickly replaced the Ghanians as skilled fishermen.

The bias toward large-scale production, which was initiated by the colonial administrations and in other West African countries, is evident in current government policies in Sierra Leone. For example, while import duties on direct fish imports are only 10 percent of the purchase value, import duties for nets, motors, and other small-scale fishing equipment are 36 1/2 percent, the same rate that is applied to such semi-luxury goods as cosmetics, carpets, etc. However, firms importing equipment for large-scale trawlers can either (a) import the trawler duty free and pay 10 percent of the value of all landings of the trawler or (b) pay outright 10 percent of the purchase value of the equipment itself. In addition large-scale firms have received development certificates which grant such concessions as extended tax holidays, exemption from import duty on packaging material and fishing gear as well as reduced duty on trawlers, diesel fuel and lubricants.

In efforts to stimulate the current 1.6 percent per annum growth in the agricultural sector, agriculture's share of total public investment has increased from 8 percent in 1971-72 to 25.5 percent over the next five year planning period [Government of Sierra Leone, 1974-b]. The goals of the current five year development plan include a 14.1 percent annual growth rate in fisheries as compared with an average of 5.2 percent for the other three agricultural subsectors, and self-sufficiency in fish production in 1977 [Government of Sierra Leone, 1974-b]. However, only about 7 percent or Le 7.5 million of agriculture's share will be allocated for fisheries over the 1974-79 period. Moreover, Le 5.0 million of this (67 percent) is scheduled over the 1974-79 period for building of a fleet of 10 large-scale trawlers, 20 purse seiners, 4 deep sea trawlers and their associated port facilities. In contrast only Le .5 million (6.7 percent) is allocated to the development of small-scale fisheries.

2.5 Summary

Sierra Leone has two fish production systems: small-scale and large-scale. Current development policies tend to concentrate 67 percent of public fisheries investment in the large-scale trawling industry in Freetown which currently accounts for only six percent of total domestic catch. In contrast, the small-scale industry which consists of nearly 5,000 firms in rural coastal communities and produces over 92 percent of total domestic catch, is allocated less than seven percent of public fisheries investment over the 1974-79 planning period. A review of the past public policies indicates that the government of Sierra Leone has had limited success in stimulating fish output.

The demand for fish is expected to grow at approximately 5 percent annually over the next five years. Given the relatively small growth in fisheries output in recent years, such an increase in demand will result in shortages, higher fish prices, and increased fish imports unless a number of steps are taken to increase domestic fish production.

CHAPTER 3

SURVEY METHODOLOGY

3.1 Review of Methodology

Economic research in Asia and Africa has focused on agriculture and largely overlooked the fisheries subsector. Fisheries research has been primarily technical or biological in nature. The few studies of the economics of fisheries in developing countries have been primarily concerned with isolated technological innovations and feasibility studies for specific projects. Most of the economic studies of West African fisheries have focused on the catch per unit effort of some specific innovation. Several of the FAO/UNDP projects provide typical examples. Grasset [1972], a fishing gear technologist, compared an improved purse seine with the traditional fishing gear in Senegal from a technical efficiency point of view. He made 21 trips to sea at one location over a one month period and compared weight of catch per unit effort for both technologies. Although the catch per unit of fishing effort was highest for the improved purse seine, he did not include the cost and returns of the two techniques. Also, Grasset's research did not consider seasonality factors in making annual projections, and it did not take account of differences in life expectancies of capital equipment when evaluating alternative technologies.

The Government of Nigeria, in cooperation with the UNDP, undertook a fisheries survey of Western and Mid-Western regions of Nigeria from 1963 to 1968 in order to collect basic information on the factors determining the exploitation and utilization of fisheries resources [UNDP, 1969]. The survey was considered comprehensive because nearly all coastal villages were visited once. Based on this census survey of the size, number, and type of equipment used, it was concluded that there was a need for improved technology. No discussion of costs or returns to scarce factors of production was reported in the study.

In his analysis of fish processing in Ghana, Kuranchie [1973] interviewed 57 fish processors on a one-time basis over a period of six weeks and estimated seasonal purchased input costs and gross margins. No consideration was given to allocation of labor production and processing activities over the season. No assessment of fixed capital inputs was made. Based on single interviews of 16 fish smokers, Kuranchie [1972] estimated the costs and returns to fish smoking. He calculated seasonal labor inputs based on single estimates of hired labor costs per basin of herring extrapolated to cover the total seasonal catch.

Raymond Firth's economic-anthropological study [1966] on the east coast of Malaysia is one of the most complete micro-level fishery surveys available from developing countries. Firth collected quantitative economic data in a single fishing community on: (1) daily records of the value of catch from each of 20 fishing firms over a 6 month period, (2) a sample census of alternative enterprises such as rice and vegetable production, recording labor input and yield and (3) a general economic census of household labor and capital equipment stock in 331 households. While not covering a complete annual production period, Firth's data spotlight the seasonal variations in labor allocations and returns.

In summary, it is evident that economic research on fisheries in West Africa has been narrowly focused. It has frequently dealt with a given technology in isolation from alternative technologies. Studies have almost universally been short term in nature varying from single visit surveys to surveys lasting several weeks but never covering the production periods over the period of a year. Frequently the sample size has been drawn from one locality and has covered only one segment of the production-processing-delivery system. Since economic and financial costs of the resources used in alternative technologies were usually not computed it was almost impossible to provide sound policy guidance.

3.2 Purpose of the 1974-75 Survey of Sierra Leone Fisheries

Given the objectives as outlined previously, four interrelated surveys were designed to examine the Sierra Leone fisheries subsector as a complete production-delivery system. Each survey contained questionnaires dealing with specific aspects of the system. A small-scale production-processing survey was designed to examine the detailed operation of firms involved in small-scale fish production and the immediate processing of their catch. A survey of small-scale marketing was designed to follow the catch of small-scale producers through the network of wholesalers and retailers in order to estimate spoilage losses as well as the returns to factors supplied by the marketing firms. The cost-route method [Spencer, 1972] was used to obtain input-output data from firms over the entire year. The cost-route method relied on memory recall in order to generate data on the seasonality of the firm's operation in fishing and nonfishing enterprises.

Similar but less detailed data were also collected from large-scale production and frozen fish marketing firms.

3.3 Small-Scale Production-Marketing Surveys

3.3.1 Defining the Population

Since there are no records of the number of small-scale firms, the population of landing sites and boats was used as a proxy. The base line survey of the 1974 National Fisheries Survey identifies a total of 554 marine and estuarine landing sites with a total of 6,150 boats or canoes [Government of Sierra Leone, 1974-a]. This frame was further stratified into three production-marketing regions.

The first region was defined as the Western Area which is primarily a mountainous region with few commercial agricultural possibilities as alternative means of local employment. Because of its close proximity to Freetown, urban employment is an alternative to fisheries. This region contains an asphalt road system with twice daily public buses connecting it with urban retail markets. Western Area primarily supplies fresh and semi-smoked fish to the Freetown markets.

The Northern Region is defined as those land resource regions as identified by Mitra [1968] whose shore lines extend from the Sierra Leone River at Freetown north to the Guinea border. This region falls within the political boundary of Northern Province; including parts of Kambia and Port Loko districts. Fishery resource potential is high in the Northern Region partially due to its wide continental shelf (30-45 miles). The region is serviced by lateritic roads connecting it to inland markets. Daily launches provide direct transport to Freetown and to major ports on the Scarcies River.

The Southern Region consists of those coastal resource regions [Mitra, 1968] between Western Area on the north and the Liberian border on the south. It includes parts of Moyamba, Bonthe and Pujehun districts of Southern Province. It has a relatively narrow continental shelf (7-9 miles) and consequently fewer good landing sites due to the dangerously high surf. In summary, the Western Area had 108 landing sites, Northern Region had 233 sites and Southern Region had 213 sites.

3.3.2 Selecting the Sample

From the total population frame of 554 landing sites, major landing sites, having 20 or more boats based at that site, were identified. Ninety-five landing sites with an average of 37 boats per site qualified as major sites.[1] Five of the 95 major sites were randomly selected with a probability proportional to the number of boats based at each site. York Village was chosen from Western Area, Yelebuya Island of Samu Chiefdom and Mayaya-Mondoh of Kaffu-Bullom Chiefdom were chosen from Northern Region and Baba Barmot of Ribbi Chiefdom and Tissana Point of Kagboro Chiefdom were selected from Southern Region. Five sites were selected because it was assumed that 20 households could be identified at each site, and this could provide a significant share (2.5 percent) of the total population of firms.

A complete enumeration of all boat owners was undertaken at each site to record major fish and nonfish sources of income. If less than 50 boat owners were based at a site, all boat owners at an additional landing site nearest the selected site were also enumerated until 50 or

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[1]Northern Region contained 40 percent of the major sites, Southern Region contained 35 percent, while Western Area had only 25 percent of the major sites.

more boat owners were identified. From these boat owners, 20 owners were randomly selected at each site using a table of random numbers. An additional 5 boat owners were selected at each site for replacement purposes. The 110 selected boat owners and their households provided the basic sample for the small-scale production and processing surveys.

For the purposes of this survey, the household was defined as the boatowner and all persons with whom he shared proceeds in common. Tollens [1975] pointed out in the study of cotton farmers in Northern Zaire, that the household, when defined as a consuming unit [Spencer, 1972] [Norman, 1973] may be different in size than when it is defined as the producing unit because all members of the consuming unit may not contribute to the producing unit. In the narrow sense this is also true of fisheries in Sierra Leone, as some members of the consuming unit may never contribute directly to the fish production unit. However, when the household unit is defined as the total production unit for fish and nonfish enterprises this possible discrepancy disappears.

3.3.3 Description of Questionnaire Design[1]

Five questionnaires were designed for collecting data on small-scale fish production and processing and three questionnaires dealt with smoked fish marketing from the processor through the retail agent. Table 3.1 provides a summary of the basic procedures followed and the content of all questionnaires.

A household listing (FS-1) was administered to the entire population at each of the five selected landing sites. This questionnaire

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[1] See Appendix 2 for a description of the administration of the survey.

TABLE 3.1
DESCRIPTION OF QUESTIONNAIRES FOR MARINE FISHERIES SURVEY

Questionnaire Form Number	Name of Questionnaire	Sampling Procedure	Total Sample Size	Frequency of Interview	Contents of Questionnaire	Major Variables Derived from Questionnaire
FS-1	Fish household listing	1. Country divided into 3 coastal supply regions 2. 2 landing sites selected from each region on probability proporational to size based on the 1974 National Fisheries Survey 3. All boat owners listed at that site	5 landing sites	Once only	Name of boat owners based at the site--major fish and non-fish enterprises	Sample frame for FS-2, FS-3, etc.
FS-2	Household and stock	25 boat owners selected at each landing site	110 households	Once only	No.&charac. of H/H members stock of equip., livestock, & tree crops	Fishing and non-fishing capital and labor stocks
FS-3	Input output	25 boat owners selected at each landing site	110 households	Twice weekly for 9-12 months	Daily records of hrs. worked/mem./enterp./day inputs pur.,hired lab.,fish & non-fish output & sales,loans	Household income and its distribution; Seasonal labor profiles of fishing and non-fishing enterprise; Labor utilization and returns to labor; Returns to alternative production technologies
FS-4	Fish weights	One household selected randomly from households being interviewed for FS-2	5 households	Twice monthly	Fresh weight of of catch by type; Dry weights of catch by type; Amount of fuel used for drying; Hours dried	Conversion ratio fresh-dry species; Technical efficiency of drying fish on traditional Banda
FS-5	Transfer of information and change	50% of households selected for FS-2 in each site	55 households	Once only	Sociological characteristics of householder; Sources of transfer of information; Capital investments in last 10 years	Pattern for transfer of information; Long run growth patterns for individual enterprises; Extent of indebtedness and source of borrowing
FS-6	Smoked Fish Wholesale Marketing	As many of the wholesale fish traders purchasing on day of interview at a site as possible	10	Once only	Sociological characteristics of trader; purchasing practices and costs involved	Costs and returns to wholesale fish trader; Major constraints in wholesale smoked fish trading
FS-7	Smoked Fish Tracing	Selecting traders who cover the most popular market channels as revealed by FS-3	10	Only once	Detailed costs, time, spoilage and problems of fish wholesaling obtained by actually traveling with the trader and monitoring continually	Major constraints in wholesale fish trading; Returns to labor and capital in wholesale fish trading
FS-8 and MT-3	Smoked Fish Retail Marketing	As many fish retailers as possible who purchase fish from respondent in FS-7	57	Once only	Costs and revenue in fish retailing	Returns to labor and capital in retail smoked fish trading
	Large scale fish production	All the firms currently having trawlers licensed to operate in Sierra Leone waters	5	Once only	Capital investments; Output records; Operating costs and revenues	Returns to labor and capital in large scale trawling technologies
	Frozen Fish Wholesale Marketing	Major frozen fish wholesalers	1	Once Only	Capital investments; Output records; Operating costs and revenues	Returns to labor and capital in frozen fish wholesale trading

provided a listing of all boat owners at each site and the relative importance of fish production, processing and marketing enterprises in each fishing household.

The stock questionnaire (FS-2) was administered at the beginning of the survey to all selected households, i.e., the 20 randomly selected households at each site. This questionnaire recorded data on the household's family labor stock, fishing and nonfishing equipment stock, produce and supplies in store, as well as investments in livestock and economic tree crops.

The basic input-output questionnaire (FS-3) was administered twice weekly to each selected household continuously over a 9 to 10 month period between October 1974 to October 1975 depending on the enumeration site. This questionnaire yielded a daily record of the activities and transactions of the household firm, including hours worked in each enterprise by each household member and hired labor, all inputs purchased and output sold each day, daily catch or harvest record and its distribution by quantity eaten, processed and given away or paid to hired labor.

Fish weighings were made on a twice monthly basis (FS-4). Because of the amount of time involved in the administration of this questionnaire and the need to be present with the respondent at specific intervals throughout the day of interview, it was administered to one household only at each landing site, which was selected because of its proximity to the enumerator's dwelling. This questionnaire was designed to: (1) obtain data on the variation of fresh weights of different species caught throughout the year, and (2) evaluate the technical efficiency of drying fish on the traditional banda in terms of the wet-dry conversion ratio by species, labor and fuel inputs used, total drying time and capacity of equipment.

A general socioeconomic questionnire was administered by the author to 50 percent of the selected small-scale households at each site (FS-5), in order to obtain data on the socioeconomic relationships within the family and village and the process by which technical innovations were spread and adopted.

Since these structured questionnaires are not appropriate for eliciting qualitative information on "non-marginal" events which directly or indirectly affects the firm's operation [Vyas, 1974], a notebook issued to each enumerator proved particularly valuable as a record of qualitative information on community events. The enumerator recorded socio-religious practices of the fishing community, disastrous events affecting the firm such as fires, theft, court cases, and equipment repossessed by creditors.

Primary marketing channels serving selected landing sites were identified in the input-output questionnaire (FS-3) as the most frequently stated market destination of fish sales for that fishing village. Three marketing questionnaires were designed to enumerate costs and returns to resources employed in these channels. The wholesale fish marketing questionnaire (FS-6) was designed to obtain data on general purchasing practices and characteristics of traders from as large a sample of traders as possible during an interview day at the selected landing site. This was followed by a market-tracing questionnaire (FS-7) in which those traders covering the specific market channels of interest, were continuously monitored. An enumerator accompanied the trader enroute from the producer-processor to the wholesale fish market. Data detailing direct transport, lodging, and market costs as well as labor and equipment invested and breakage were recorded. Similar data on retailing practices and costs were obtained through a retailing questionnaire (MT-3 and FS-8) administered in the four major inland consumption centers. Figure 3.1 illustrates the primary marketing channels connecting production regions with the retail markets in Makeni, Koidu, Bo, and Freetown.

3.3.4 Quality of Data

Throughout the survey, several problems affected the enumerator's ability to collect accurate fishing data over a long period. Spencer [1972] considers the ability of the enumerator to speak the local language as a necessary condition to being accepted by the host community. However, in two fishing sites it appeared that the ethnic origin of the enumerator was also crucial. In two sites even though the enumerators could speak the local language, fishermen and local authorities reported that they preferred enumerators of common ethnicity as "being one of them" even though they did not originate from the immediate area. In the first case, the enumerator quit his position after two months data collection and was replaced by an enumerator of the same ethnicity as the respondents. In the second case, the situation was discovered shortly before the termination of the research, and the enumerator was allowed to complete his work.

Great difficulty was experienced in obtaining complete labor input data. Norman [1973], Spencer [1972], Tollens [1975], and others have cited the difficulty of estimating the hours of labor when most of the respondents did not possess watches. Muslim prayer periods and the

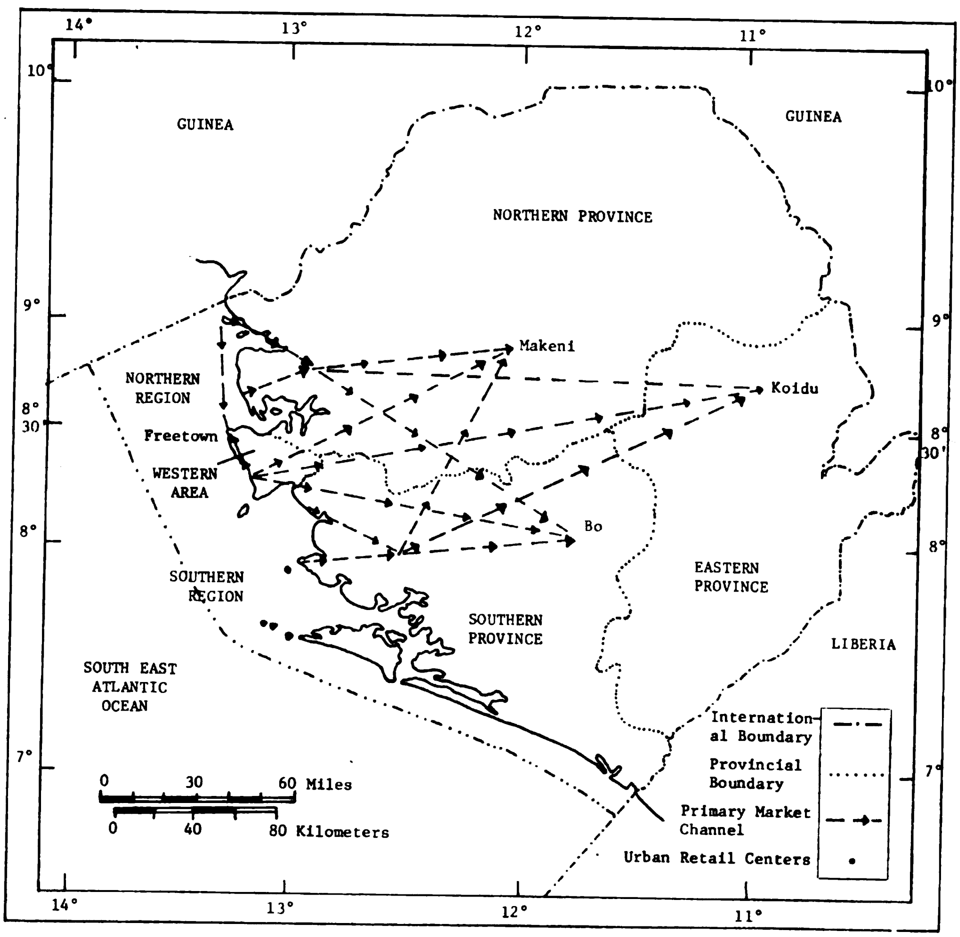

FIGURE 3.1
SIERRA LEONE: MAJOR MARKET CHANNELS BETWEEN PRODUCTION AND CONSUMPTION CENTERS

position of the sun were used in the present survey to help generate reliable labor data. In addition, when the boat owner moved his equipment and part of his family to better fishing grounds along the coast during certain seasons, it was impossible to secure a detailed breakdown of hourly labor input and the species caught. However, total person days spent by enterprise for the migratory labor was recorded.

Because of the lack of business records, enumerators relied on the recall of data by the respondent over a four-day period. However at one landing site the size of household was so large that the total recall of the activities of each household member resulted in long interviews. The total sample size was decreased and activities undertaken by a group of household members were recorded on a group basis rather than by individual members in order to facilitate the interview.

The measurement of fish output was particularly difficult because of the large quantities landed and the resultant time pressure to sell or process the fish quickly before putrifying. Traditionally the catch is measured in units of single count, dozens, or volume. However, the average weight per fish of a particular species reported in dozens is generally less than the average weight per fish reported in single units because the smaller fish are grouped into dozens for sale while the larger fish are sorted singly, usually bringing a higher price. Fish weighings had to be made species specific for single fish, dozen counts and four different volume measures. Over 40 different species were landed over the year, each varying in average weight. It was also noted that average weights of the same species varied from region to region. Consequently, weighings were made of 33 different major species specific for each region for each unit of measure. An average unit weight was calculated for the remaining minor species for each region.

No significant variation in average fish weight was noticed from season to season. FAO [1973] attributed this relative stability in modal fish size of pelagic species to a regular recruitment of young stock and a removal of older fish from the area as a result of fish migration or mortality.

3.4 Large-Scale Production-Marketing Surveys

As previously described, 44 large-scale fishing vessels possessed valid licenses from the Ministry of Agriculture and Natural Resources for fishing in Sierra Leone waters in June, 1975. A total of 11 of the 44 boats were registered as "owned" rather than chartered by local companies and were included in the study. The 33 chartered vessels were not included in the survey population as their catch is not considered domestic and much of it never enters the Sierra Leone market.

Because of the small number of large-scale vessels owned by five locally based firms, an attempt was made to include the entire populaton of firms in the sample. A questionnaire on large-scale production was designed for the purpose of recording total capital investments, fixed and variable operating costs as well as output and sales records of large-scale trawler firms. Letters of introduction were sent by Njala University College to the General Manager of each firm and interviews were conducted by the author with their chief accountant. Because of the dominance of expatriate private interests in the large scale industry, it was difficult to secure the cooperation of these firms.

Accurate input-output data were obtained for only three of the eleven vessels. Large-scale frozen fish wholesaling is conducted by a single joint-venture corporation and accurate data were obtained for this firm.

CHAPTER 4

MICROECONOMIC ANALYSES OF SMALL-SCALE FISH PRODUCTION

In this chapter the small-scale fish production firm will be examined in terms of the economic use of scarce resources by the firm and compared with large scale production firms. A description of the socio-cultural environment in which the firm operates will be discussed in Section 4.1. Section 4.2 will present the methodology and justification for grouping firms into nine representative firm types facilitating a linear programming model in Chapter 6. Sections 4.3 through 4.5 discuss the resource utilization of these nine firm types. The composition and seasonal distribution of output produced by each firm type is discussed in Section 4.6. Based on the result of Sections 4.3 through 4.6, representative firm budgets are developed in Section 4.7 which are then compared with similar budgets for large-scale firms in Section 4.8. Section 4.9 summarizes the major findings of the chapter.

4.1 The Socio-Cultural Environment

Five major ethnic groups populate the coastal regions of Sierra Leone. The Krio predominate in rural Western Area while the Temne and Susu dominate in the Northern Region and the Mende and Sherbro dominate in the southern coastal region. However, regardless of the dominant ethnicity of the coastal population, the Temne constitute the major ethnic group among the fishermen in each region.[1]

The accessibility of educational and medical facilities as well as other social amenities varied from village to village. Table 4.1 shows that primary education is easily accessible to the sample villages while secondary education and medical facilities are less accessible. Slightly more than half of the villages were accessible by vehicle year round. The majority of the villages which were inaccessible by vehicle were located in the southern coastal region where low-lying mangrove swamps greatly restrict land travel. However most villages had some contact with outside areas by means of either boat or vehicle on a daily basis. All the villages without daily transportation services were found in the Southern Region.

Along the Bullom Peninsula of Northern Region commercial agriculture provided important alternative means of employment. Onions, tomatoes, and other fresh vegetables as well as swamp rice produced in the region were readily marketable in Freetown. In other regions surveyed, subsistence agriculture was the most important alternative to fishing except in the Western Area where employment in Freetown was attractive because of its close proximity.

The cultural setting in which the small-scale firm operates varies considerably from region to region. Different cultural and ethnic beliefs generally prescribe what is the "accepted" practice in

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[1]Over the entire sample of small-scale firms, the ethnic origin of the head of each firm was as follows: Temne, 56 percent; Susu, 20 percent; Sherbro, 7 percent; other ethnic origins, 17 percent. Approximately 2 percent of the sample were Ghanian fishermen.

TABLE 4.1

SOCIAL AMENITIES FOUND IN FISHING VILLAGES BY REGION

	NORTHERN REGION		WESTERN AREA		SOUTHERN REGION		NATIONAL AVERAGE		
	No. of Villages	Average Distance to Facility (Miles)	No. of Villages	Average Distance to Facility (Miles)	No. of Villages	Average Distance to Facility (Miles)	No. of Villages	% of Sample Villages	Average Distance to Facility (Miles)
A. Primary School									
Present within Village	2		1		0		3	25%	
Not Present in Village	1	1	1	2	7	1.8	9	75%	1.7
B. Secondary School:									
Present within Village	0		0		0		0		
Not Present in Village	3	17.6	2	15	7	17.0	12	100%	16.8
C. Dispensary/Hospital:									
Present within Village	0		1		0		1	8%	
Not Present in Village	3	13.7	1	2	7	16.9	11	92%	14.7
D. Post Office:									
Present within Village	0		1		0		1	8%	
Not Present in Village	3	9.0	1	2	7	17.0	11	92%	13.5
E. Agricultural Instructor (MANR):									
Present within Village	0		0		0		0		
Not Present in Village	3	14.3	2	20	7	20.0	12	100%	18.6
F. Religious Mosque or Church									
Present within Village	3		2		3		8	67%	
Not present in Village	0		0		4	15.0	4	33%	15.0
G. Year Round Accessiblity by Road	2		2		4		8	67%	
H. Accessibility by Sea Only	1		0		3		4	33%	
I. Vehicle/Boat Transport Service:									
On Weekly Basis Only	0		0		7		7	58%	
At Least Daily	3		2		0		5	42%	
Total Sample Size	3		2		7		12		

a particular locality. Fishing on Sundays or Fridays was generally restricted in Christian or Muslim areas respectively. In addition, most localities had special cultural practices affecting the fishing firms. A day of feasting, dancing, saying prayers and feeding ancestral spirits usually marks the beginning of construction of a new boat as well as its first trip to sea. Less involved ceremonies are also arranged by the household head when a new net or outboard motor is purchased. During periods of unusually poor catch or high accident rate at sea, similar ceremonies involving the entire community may be repeated.

4.2 Classification of Representative Firms

Based on the census survey (FS-1), 110 small-scale firms were randomly selected from the five landing sites. Approximately nine firms were dropped from the survey during the year due to death, permanent migration or because the chosen fisherman had ceased active fishing. As a result, the survey finished with 101 firms. Of these, 93 firms were stratified into nine different production technologies.[1] Eight firms were not included in any representative production firm strata because complete data on total catch or purchased inputs were not available. The extent of their incompleteness distorted any measures of efficiency of resource use in these firms.

When stratifying firms into representative groupings, Day [1963] points out that only under specific conditions will the optimal linear

[1] Ideally a representative sample of each production technology would be chosen from each production region. However this two-fold stratification by technology and region was impractical as it would have required a considerable increase in the number of landing sites surveyed because all production technologies are never found at a single landing site.

programming aggregate solution based on these groupings equal the direct aggregation of the optimal solutions for the individual firms. These conditions are (1) proportional variations of resources and behavioral "bounds," (2) proportional variation of net return expectations among all firms and (3) common technical coefficients on the constraining resources. Miller [1966] attempts to relax Day's conditions by proposing that essentially two conditions are necessary to avoid aggregation bias when using representative firm groupings, namely: (1) all firms have identical coefficient matrices and (2) all firms have qualitatively homogeneous output vectors, i.e., the optimal solution for the individual firms would include the same set of activities but their levels may differ. Buckwell and Hazell [1972] point out that one of the principle problems with Day's and Miller's conditions is that full foreknowledge of the technical matrices of the individual firms is required, when the very reason for using representative firms is to avoid the need for full data on all firms. They emphasize that the literature offers no help in solving the problem and that in reality aggregation bias is unlikely to be totally avoided in any empirical model due to other inaccuracies and discrepancies in the aggregating model.

In an effort to reduce aggregation bias, firm groupings were made according to production technology specifying the various boat, net and propulsion combination used. Table 4.2 describes the nine representative firm types and their corresponding fishing technologies.

Various economic ratios can be used to provide some general indicators of relative productivities of various inputs among different

TABLE 4.2

REPRESENTATIVE FIRM TYPES AMONG SMALL-SCALE FISHERIES

Characteristics	FIRM TYPE								
	A	B	C	D	E	F	G	H	I
Boat type used:	Standard Canoe	Standard Canoe	Standard Canoe	Kroo Canoe	Salla Boat	Salla Boat	Salla Boat	Fante Boat	Fante Boat
Net type used:	Ring Net	Set Net	Drift Net	Cast Net and Hood & Line	Beach Seine	Ring Net	Ring Net	Ring Net	Ring Net
Type and size of propulsion:	Paddle & Sail	Paddle & Sail	Paddle & Sail	Paddle	Paddle	Outboard <15H.P.	Outboard >15H.P.	Outboard <26H.P.	Outboard >26H.P.
Number of firms in Sample:									
Northern Region	2		6			8	5	8	6
Western Area		16		5					
Southern Region	5	1	25	—	6	—	—	—	—
Total Sample Size	7	17	31	5	6	8	5	8	6
Economic Ratios:[a]									
Output[b]-Capital Ratio Mean	8.75	8.73	6.52	22.05	5.42	3.37	7.66	8.47	5.50
Output[b]-Labor[c] Ratio Mean	.47	.43	.37	.51	.32	.48	.37	.36	.30
Labor-Capital Ratio Mean	18.53	19.93	17.78	43.10	16.73	6.98	20.56	23.81	18.18

[a]All ratios were calculated on the annual flow of resources (outputs) utilized in fish production activities, i.e., hours of labor, Leones of annual service costs of capital, etc.

[b]Output was defined in terms of value added at the exvessel value (farm gate value in farm management studies) of the annual catch less any purchased material and service input costs.

[c]Labor includes both family and hired labor used.

technologies as well as the intensity with which scarce resources are used in combination. Comparison of the different firm types in Table 4.2 shows that the greatest amount of output in terms of value added can be obtained per unit of scarce capital available in firm type D as well as the highest productivity of labor. Since labor is one of the major inputs supplied by the firm household, the productivity of labor is of special interest in defining homogeneous representative firm groups. The value added/labor ratio is an indication of labor productivity or the intensity with which labor is utilized in combination with other capital inputs. The firms operating salla and fante boats with larger outboard engines have a labor productivity considerably higher than the small standard and Kroo canoe firms.

An analysis of variance in the value added/labor ratios between firms in different regions and different firm types revealed that regional effects were not significant even at the 30 percent level, whereas the firm type was significant at the .1 percent level. The R^2 for this analysis was .7, indicating that a high percentage of variation can be explained by differences in equipment technology and a low percentage due to regional difference. This suggests a high degree of homogeneity in firm groupings.

The lower labor/capital ratio of firm type F indicates a greater capital intensity in this firm type than in all other small-scale firm types examined. Although there is a wide range of labor/capital ratios between different technology types, from a low of 6.98 in firm type F to a high of 43.10 in firm type D, the labor capital ratio of most firm types are closely clustered between 16.73 and 23.81. It is hypothesized that the choice of technology would be quite insensitive among these centrally clustered firm types to changes in the relative factor prices between labor and capital inputs. This hypothesis will be analyzed further in Chapter 6.

4.3 Labor Utilization by the Firm

4.3.1 Family Labor Characteristics

The stock of family labor present in the household is shown in Table 4.3 to range from 2.8 persons for firm type D (kroo canoe and cast net), to 16.5 persons in firm type I (fante boat, >26 HP engine, ring net). An hour of child labor (10-15 years old) was considered as half the value of an hour of adult labor of the same sex based on Spencer and Byerlee's [1976] findings that child wages in Sierra Leone are approximately half their adult equivalent. Children less than 10 years of age were not considered as contributing to the family labor supply. If the family labor stock is discounted for these factors, the number of contributing members varied from a low of 2.4 adult equivalents in those firms operating the small kroo canoes, firm type D, to a high of 11.5 adult equivalents in the larger firms of type I (fante boat, >26 HP engine, ring net). Household size is therefore closely associated with the type of technological equipment employed by the firm.

Household heads possessed a variety of skills and backgrounds. About 60 percent of the household heads achieved their fishing skills through informal training by a relative, while 26 percent had undergone some form of apprenticeship with more experienced fishermen for an average term of 4 years. Formal English education was limited to an average of only 1.3 years among all household heads.

The allocation of family labor between fish production, processing and trading and nonfish enterprises varied by firm type, season

TABLE 4.3

AVERAGE HOUSEHOLD SIZE BY FIRM TYPE

Characteristics	Firm Type									National Average[a]
	A	B	C	D	E	F	G	H	I	
Male Adults (15+ Years)	3.43	1.77	2.90	1.40	4.00	3.38	6.20	5.88	4.66	2.82
Female Adults (15+ Years)	2.86	1.47	2.10	1.00	3.00	2.75	4.40	4.25	6.83	2.18
Children (10-15 Years)	.57		.36			.88				.28
Children (<10 Years)	.71	1.12	1.16	.40	2.00	3.13	3.20	4.13	5.00	1.31
Total Number of Persons	7.57	4.36	6.52	2.80	9.00	10.14	13.80	14.26	16.49	6.59
Number of Adult Equivalents	6.58	3.24	5.18	2.40	7.00	6.57	10.60	10.13	11.45	5.11

[a]Weighted Average according to the estimated number of firms of each type in total population

and sex. It is evident from Table 4.4 that fish production occupies a major share of the males' economic activity while females are primarily involved in the fish processing activities. Exceptions to this are noted in firm type F in which fishing holds a minor position in relation to other nonfishing enterprises. The increased amount of female labor allocated to fish production in those firms using larger mechanized Salla and Fante boats (type G, H and I) is primarily due to the extra time required to cook meals for a larger hired labor force employed by the firms in fish production.

Hours of economic activity used in Table 4.4 were limited to those hours spent at the enumeration site in activities which directly contribute to some business enterprise of the firm. Time spent resting, or out of town for business or liesure purposes was not included.

A majority of the firms comprising firm type D were located in Western Area. Consequently wholesale trading of fish in Freetown accounted for a greater proportion of female economic activity. Similarly in the sample, firm type F was primarily found in the Northern region where commercial agriculture tends to absorb a higher proportion of male and female economic activity.

Almost 42 percent of the male labor allocated for fish production in the entire sample was used to repair nets, whereas only 52 percent of fish production labor was actually spent at sea in fish harvesting activities. The only exception is firm type D which operates a shallow cast net which seldom needs repair.

Seasonal variation in labor inputs in fisheries is affected by weather, fish migratory patterns, type of equipment used, seasonality of competitive nonfish enterprises, and other factors. During the

TABLE 4.4

ANNUAL LABOR ALLOCATIONS AMONG ALTERNATIVE ENTERPRISES BY FIRM TYPE[a]

Item	FIRM TYPE																		National Average Labor Allocations[b]	
	Standard Canoe						Kroo Canoe		Salla Boat						Fante					
	Ring Net Pad & Sail		Set Net Pad & Sail		Drift Net Pad & Sail		Cast Net Hook & Line Paddle		Beach S. Paddle		Ring Net <15H.P. Eng.		Ring Net >15H.P. Eng.		Ring Net <26H.P. Eng.		Ring Net >26H.P. Eng.			
	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%	Hrs.	%
	A		B		C		D		E		F		G		H		I			
Male Family Labor:																				
Fish Production	2508	76.3	1781	97.3	1544	64.4	1492	98.1	1944	80.9	3664	47.7	5711	88.8	11023	98.6	4454	97.7	2101	74.9
Fish Processing	110	3.2	6	.3	114	4.8			268	11.2	2		10	.2	45	.4	9	.2	79	2.8
Fish Trading	1	.3	6	.3	11	.5	4	.3	24	1.0			1		25	.2	2		8	.3
Non-Fish Enterprise	671	20.2	37	2.0	726	30.3	25	1.6	165	6.9	4019	52.3	710	11.0	91	.8	96	2.1	618	22.0
Total Male Family Labor	3290	100.0	1830	99.9	2395	100.0	1521	100.0	2401	100.0	7685	100.0	6432	100.0	11184	100.0	4561	100.0	2806	100.0
Female Family Labor:																				
Fish Production	4	.6	4	.4	15	1.8			234	15.5	161	6.0	1328	47.0	1675	51.3	1617	52.1	95	9.3
Fish Processing	482	67.0	761	85.4	445	52.7	318	65.7	943	62.2	207	7.8	896	31.7	1345	41.2	1132	36.5	557	54.4
Fish Trading	3	.4	119	13.4	34	4.0	152	31.4	49	3.2			246	8.7	201	6.2	197	6.4	64	6.3
Non-Fish Enterprise	230	32.0	7	.8	350	41.5	14	2.9	289	19.1	2304	86.2	354	12.5	43	1.3	155	5.0	307	30.0
Total Female Family Labor	719	100.0	891	100.0	844	100.0	484	100.0	1515	100.0	2672	100.0	2824	99.9	3264	100.0	3101	100.0	1023	100.0
Male Hired Labor:																				
Fish Production	961	92.1	2012	99.4	685	84.8			2611	97.6	594	49.5	26556	70.4	34330	99.5	41589	100.0	2593	90.4
Fish Processing	18	1.7	2	.1	46	5.7			37	1.4					26	.1			27	.9
Fish Trading									3	.1										
Non-Fish Enterprise	65	6.2	10	.5	77	9.5	76	100.0	23	.9	606	50.5	11143	29.6	147	.4			249	8.7
Total Male Hired Labor	1044	100.0	2024	100.0	808	100.0	76	100.0	2674	100.0	1200	100.0	37699	100.0	34503	100.0	41589	100.0	2869	100.0
Female Hired Labor:																				
Fish Production	1	2.0			1	2.0			125	90.0					298	26.1	60	7.9	113	16.8
Fish Processing	50	98.0			49	98.0			2	1.4			8	100.0	721	63.3	652	86.4	522	77.8
Fish Trading									1	.7					121	10.6	43	5.7	31	4.6
Non-Fish Enterprise									11	7.9	4	100.0							5	.7
Total Female Hired Labor	51	100.0			50	100.0			139	100.0	4	100.0	8	100.0	1140	100.0	755	100.0	671	99.9
Total Labor:																				
Fish Production	3474	68.0	3797	80.0	2245	54.8	1492	71.7	4914	73.0	4419	38.2	33595	71.5	47326	94.5	47720	95.4	4902	66.5
Fish Processing	660	12.9	769	16.2	654	16.0	318	15.3	1250	18.6	209	1.8	906	1.9	2137	4.3	1793	3.6	1185	16.1
Fish Trading	4		125	2.6	45	1.1	156	7.5	77	1.1			247	.5	347	.7	242	.5	103	1.4
Non-Fish Enterprise	970	19.0	54	1.1	1153	28.1	115	5.5	488	7.3	6933	60.0	12207	26.0	281	.5	251	.5	1179	16.0
Total Labor Used	5108	99.9	4745	99.9	4097	100.0	2081	100.0	6729	100.0	11561	100.0	46955	99.9	50091	100.0	50006	100.0	7369	100.0

[a]Actual hours utilized per firm.
[b]Weighted Average according to the estimated number of firms of each type in total population.

height of the rainy season (July-August) the sea becomes rough and hazardous for small craft loaded with net and other gear. In addition, high waves move the nets which need to remain perpendicular in the water to encircle the fish. At the beginning of the dry season, Bonga and other species which have a low salinity tolerance tend to move in closer to shore and even up into the river estuaries, well within the reach of small scale technologies.

Figure 4.1 shows the seasonal labor profiles for the nine representative firm types. It is clear that on the average, June through September are the months of lowest activity in fisheries. With the end of the rains in October-November, and continuing through until February or March, more labor is used in fisheries.

The type of boat, net and propulsion equipment operated by the firm also affects the seasonal distribution of labor. Firm types A through D all operate small canoes propelled by paddle or sail relatively close to shore, however type B operates a set net positioned near the sea floor. Consequently it is less dependent on surface weather conditions for ideal operation than are types A, C, and D which operate surface nets. As a result the variation seen in season labor use for fishing by firm type B is considerably less than types A, C, or D.

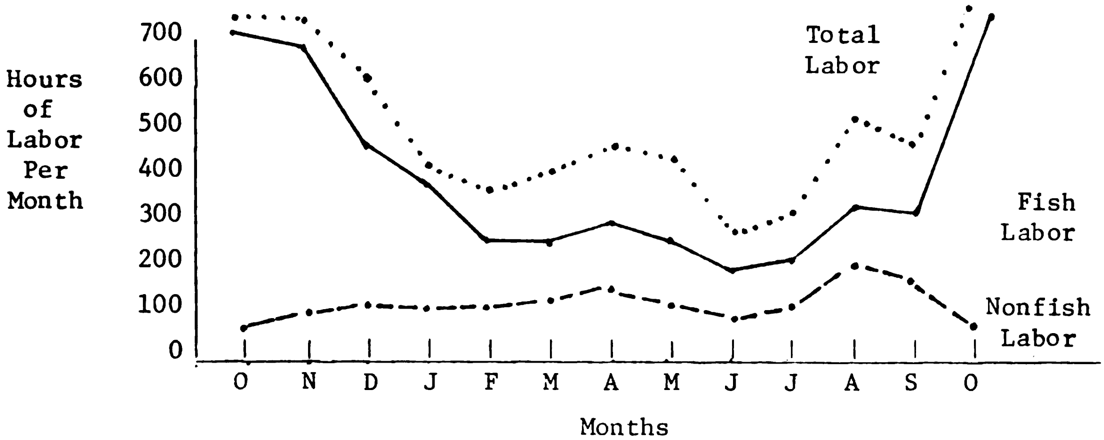
In comparing the seasonal labor variation of all firm types operating canoes (types A through D) and larger boats (types E through I), there is significantly less variation in the seasonal labor use by the latter group. This is expected since their boats are larger and more seaworthy and therefore capable of safe operations under most weather conditions.

FIGURE 4.1

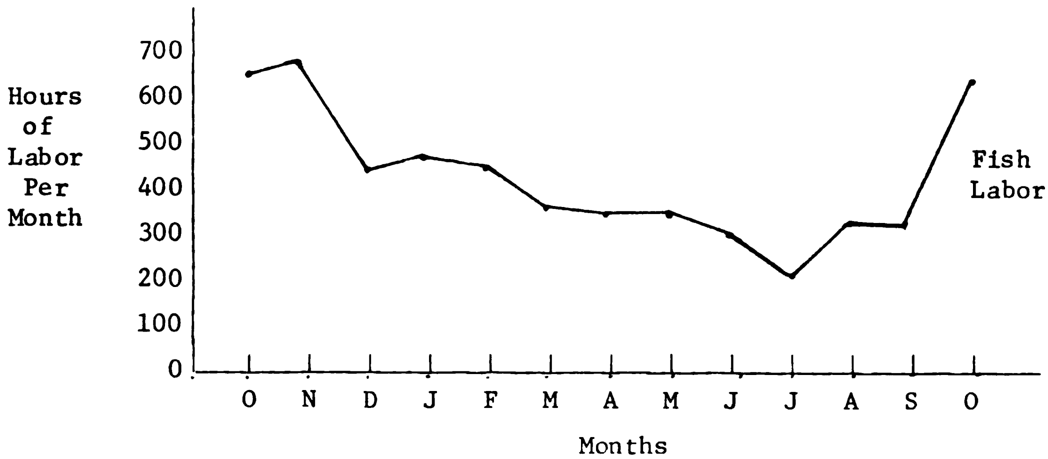
SEASONAL PROFILES FOR TOTAL FIRM LABOR[a] BY REPRESENTATIVE FIRM TYPES, 1974-1975

a) Representative Firm A, b) Representative Firm B, c) Representative Firm C, d) Representative Firm D, e) Representative Firm E, f) Representative Firm F, g) Representative Firm G, h) Representative Firm H, i) Representative Firm I.

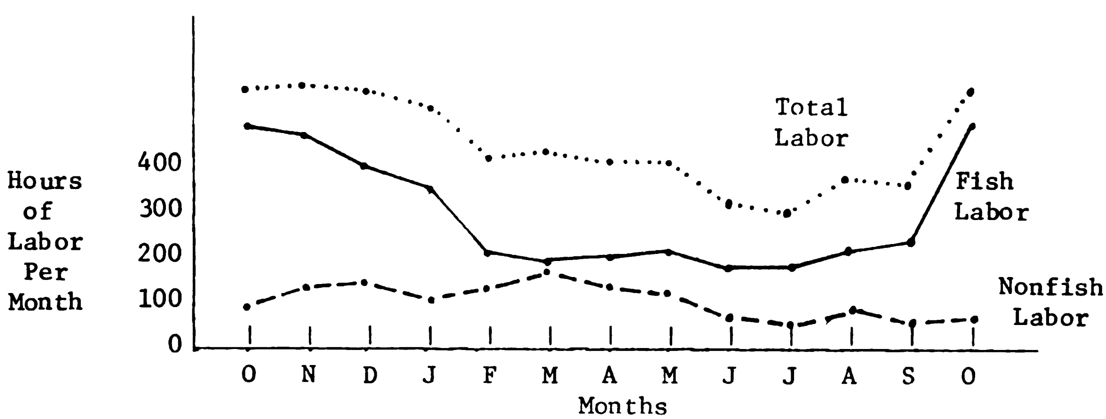
[a]Include both Hired and Family Labor measured in Adult Equivalent Hours. One hour of child labor (ages 10-15) equals .5 hours of adult labor (over age 15).



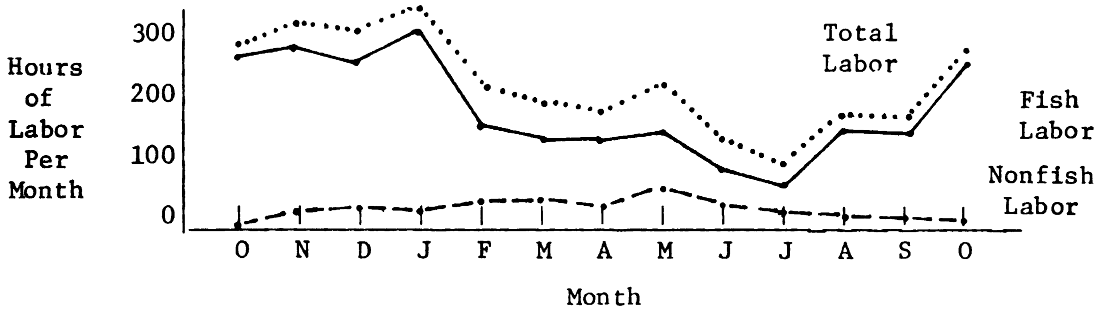
a) Representative Firm A.



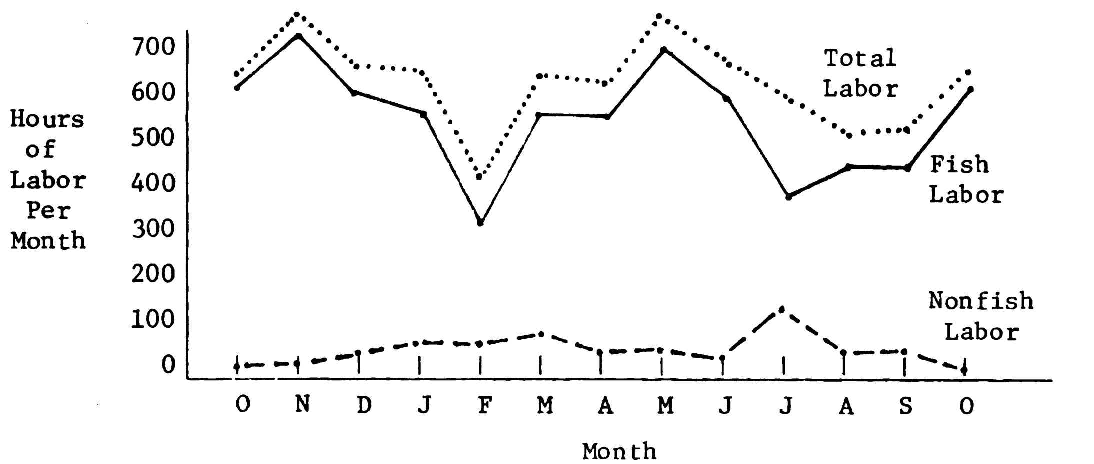
b) Representative Firm B.



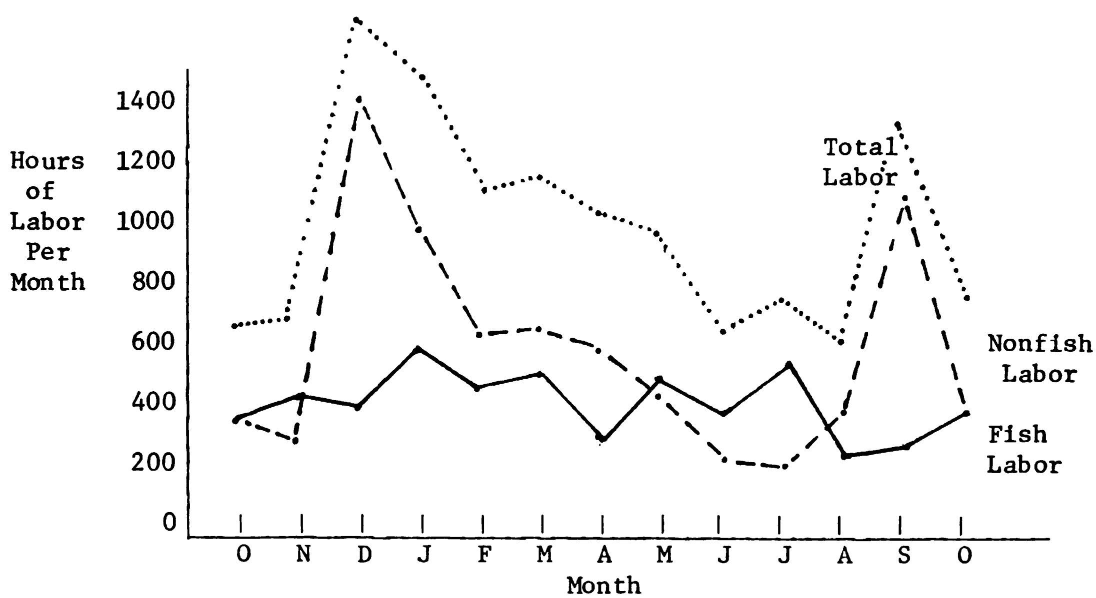
c) Representative Firm C.



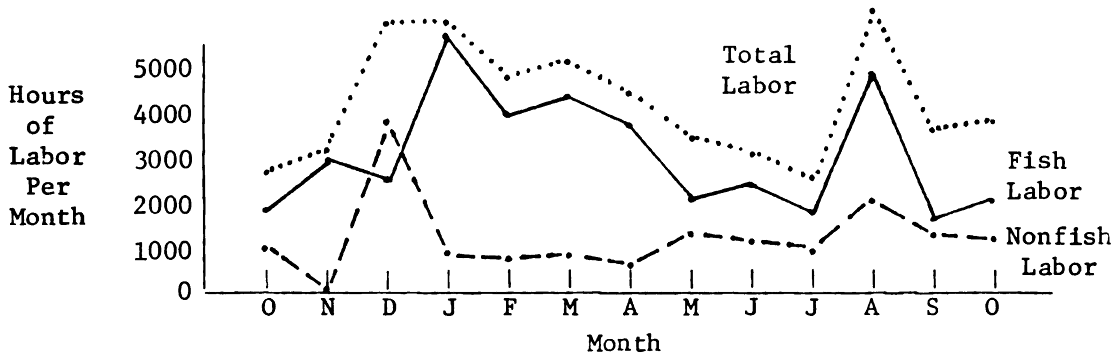
d) Representative Firm D



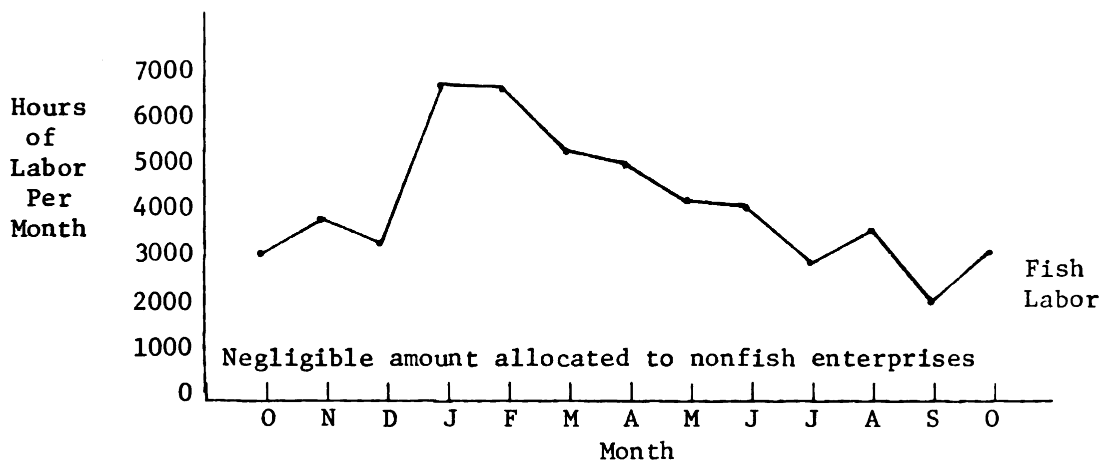
e) Reprêsentative Firm E



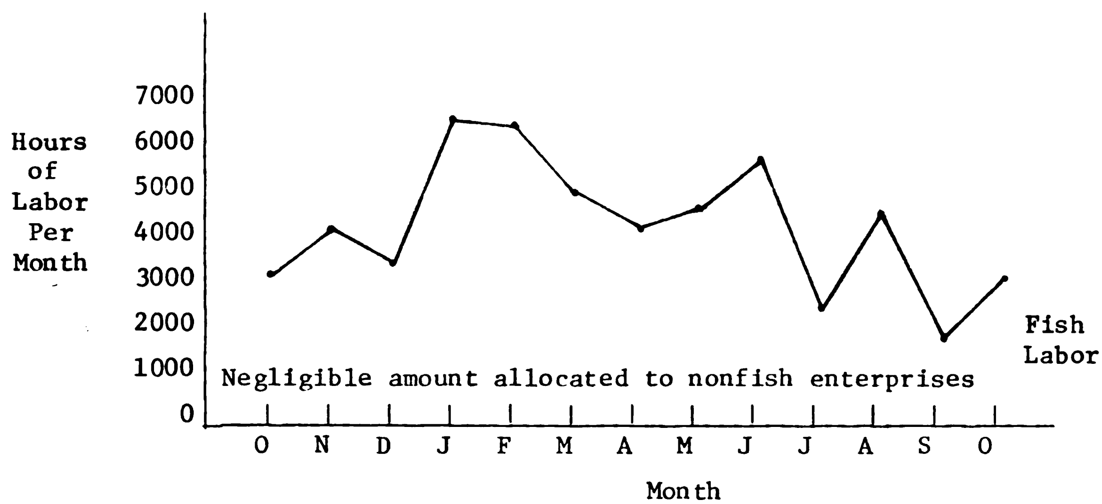
f) Representative Firm F



g) Representative Firm G



h) Representative Firm H



i) Representative Firm I

From Figure 4.1 it is evident that agriculture and other non-fishing enterprises actively compete with fishing for the limited labor supply. For example, in firm type A, as long as fishing enterprises absorb less than 300 hours of labor per month, labor used in nonfish enterprises tend to vary in the same direction as the fishing enterprises. However when labor requirements in fishing rise above the 300 hour per month level, a counterbalancing change in the opposite direction is evident in the nonfishing enterprises. The same opposing trends appear in all other firm types which are engaged in both fishing and nonfishing enterprises. This could be due to the fact that given the fixed supply of family labor, peak seasonal demands for labor in fishing result in a shortage of labor and precipitates a contraction of nonfishing activities.

4.3.2 Hired Labor Characteristics

In the extended family system found in many coastal villages, the distinction between hired and family labor is difficult to define. Frequently the "employee" was distantly related and had joined the firm for several possible reasons: 1) an opportunity to earn cash income, 2) informal on-the-job training for a future occupation, 3) to establish some socioeconomic ties with the firm head who would then be responsible for the "employee" in times of future need, i.e., buying initial equipment for his own firm, marriage arrangements, court cases, etc., or 4) to provide the basic essentials for oneself such as a room, clothes, and food. A combination of several or all of these factors usually led the "employee" to offer his services.

This informal hiring relationship meant that accurate assessment of wages received for services rendered was extremely difficult if not impossible to obtain as a supplemental payment may be delayed two or more years until a time of crisis or celebration required it. However an attempt was made to record all payments of goods in kind such as meals, fish, cigarettes, medicines, etc., as well as cash payments in figuring the wage rate as shown in Table 4.5. The value of fish paid to hired labor usually varied with the size of the catch, but no negotiated percentage was identified. In times of poor catch the workmen may get no part of the catch, while in times of abundance he may receive a sizable share. In some areas a specified day (for example every Saturday) is set aside for the workmen to use the boat and equipment for their own catch with the firm paying all purchased input costs, such as petrol, oil, and net repair.

The average total wages varied from region to region depending on the demand for labor in fisheries as well as in alternative industries in that region.

The average wage rate for women was approximately 66 percent of the male wage rate over the entire sample. Only about 6.4 percent of the wages were paid in cash with the remaining 93.6 percent being paid in kind. Raw fish constituted the most common form of payment in kind; followed by payments in meals.

TABLE 4.5

WAGE RATE PER HOUR IN FISHERIES BY REGION BY SEX
(Leones per hour)

Region	Sex	
	Male	Female
Western	.09	.06
Northern[a]	.15	.08
Southern	.11	.09

[a]Northern contained two enumeration sites. One site revealed the values shown in the table. The second site revealed values less than half that of the surrounding nonfish industries [Spencer and Byerlee; 1976]. It is believed that the low recorded values of the second site were understated due to the large number of persons employed per household at this site in comparison with other sites which made it extremely difficult for respondents to recall the exact amount paid.

Hired labor was usually used in fishing activities as shown in Table 4.4 and on the average less than 22 percent of all labor hired by the firms was allocated to nonfishing enterprises. The various firm types vary widely in their use of hired labor. The firms operating the larger mechanized salla and fante boats use mostly hired labor while other firms depend on family labor. Hired labor is also more important in fish enterprises while family labor is more important in nonfish enterprises. Firm type D (Kroo canoe, cast net, paddle) is almost completely family operated while hired labor accounted for 75 percent of total labor inputs for those firms operating salla and fante boats (types G, H, and I). In these firm types, family labor assumes more a managerial role. In the entire sample, males supplied over 96 percent of the hired labor allocated to fisheries production.

Seasonal distribution of hired labor use closely follows the profile of family labor use presented in Figure 4.1. Firm type G through I employ much of their hired labor in the beginning of the dry season (December through April) which are their peak fishing months. Firm types A through F experience their peak demand for hired labor in the October to December period; this difference in peak seasons may be partially due to the fact that firm types G through I operate technologies which allow them to follow the fish migrations in more distant offshore fishing grounds, thus extending the prime fishing season. Firm types A through F are more limited to inshore fishing and must utilize the brief period in October to December when fish come close to shore.

4.4 Capital Utilization

4.4.1 Level of Capital Stock

Capital stock among small-scale fishing firms consists primarily of working stock capital in the form of supplies and outputs held in store and equipment capital which includes nets, boats, propulsion equipment and other minor tools. Because of the rapid rate of fish putrification, inventories of smoked fish output were minor. Table 4.6 shows the level of working stock capital inventories at the beginning of the survey.

Fish net supplies such as cork, lead, and nylon thread constitutes a major share of total working stock capital. Local traders handle a ready supply of most purchased inputs such as petrol, oil, nylon, etc., so daily requirements are usually purchased directly.

TABLE 4.6

VALUE OF WORKING STOCK CAPITAL BY REPRESENTATIVE FIRM TYPE (LEONES)

	FIRM TYPE									National Average Working Capital Per Firm[a]
	Standard Canoe			Kroo Canoe Cast Nets Paddle	Salla Boats			Fante Boats		
	Ring Net Pad & Sail	Set Net Pad & Sail	Drift Net Pad & Sail		Beach S. Paddle	Ring Net <15H.P. Eng.	Ring Net >15H.P. Eng.	Ring Net <26H.P. Eng.	Ring Net >26H.P. Eng.	
	A	B	C	D	E	F	G	H	I	
Dry Fish in Store	2.14	.91	2.13		4.83	1.29	11.43	17.50	6.67	2.32
Other Fish in Store	.86	.31	.31							.31
Fish Net Supplies	17.10	48.90	1.40	6.90	1.39		4.20	31.46	33.33	15.58
Other Fish Supplies	7.91	.02	1.85	.27		5.00		.75		2.01
Total Stock of Working Capital	28.01	50.14	5.69	7.17	6.22	6.29	15.63	48.71	40.00	20.22

[a]Weighted Average according to the estimated number of firms of each type in the total population.

In contrast to the low level of working stock capital, equipment stocks are significant. Equipment stocks valued at their acquisition cost as estimated by the household head are shown in Table 4.7.

The wide range in total value of equipment in Table 4.7 shows the large amount of variation between different technology types. A new firm entering the industry usually begins as firm type A through D because of its relatively low initial capital investment needed. Over the life of the firm, it may expand to new more capital-intensive technologies as seen in types E through I. The cost of net equipment comprises over 60 percent of total equipment acquisition costs for the small canoe firms (types A through D) but only 46 percent of total equipment costs for large boats (type E through I) in which a relatively higher share of total equipment costs are derived from outboard engines. Imported equipment requirements which comprise about 60 percent of total equipment cost or an average of Le 165 per firm among the canoe firms (types A through D) increase to over 81 percent of total equipment costs or an average of 2001 leones per firm among the large boat firms (types E through I). With a major portion of the equipment being imported, the current 36 1/2 percent import duty results in a considerable increase in total equipment costs for small-scale firms.

4.4.2 Sources of Capital Accumulation

Over the life of a firm, several sources of capital funds are used to acquire fishing equipment. Fifty-three percent of initial investment capital came from previous savings while 47 percent was obtained through loans. Employment by other fishermen provided 32 percent of the capital derived from savings while agriculture, trading,

TABLE 4.7

ACQUISITION COST OF EQUIPMENT INVESTMENT BY FIRM TYPE (LEONES)

	FIRM TYPE: Standard Canoe — Ring Net Paddle & Sail	Standard Canoe — Set Net Paddle & Sail	Standard Canoe — Drift Net Paddle & Sail	Kroo Canoe Cast Nets Paddle Only	Salla Boats Beach Seine Paddle Only
	A	B	C	D	E
Boat	102.43	84.07	61.93	31.67	186.09
Other Boat Equipment	3.74	4.06	4.03	1.40	16.64
Total Boat Equipment	106.17	88.13	65.96	33.07	202.73
Paddles	3.17	2.42	2.04	1.30	5.47
Sails	1.64	1.43	3.70		1.67
Total Propulsion Equipment	4.81	3.85	5.74	1.30	7.14
Total Net Equipment	237.41	228.12	173.09	21.68	432.70
Other Fishing Equipment	1.03	1.57	2.62	.97	4.16
Total Acquisition Cost of Investment	349.42	321.67	247.41	57.02	646.73

	Salla Boats — Ring Nets <15H.P. Eng.	Salla Boats — Ring Nets >15 H.P. Eng.	Fante Boats — Ring Nets <26 H.P. Eng.	Fante Boats — Ring Nets >26 H.P. Eng.	National Average Equipment Investment Per Firm[a]
	F	G	H	I	
Boat	207.74	304.36	325.29	677.66	95.15
Other Boat Equipment	13.36	31.94	33.83	65.60	6.31
Total Boat Equipment	221.10	336.30	359.12	743.26	101.46
Paddles	2.78	7.08	7.80	6.93	2.60
Sails		8.05	3.89	5.48	2.65
Outboard	549.50	1119.00	1277.50	1966.16	86.39
Total Propulsion Equipment	552.28	1134.13	1289.19	1978.57	91.64
Total Net Equipment	461.99	1136.80	1457.83	1603.83	262.37
Other Fishing Equipment	.05	5.55	8.66	10.20	2.32
Total Acquisition Cost of Investment	1235.42	2612.78	3114.80	4335.86	457.79

[a]Weighted Average according to the estimated number of firms of each type in the total population.

and other sources supplied 18, 21, and 29 percent of the saved capital, respectively. Family members were the most important source of loans for initial capital supplying 56 percent of the borrowed funds. Friends and traders each supplied 20 percent while the commercial banking system was never used by members of the sample as a source of borrowed funds in establishing small-scale fishing firms.

Working capital requirements for daily purchased inputs were most frequently met from retained earnings. However, during periods of poor catch or natural disasters which depleted the working stock capital, the local trader was the most frequent source of short term working capital loans. In that event fishermen may receive nylon, petrol, etc. on credit from the local shopkeeper to be repaid the same day after the catch has been sold but most frequently it involved a long term symbiotic relationship with a local fish wholesaler. Approximately 57 percent of the firms borrowed regularly from their "customer," i.e., fish wholesaler. Repayment of these short term loans (average length of loan was 33 days) was almost universally made in kind, i.e., raw or smoked fish. Fish used as repayment were usually valued at 8 to 11 percent less than the market price at the time of repayment. While the loan was outstanding the fisherman was obligated to sell only to his "customer" whenever she was in the locality. This provided the wholesaler with an assured source of supply and a monopsonistic bargaining position but it also allowed the fisherman a ready source of secure credit to meet his needs. Approximately 70 percent of the firms who had borrowed from fish traders were currently indebted to them.

Larger medium-term loans for equipment capital usually came from larger trading firms in the area, usually from Sierra Leoneans of Arab descent. Within the sample of 93 fishermen, 12 such loans were currently being repaid. All had been obtained to purchase new outboard engines varying in size from 8 to 26 horsepower. The average size of loan from this source was Le 764. The following formula[1] was used to solve for the interest rate "r" in the rural money market:

$$P = (1-d)\left[\frac{A}{(1+\frac{r}{12})} + \frac{A}{(1+\frac{r}{12})^2} + \frac{A}{(1+\frac{r}{12})^3} + \ldots + \frac{A}{(1+\frac{r}{12})^n}\right] + (d)(g)(E)$$

where: P = principal
d = the default rate
A = the amount of each monthly repayment
g = the probability of actually repossessing the defaulted engine
E = the depreciated value of the engine at the time of repossession
n = the number of months since the loan was received
r = the interest rate

At the time the loan was received, the average repayment schedule legislated by the trader, assuming no default (i.e., d = 0), implied an annual interest charge of 169 percent. For example, the terms for one fisherman were stated as follows: a) Le 460 cash for the engine or b) Le 530 credit with Le 160 downpayment and Le 100 repayment per month for the next 3.7 months. That is, P = 530 - 160 = 370, A = 100 and n = 3.7. However, for 83 percent of the loans which were

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[1]Bottomley [1975] develops a theoretical framework for incorporating risk premiums, administration costs, monopoly profit, and the opportunity cost of capital in his examination of rural interest rates.

repaid, delayed payments usually extended the life of the loan and thus reduced the actual interest rate of repaid loans to 73 percent annually. If this actual rate is adjusted for the risks involved through loan default, computed as d = 16.77 percent of all loans, the "realistic" interest rate reduces to 43.3 percent annually.[1]

4.4.3 Annual User Cost of Capital

In order to assess the annual flow of services derived from working and equipment capital stocks, all stocks of capital were converted into annual user service costs. This was done by applying the capital recovery formula [Yotopoulous, 1967]:

$$R = \frac{rV}{1 - (1+r)^{-n}}$$

where V is the original acquisition cost of the capital item; r is an appropriate discount rate reflecting the opportunity cost of the capital and n is the life expectancy of the capital item. The computed R is a constant annual capital service cost or rental value of the capital reflecting both the opportunity cost of funds invested in the capital and the depreciation in the value of capital over its expected life. Data on the original acquisition cost and the life expectancy of equipment items were collected from respondent estimates. To provide some degree of allowance for individual differences in management, maintenance and intensity of use, the respondent's actual

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[1]Assumes a 50 percent probability (c) of repossessing the defaulted engine after 3 months use during which the engine depreciates on a straight line depreciation schedule over its expected life.

life expectancy estimate was used.[1]

The source of capital is a major factor in determining its actual cost. It was noted earlier that indigenous traders receive slightly over 40 percent annual interest on medium term (4-5 month) loans when adjusted for default risk. On the other extreme, commercial banks are reported to charge a maximum discount rate of 12 percent [Liedholm and Chuta, 1976]. Initially the actual cost of capital facing small-scale firms (i.e., 40 percent) was used as the appropriate discount factor. Table 4.8 shows the annual service cost of equipment capital by representative firm group using the estimated 40 percent as the opportunity cost of capital. As the size of firm in terms of total capital investment increases from the small canoe firms (types A through D) to the larger boat firms (types E through I), the service cost of boat and net equipment represent a smaller fraction of total service cost. This is due to the relatively long expected life of these items in comparison with the short-lived outboard engine which is purchased by the larger firms. The annual service cost of propulsion equipment increases dramatically from Le 1.05 for the firm operating a small Kroo Canoe to over Le 1068.00 for firms operating the large Fante boats. Particularly noteworthy is the wide range of total annual service cost from a low of Le 35 to over Le 2600. This is primarily due to the differences in propulsion equipment used.

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[1]If the life expectancy was unknown or the respondent's estimate was greater than three standard deviations from the mean sample estimate for that item, the sample mean expected life for the item was used.

TABLE 4.8

ANNUAL SERVICE COSTS OF FISH PRODUCTION EQUIPMENT[a]

Equipment Item	FIRM TYPE									National Average[b]
	A	B	C	D	E	F	G	H	I	
	Leones									
Boat:										
Kroo Canoe				17.43						.79
Standard Canoe	50.96	39.30	29.30		2.20					29.42
Salla Boat					81.22	91.12	140.38		52.92	8.57
Fante Boat								162.45	281.77	6.37
Propulsion Equipment										
Paddles	1.91	1.75	1.29	1.28	2.85	2.06	6.33	7.77	8.00	1.83
Sails	1.05	1.01	2.21		.90		5.18	3.18	5.95	1.68
Outboard 7H.P.						264.86				10.42
12H.P.							80.56	45.45		2.24
17H.P.							650.35	332.48	468.55	21.93
22H.P.									141.79	1.40
22+H.P.								547.25	757.63	19.57
Nets:										
Ali "Ring" net	78.19		2.48			256.19	614.63	852.45	843.92	56.50
Drift net	26.66	3.29	80.14		4.66	11.59	64.85			44.77
Set net	25.71	139.51	6.65				37.14			39.71
Beach Seine					190.41					5.42
Cast net		.52	.17	14.07						.84
Hook and line		.18		.25						.05
Other Boat Equipment	2.25	3.74	2.30	.86	8.34	7.00	27.92	26.91	52.07	4.35
Other Fishing Equipment	.71	1.20	1.69	.73	3.23	.07	6.54	9.33	13.48	9.51
Total Annual Service Cost of Fishing Production Equip.	187.44	190.50	126.23	34.62	293.81	632.89	1633.88	1987.27	2626.08	265.37

[a]A discount rate of 40 percent reflecting the financial cost of capital was used in calculations.

[b]Weighted Average according to the estimated number of firms of each type in the total population.

4.5 Purchased Material Inputs

The annual cost of purchased material inputs vary considerably depending on the type of technology used, the location of the landing site, and the area of sea most frequently harvested. The design of a particular equipment item and the intensity with which it is used affect the amount of operating, maintenance and repair costs needed annually. Table 4.9 describes the annual purchased material input costs for the ring, drift, and set nets which are frequently torn by larger fish or by large rocks on the sea floor, while the cast net (firm type D) is designed for small fish captured in the top three to four fathoms of surface water and thus requires less maintenance costs. The location of the landing site affects operating and maintenance costs in two respects. First, if the site is near a main urban center the retail price of petrol, nylon thread, paint, etc. is lower than in the more isolated sites. Second, if the site is located near major fishing grounds, fewer costs are involved in getting to and from the fishing area. Firms which operate in deeper waters (types G, H, I) or in regions of the continental shelf which has a sandy bottom have fewer net maintenance costs per unit of fishing time than firms operating in shallow waters with a rocky sea floor.

It is evident that the large firms (types F through I) have significantly higher purchased input costs due to the operation and repair of the outboard engine which alone accounts for over 85 percent of total purchased input costs for these firms. Nearly all of these additional costs are for imported materials which are currently subject to substantial import duties. Hence a potentially important policy

TABLE 4.9

ANNUAL PURCHASED MATERIAL INPUTS BY FIRM TYPE

Item	FIRM TYPE									
	Standard Canoe			Kroo Canoe	Salla Boat			Fante Boat		National Average[a]
	Ring Net Pad & Sail	Set Net Pad & Sail	Drift Net Pad & Sail	Cast Net Hook & Line Paddle	Beach S. Paddle	Ring Net <15HP.P Eng.	Ring Net >15H.P. Eng.	Ring Net <26H.P. Eng.	Ring Net >26H.P. Eng.	
	Leones									
Net Maintenance	36.10	63.35	27.62	7.13	23.75	92.60	384.04	401.74	473.00	56.65
Boat Maintenance	18.38	4.38	6.33	.95	49.55	18.51	169.39	92.34	302.88	15.99
Petrol						363.62	2882.55	3823.78	4262.98	185.01
Grease and Oil						34.79	400.31	549.59	698.05	26.53
Outboard Engine Repairs						4.71	312.96	153.46	258.21	10.92
Other Purchased Material Inputs	10.22	2.25	.34			.19		1.34	27.61	2.14
Total Purchased Material Inputs	64.70	69.98	34.29	8.08	73.31	514.42	4149.23	5022.24	6022.74	297.24

[a]Weighted Average according to the estimated number of firms of each type in the total population.

issue which will be analyzed later is the impact of changing import duties on the profitability of various technologies.

4.6 Output Harvested

There is large variation in size, type, and quantity of fish caught depending on the type of technology employed by fishing firms. The type of net which determines the position of the net in the water as well as the size of the net's mesh is selective in capturing particular demersal or pelagic species. This is illustrated in Table 4.10 which describes the top ten species in terms of pounds of annual catch by each firm type. The selectivity of technologies is evident in several respects. A majority of firm types (A, C, E, F, G, H, I) fish primarily in surface water (top 12 fathoms). Bonga constitutes almost 80 percent of their total catch while comprising only 4 percent of the total catch of firms fishing at lower depths (types B and D). Particular species such as Coureh, Couta, Joefish, Keni, Snapper, and Shark are found in higher concentration in the catch of firm types B and D which operate nets or lines on the sea floor. A majority of these species are demersal types which are of higher quality and command a higher price in the wholesale market. Even within a single species, different firm types selectively capture a particular size and maturity of fish. For example, firm type D, which operates a cast net, captures a negligible amount of adult Bonga but a substantial amount of its catch is Awefue, an immature Bonga. The top ten species account for between 75 and 99 percent of the total catch depending on the firm type.[1]

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[1] See Appendix 1 for a listing of all major commercial species and their respective weights.

TABLE 4.10

ANNUAL FISH CATCH OF MAJOR SPECIES PER FIRM BY FIRM TYPE

Creole Species Name	FIRM TYPE																		National Average[b]	
	Standard Canoe						Kroo Canoe		Salla Boat						Fante Boat					
	Ring Net Pad & Sail		Set Net Pad & Sail		Drift Net Pad & Sail		Cast Net Hook & Line Paddle		Beach Seine Paddle		Ring. Net <15H.P. Eng.		Ring Net >15H.P. Eng.		Ring Net <26H.P. Eng.		Ring Net >26H.P. Eng.			
	A		B[a]		C		D[a]		E		F		G		H		I			
	lbs.	% of Total Catch	Lbs.	% of Total Catch	Lbs.	% of Total Catch	Lbs.	% of Total Catch	Lbs.	% of Total Catch	Lbs.	% of Total Catch	Lbs.	% of Total Catch	Lbs.	% of Total Catch	Lbs.	% of Total Catch	Lbs.	% of Total Catch
Awefue	278	1.8			374	3.6	852	17.0	852	3.1	150	.5							284	1.4
Bonga	11590	73.2	813	8.9	6975	67.6			2609	9.6	25907	89.0	126769	83.1	181967	82.3	183021	84.3	13768	67.2
Catfish	403	2.5			110	1.1							6300	4.1	10095	4.6	10923	5.0	526	2.5
Coureh			559	6.1							10	.03							133	.6
Couta			481	5.3			193	3.8			3	.01							123	.6
Crocus	167	1.1	677	7.4			405	8.1			55	.2	710	.5	332	.2	620	.3	224	1.1
Cutmoney									319	1.1	44	.2							11	
Gwangwa	138	.9	396	4.3	135	1.3	488	9.7	1619	6.0			3475	2.3	5088	2.3	3748	1.7	446	2.2
Herring	359	2.3	947	10.4	1134	11.0			5619	20.7	432	1.5	5381	3.5	7196	3.3	6862	3.2	1309	6.4
Joe-fish							178	3.5											8	
Keni							703	14.6											32	.2
Ladyfish	354	2.2	342	3.8	116	1.1			29	.1							124	.06	179	.9
Lattie					386	3.7			12013	44.3	341	1.2							546	2.7
Mackerel	126	.8	1071	11.7	72	.7	372	7.4	251	.9			2756	1.8	3044	1.4	2143	1.0	458	2.2
Mullet					124	1.2	147	2.9	145	.5									72	.4
Shark			643	7.0															152	.7
Shinenose					124	1.2			1659	6.1	27	.1	3012	2.0	2992	1.4	2456	1.1	246	1.2
Skeet	561	3.5													909	.4			82	.4
Snapper							397	7.9					379	.2					24	.1
Spanish											37	.1	711	.5	633	.3	297	.1	29	.1
Whiting	184	1.2	922	10.9			399	8.0					1910	1.3	4742	2.1	2951	1.4	420	2.0
All Other Species	1674	10.5	2268	24.2	771	7.5	882	17.1	2000	7.6	2096	7.2	1131	.7	4238	1.7	4085	1.8	1429	7.0
Total Lbs. Catch	15834	100.0	9119	100.0	10321	100.0	5016	100.0	27115	100.0	29102	100.0	152534	100.0	221236	100.0	217230	100.0	20501	100.0

[a] Total catch figures for firm types B and D were adjusted according to species unit weights from other firms due to insufficient unit weight data for species actually caught by these firms.

[b] Weighted Average according to the estimated number of firms of each type in the total population.

The market value of the catch depends on the type, size, and quality of the fish, the demand for fish in terms of the number of traders actively buying in a given locality at the time of landing and the proximity of urban consumption centers to the landing site. Table 4.11 shows the annual average price per pound for raw fish of the major species sold in each region. The higher prices evident in Western Area are largely due to the fresh fish demand in nearby Freetown.

Total catch varies seasonally over the production year with migration of fish and changes in weather conditions. Upswellings of nutrient rich water during the early rainy season and rich river water runoff provide a period of growth for plankton upon which fish feed. In addition, favorable weather conditions provide calm seas late in the rainy season or early dry season and allow small boats to operate more frequently. Figure 4.2 graphically illustrates a seasonal profile of the total catch by each firm type. Although there is considerable variation between firm types, lowest production occurs on the average some time in the early to mid rainy season (July-September) while highest production occurs in the late rainy season to early dry season. Figure 4.3 shows that the total sawfish supply generated by the small-scale industry is 61 percent higher during the six month period between October and March than during the April through September period.

4.7 Enterprise Budgets for Small-Scale Fishing Firms

A better understanding of small-scale production is obtained by examining the firm as a complete entity combining the working and

TABLE 4.11

AVERAGE ANNUAL EX VESSEL SALES PRICE FOR MAJOR SPECIES BY REGION, 1974

Common Name	REGION		
	Northern Region	Western Area	Southern Region
	Leones Per Lb.		
Awefue	.090	.120	.080
Bonga	.090	.189	.079
Catfish	n.a.	.186	.121
Coureh	n.a.	.205	.071
Couta	n.a.	.188	n.a.
Crocus	.094	.173	.120
Cutmoney	.068	.055	.039
Gwangwa	.093	.136	.095
Herring	.136	.038	.044
Joe-fish	n.a.	.095	n.a.
Keni	n.a.	.106	.057
Ladyfish	.061	.173	.074
Lattie	.081	n.a.	.048
Mackerel	.068	.180	.135
Mullet	.121	.042	.064
Shark	.249	.136	.186
Shinenose	.085	.191	.090
Skeet	.068	.140	.108
Snapper	.079	.170	n.a.
Spanish	.094	.219	.147
Whiting	.078	.133	.182

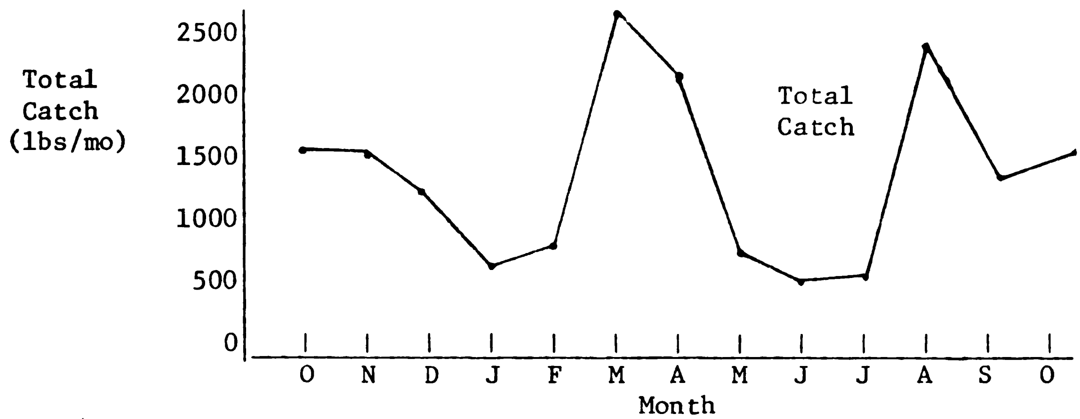
SOURCE: Survey Data.

n.a.: did not appear in sample sales data for this region.

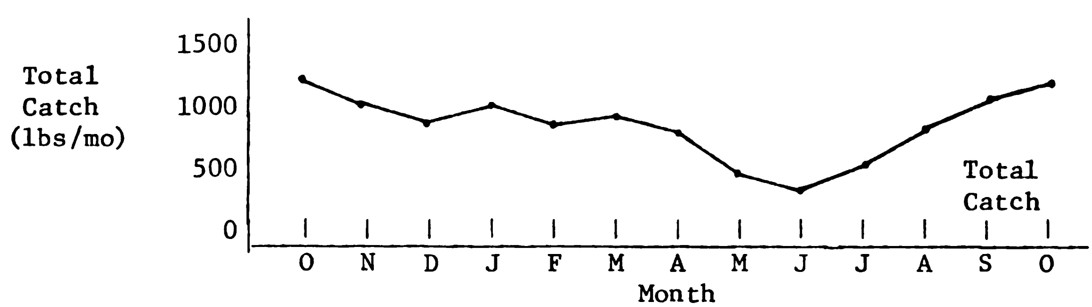
FIGURE 4.2

SEASONAL PROFILES FOR FISH CATCH BY REPRESENTATIVE FIRM TYPE, 1974-1975

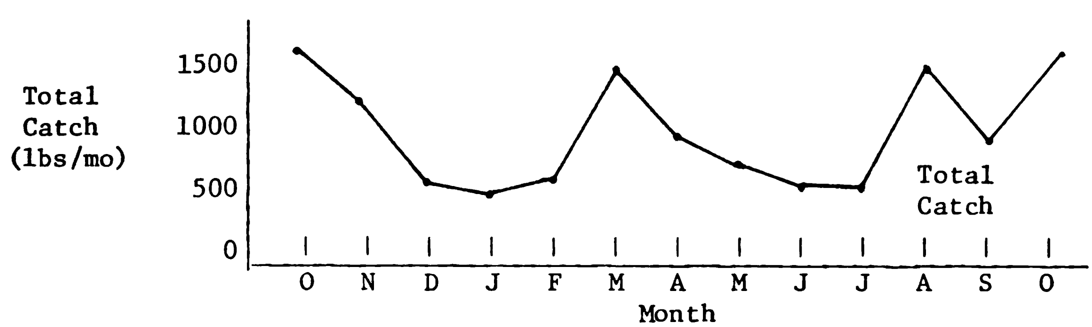
a) Representative Firm A, b) Representative Firm B, c) Representative Firm C, d) Representative Firm D, e) Representative Firm E, f) Representative Firm F, g) Representative Firm G, h) Representative Firm H, i) Representative Firm I.



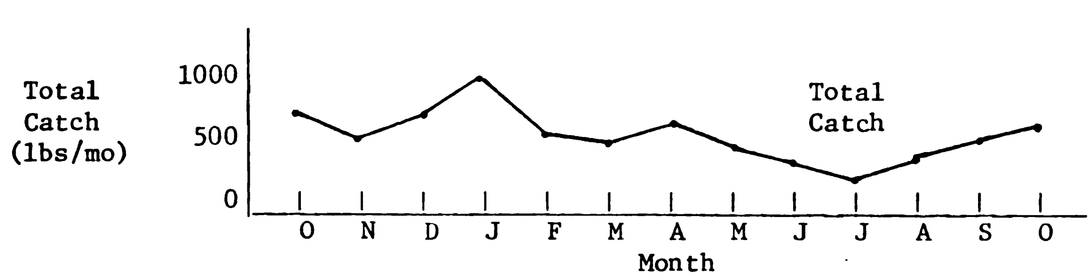
a) Representative Firm A



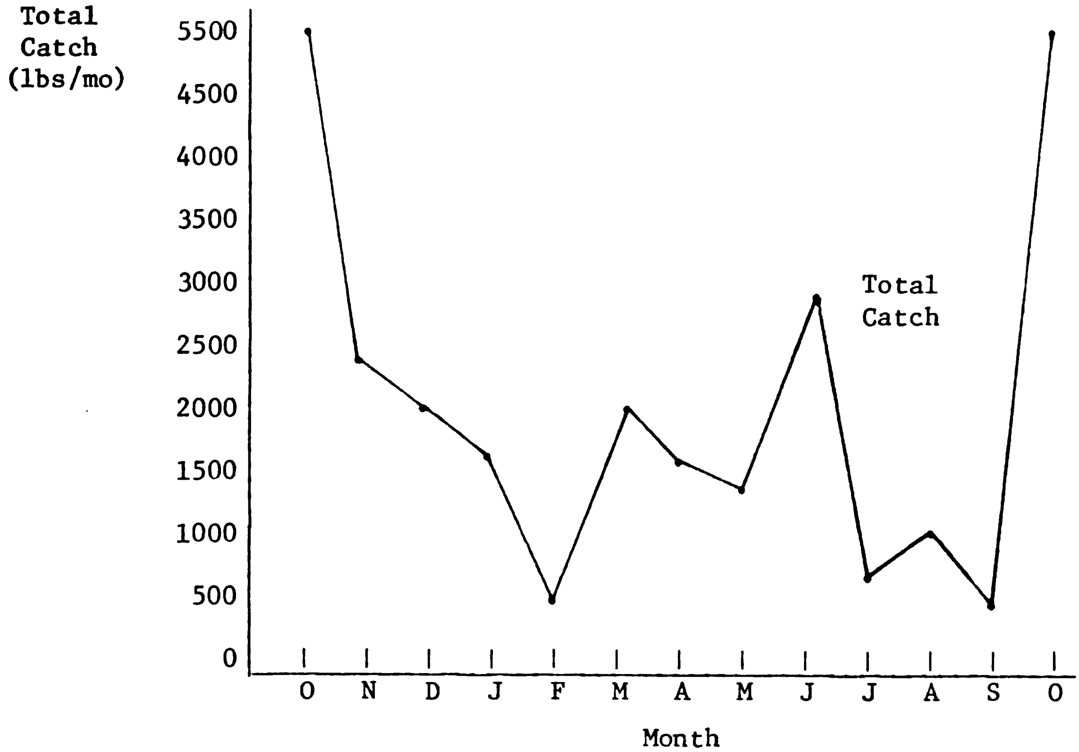
b) Representative Firm B



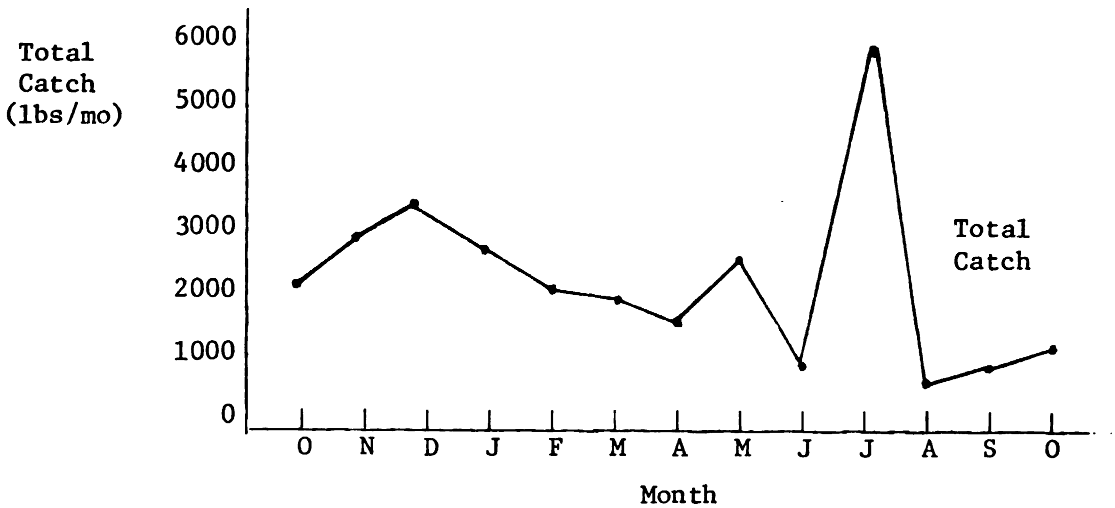
c) Representative Firm C



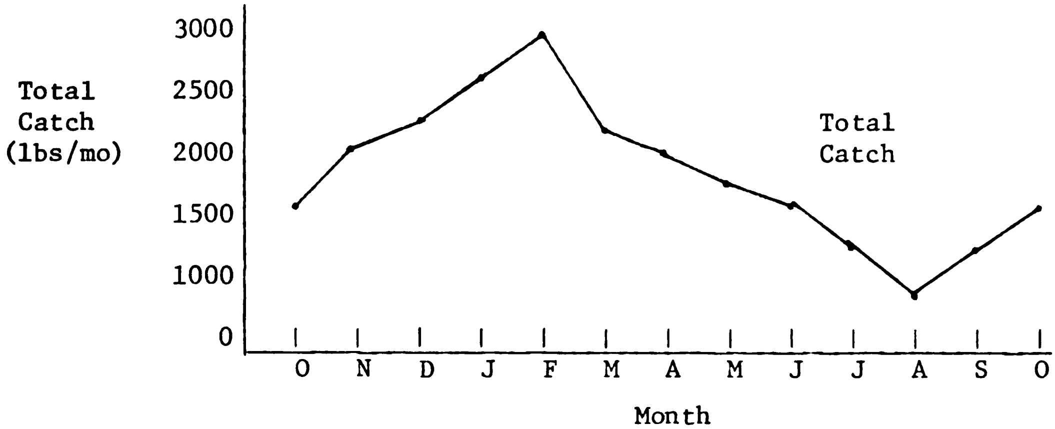
d) Representative Firm D



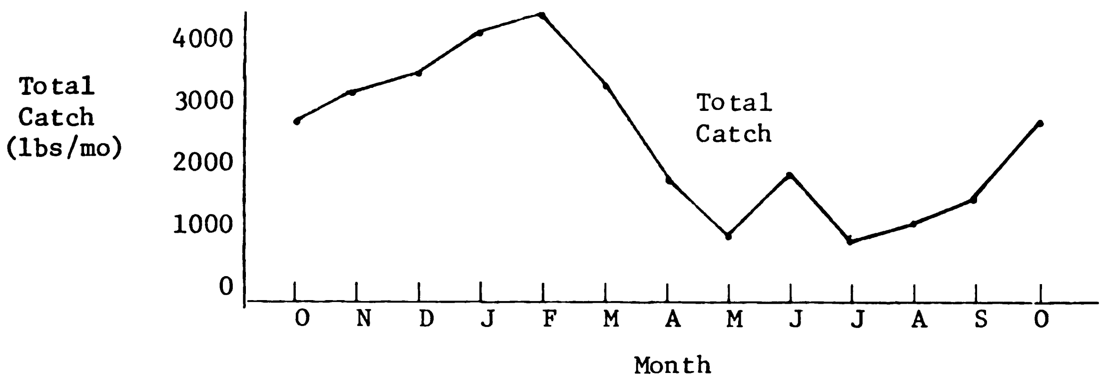
e) Representative Firm E



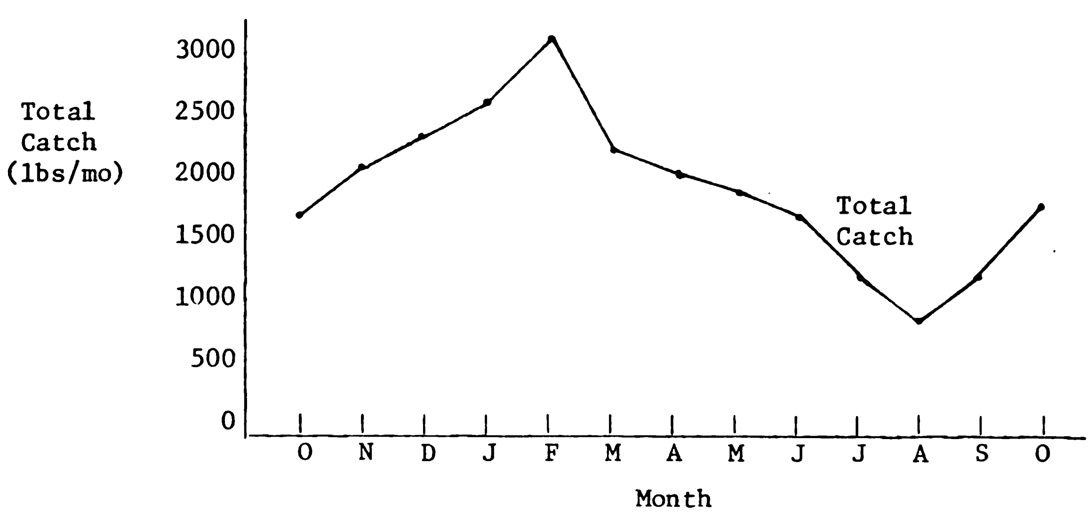
f) Representative Firm F



g) Representative Firm G



h) Representative Firm H



i) Representative Firm I

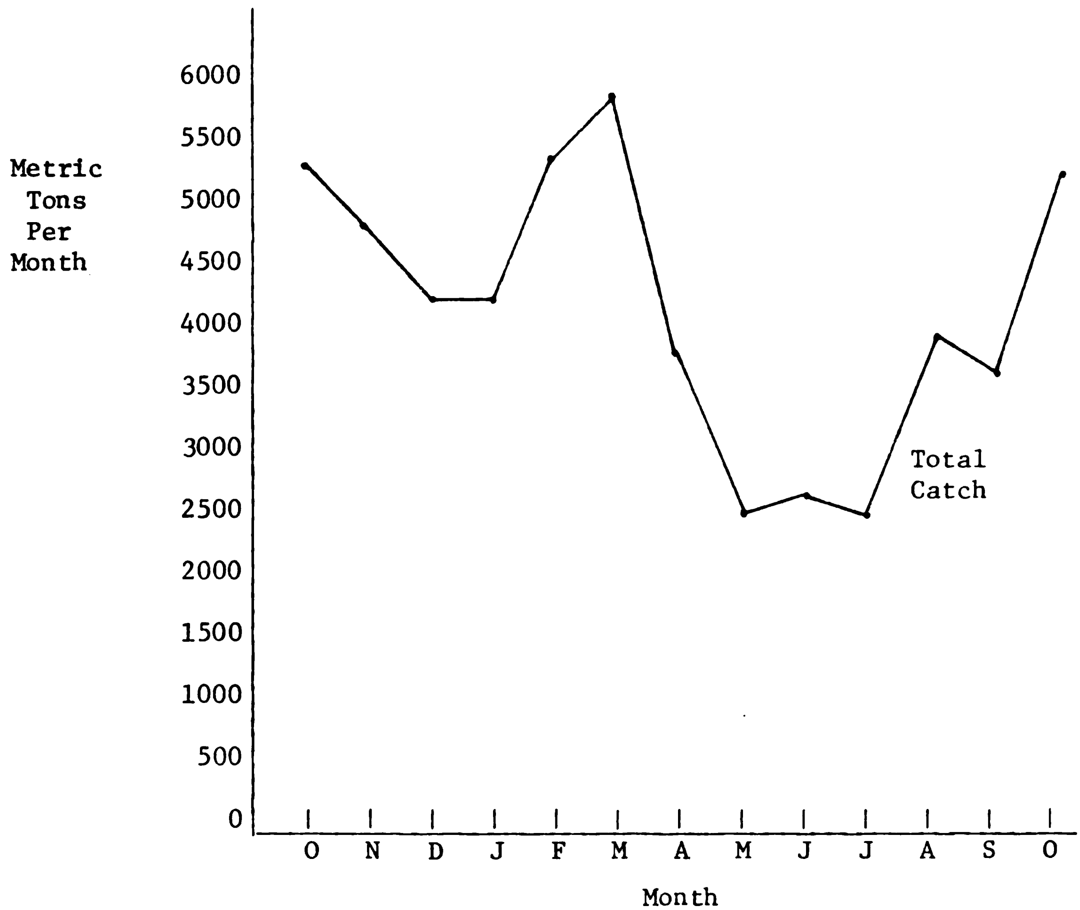


FIGURE 4.3

TOTAL DOMESTIC SEASONAL SUPPLY FROM SMALL-SCALE FISHERIES, 1974-1975 equipment capital with the family and hired labor resources at its disposal. In order to estimate costs and returns to scarce resources used by the firms in fish production, enterprise budgets for each firm type are shown in Table 4.12. All costs and returns shown in Table 4.12, 4.13, 4.14, and 4.15 refer to the financial or private costs and returns to the fisherman; that is all inputs and outputs are valued at the prices fishermen actually paid or received.

The wage rates used in valuing family and hired labor were the actual regional wage rates by sex group employed in the region in which the firm was located. The exvessel price of output was based on the regional raw fish price for each species comprising the actual catch of the firm type. In contrast, economic costs and returns to the system value the resources and output from the point of view of the national economy, eliminating factor-price distortions between the various submarkets within the economy. Table 4.15 approximates the economic costs and returns as costs of capital and import duties are nearly equalized between the large and small-scale industries.

The net profit for the firm may be termed a "pure" financial profit as it consists of the remainder after paying all factors of production including family labor, its actual market value for that firm type and that location. In comparing the net profits between the different firm types (line E) in Table 4.12, all firm types are obtaining some degree of "pure" profit or return to the managerial skill of the household. However, the range of net profit is considerable, from a low of Le 373 for type C to the most profitable firm type H with net earnings of over Le 6000. These differences may be explained due to either regional differences in the cost of inputs as

TABLE 4.12

FISH PRODUCTION ENTERPRISE BUDGETS FOR SMALL-SCALE REPRESENTATIVE F[illegible]I TYPES BASED ON SURVEY DATA OF 93 FIRMS IN SIERRA LEONE UNDER ACTUAL CONDITIONS: 40 PERCENT COST OF CAPITAL [illegible]D 36 PERCENT IMPORT DUTY ON FISH EQUIPMENT

Item	Standard Canoe			Kroo Canoe	Salla Boat			Fante Boat		National Average
	Ring Net Pad & Sail	Set Net Pad & Sail	Drift Net Pad & Sail	Cast Net Hook & Line Paddle	Beach S. Paddle	Ring Net <15H.P. Eng.	Ring Net >15H.P. Eng.	Ring Net <26H.P. Eng.	Ring Net >26H.P. Eng.	
	A	B	C	D	E	F	G	H	I	
EXPENDITURES										
A. Annual Service Cost of Capital										
1. Propulsion Equipment	2.96	2.76	3.50	1.28	3.75	266.92	742.42	936.13	1381.92	59.07
2. Boat and Boat Equipment	53.21	43.04	31.60	18.29	91.76	98.12	168.30	189.36	386.76	49.50
3. Net Equipment	130.56	143.50	89.44	14.32	195.07	267.78	716.62	852.45	843.92	147.30
4. Other Production Equipment	.71	1.20	1.69	.73	3.23	.07	6.54	9.33	13.48	1.76
a) Total Annual Service Cost of Equipment Capital	187.44	190.50	126.23	34.62	293.81	632.82	1633.88	1987.27	2626.08	257.63
b) Total Annual Service Cost of Working Stock Capital	11.20	20.06	2.28	2.87	2.49	2.52	6.25	19.48	16.00	8.09
B. Annual Labor Utilization by Type:										
1. Male Family Labor	300.96	160.27	185.28	134.28	213.84	540.59	856.58	1653.45	668.10	252.42
2. Female Family Labor	.36	.26	1.35		21.06	12.85	106.23	134.00	129.36	7.74
3. Male Hired Labor	115.32	181.05	82.20		287.21	89.12	3983.34	5149.50	6238.35	344.12
4. Female Hired Labor	.09		.09		11.25			23.84	4.80	.95
a) Total Annual Labor Costs	416.73	341.58	268.92	134.28	533.36	651.55	4946.15	6960.79	7040.61	605.23
C. Purchased Materials Inputs:										
1. Net Maintenance	36.10	63.35	27.62	7.13	23.75	92.60	384.04	401.74	473.00	56.55
2. Boat Maintenance	18.38	4.38	6.33	.95	49.55	18.51	169.39	92.34	302.88	15.99
3. Petrol						363.62	2882.55	3823.78	4262.98	185.01
4. Grease and Oil						34.79	400.31	549.59	698.05	26.53
5. Outboard Repairs						4.71	312.96	153.46	258.21	10.92
6. Other Purchased Material Inputs	10.22	2.25	.34			.19		1.34	27.61	2.14
a) Total Purchased Material Inputs	64.70	69.98	34.29	8.08	73.31	514.42	4149.23	5022.21	6022.74	297.24
D. Total Operating Expenditures	680.07	622.12	431.72	179.85	902.97	1801.31	10735.51	13989.78	15705.43	1168.19
INCOMES										
1. Value of Catch[a]	1359.60	1224.40	804.70	654.80	1589.66	2657.00	13933.00	20174.50	19891.60	1871.10
2. Less Total Operating Expenditures	680.07	622.12	431.72	179.85	902.97	1801.31	10735.51	13989.78	15705.43	1168.19
E. Net Profit for the Firm	679.53	602.28	372.98	474.95	686.69	855.69	3197.49	6184.72	4186.17	702.91
F. Net Returns per Hour of Family Labor	.39	.43	.36	.41	.42	.37	.59	.63	.82	.40
G. Cost per Metric Ton Landed	94.49	150.09	92.02	78.88	73.26	146.15	154.84	139.12	159.06	109.71
H. Net Returns Per Hour of Total Labor	.32	.25	.29	.41	.25	.34	.24	.28	.24	.27
I. Net Returns Per Leone of Capital Invested	2.33	2.19	1.98	7.93	1.51	1.20	1.85	2.59	1.56	2.03
J. Profit Per Leone of Fish Produced	.50	.49	.46	.73	.43	.32	.23	.31	.21	.38

well as sales price for the outputs received by the firm or to differences in the technological differences among the firm types. The regional differences in raw fish sales prices and wage rates were shown to vary significantly in Tables 4.11 and 4.5 respectively. Firm types B and D are comprised of firms from Western Area which obtained the highest raw fish sales prices and the lowest average rural wage rate of all regions. Firm types A, C and E are primarily composed of firms from Southern Region while types F through I come from Northern Region where rural wage rates are high and average raw fish prices are low in relation to other regions. However, these relative disadvantages for Types F through I are not reflected in either net profit or in returns to labor, which would tend to indicate efficiency differences in the technologies being practiced by the firm types. When comparing firms F through I, the possibility of regional influences is removed as the firms all pay the same unit cost for inputs and receive the same exvessel price for fish. It is interesting that when firms expand in the form of more mechanization and larger boat types, pure financial profits increase up to firm type H which has less than 26 horsepower. But when additional horsepower and boats of the same technological type are added, pure financial profits decline.

The net returns per hour of family labor (line F) in Table 4.13 are computed by costing all inputs except family labor at their current market value with the remainder being divided by the amount of family labor used. An implicit average value per hour of household labor is derived, which ranges from the lowest of Le .36 per hour from firm type C to a high of Le .82 per hour in firm type H which uses less family labor and more hired labor.

Public policy makers having a primary goal of producing fish in the least cost method would tend to compare firms across the line G, the cost per metric ton landed. Such a comparison, however, could be misleading as costs per metric ton do not reflect differences in value of the landing due to locational advantages of the landing with respect to lowest cost delivery to consumers and due to quality differences in the composition of the catch. A more appropriate comparison might be the cost per Leone of fish landed as shown in line J. Using this comparison, firm type E which ranked as best in the previous comparison fell to fifth rank behind firm types A, B, C and D.

Tables 4.13, 4.14 and 4.15 present a summary of similar budgets under alternative assumptions of varying the cost of capital and the import duty of fish equipment. In comparison with Table 4.12, Table 4.13 shows that while decreasing the cost of capital from 40 percent to 20 percent benefits firm types F, G, H and I relatively more than smaller firms (type A through E), it is insufficient to decrease total costs per Leone of fish landed enough to change the relative ranking of any firm in this comparison. This relative insensitivity to changes in capital costs between small-scale firms is primarily due to the small amounts of capital used in relation to other resources. The policy implications of this are discussed in Chapter 7.

If the rate of import duty is lowered to ten percent, i.e., the rate currently charged large scale equipment, the resulting budgets are shown in Table 4.14. This reduced rate would apply to imported canvas cloth for sails, nets and net supplies, and outboard engines and engine spare parts but not to petrol or oils used in outboard operation. It is evident that such a change would provide a greater

TABLE 4.13

FISH PRODUCTION ENTERPRISE BUDGETS FOR SMALL-SCALE REPRESENTATIVE FIRM TYPES BASED ON SURVEY DATA OF 93 FIRMS

IN SIERRA LEONE UNDER ASSUMED CONDITIONS: 20 PERCENT COST OF CAPITAL AND 36 PERCENT IMPORT DUTY ON FISH EQUIPMENT

Item	FIRM TYPE								
	Standard Canoe			Kroo Canoe	Salla Boat			Fante Boat	
	Ring Net Pad & Sail	Set Net Pad & Sail	Drift Net Pad & Sail	Cast Net Hook & Line Paddle	Beach S. Paddle	Ring Net <15H.P. Eng.	Ring Net >15H.P. Eng.	Ring Net <26H.P. Eng.	Ring Net >26H.P. Eng.
	A	B	C	D	E	F	G	H	I
	Leones								
EXPENDITURES									
1. Annual Service Cost of Equipment Capital	132.43	139.54	87.63	25.60	186.26	435.90	1162.97	1495.04	1942.85
2. Annual Service Cost of Working Stock Capital	5.60	10.03	1.14	1.43	1.25	1.26	3.12	9.74	8.00
3. Annual Family and Hired Labor Costs	416.73	341.58	268.92	134.28	533.36	651.55	4946.15	6960.79	7040.61
4. Annual Purchased Material Input Costs	64.70	69.98	34.29	8.08	73.31	514.12	4149.23	5022.24	6022.74
5. Total Annual Operating Expenditures	619.46	561.13	391.98	169.39	794.18	1603.13	10261.47	13989.78	15014.20
INCOMES									
1. Value of Catch[a]	1359.60	1224.40	840.70	654.80	1589.66	2657.00	13933.00	20174.50	19891.60
2. Less Total Operating Expenditures	619.46	561.13	391.98	169.39	794.18	1603.13	10261.47	13487.81	15014.20
3. Net Profit for the Firm	740.14	663.27	412.72	485.41	795.48	1053.87	3671.53	6686.69	4877.40
4. Net Returns per Hour of Family Labor	.42	.46	.38	.42	.47	.42	.66	.67	.93
5. Cost per Metric Ton Landed	86.07	135.38	83.55	74.29	64.44	121.19	148.00	134.12	152.06
6. Cost per Leone of Fish Landed	.46	.46	.49	.26	.50	.60	.74	.67	.76

[a]Valued at ex vessel price.

TABLE 4.14

FISH PRODUCTION ENTERPRISE BUDGETS FOR SMALL-SCALE REPRESENTATIVE FIRM TYPES BASED ON SURVEY DATA OF 93 FIRMS IN SIERRA LEONE UNDER ASSUMED CONDITIONS: 40 PERCENT COST OF CAPITAL AND 10 PERCENT IMPORT DUTY ON FISH EQUIPMENT

Item	FIRM TYPE								
	Standard Canoe			Kroo Canoe	Salla Boat			Fante Boat	
	Ring Net Pad & Sail	Set Net Pad & Sail	Drift Net Pad & Sail	Cast Net Hook & Line Paddle	Beach S. Paddle	Ring Net <15H.P. Eng.	Ring Net >15H.P. Eng.	Ring Net <26H.P. Eng.	Ring Net >26H.P. Eng.
	A	B	C	D	E	F	G	H	I
	Leones								
EXPENDITURES									
1. Annual Service Cost of Equipment Capital	160.12	167.70	116.70	31.29	248.78	535.15	1280.15	145.63	2080.49
2. Annual Service Cost of Working Stock Capital	11.20	20.06	2.28	2.87	2.49	2.52	6.25	19.48	16.00
3. Annual Family and Hired Labor Costs	416.73	341.58	268.92	134.28	533.36	651.55	4946.15	6960.74	7040.61
4. Annual Purchased Material Input Costs	57.69	57.68	28.93	6.70	68.69	495.53	4088.49	4914.47	5972.60
5. Total Annual Operating Expenditures	645.74	587.02	416.83	175.14	853.32	1684.75	10321.04	13351.37	15109.70
INCOMES									
1. Value of Catch[a]	1359.60	1224.40	804.70	654.80	1589.66	2657.00	13933.00	20174.50	19891.60
2. Less Total Operating Expenditures	645.74	587.02	416.83	175.14	853.32	1684.75	10321.04	13351.37	15109.70
3. Net Profit for the Firm	713.86	637.38	387.87	479.66	736.34	972.25	3611.96	6823.13	4781.90
4. Net Returns per Hour of Family Labor	.40	.45	.37	.41	.45	.40	.65	.68	.92
5. Cost per Metric Ton Landed	89.72	141.62	88.85	76.82	69.23	127.36	148.86	132.77	153.02
6. Cost per Leone of Fish Landed	.47	.48	.52	.27	.54	.63	.74	.66	.76

[a]Valued at ex vessel price.

TABLE 4.15

FISH PRODUCTION ENTERPRISE BUDGETS FOR SMALL-SCALE REPRESENTATIVE FIRM TYPES BASED ON SURVEY DATA OF 93 FIRMS IN SIERRA LEONE UNDER ASSUMED CONDITIONS: 20 PERCENT COST OF CAPITAL AND 10 PERCENT IMPORT DUTY ON FISH EQUIPMENT

Item	FIRM TYPE								
	Standard Canoe			Kroo Canoe	Salla Boat			Fante Boat	
	Ring Net Pad & Sail	Set Net Pad & Sail	Drift Net Pad & Sail	Cast Net Hook & Line Paddle	Beach S. Paddle	Ring Net <15H.P. Eng.	Ring Net >15H.P. Eng.	Ring Net <26H.P. Eng.	Ring Net >26H.P. Eng.
	A	B	C	D	E	F	G	H	I
	Leones								
EXPENDITURES									
1. Annual Service Cost of Equipment Capital	113.03	123.97	83.92	22.98	154.31	369.71	941.79	1055.82	1511.31
2. Annual Service Cost of Working Stock Capital	5.60	10.03	1.14	1.43	1.25	1.26	3.12	9.74	8.00
3. Annual Family and Hired Labor Costs	416.73	341.58	268.92	134.28	533.36	651.55	4946.15	6960.74	7040.61
4. Annual Purchased Material Input Costs	57.69	57.68	28.93	6.70	68.69	495.53	4088.49	4914.47	5972.60
5. Total Annual Operating Expenditures	593.05	533.26	382.91	165.39	757.61	1518.05	9979.55	12940.82	14532.52
INCOMES									
1. Value of Catch[a]	1359.60	1224.40	804.70	654.80	1589.66	2657.00	13933.00	20174.50	19891.60
2. Less Total Operating Expenditures	593.05	533.26	382.91	165.39	757.61	1518.05	9979.55	12940.82	14532.52
3. Net Profit for the Firm	766.55	691.14	421.79	489.41	832.05	1138.95	3953.45	7233.68	5359.08
4. Net Returns per Hour of Family Labor	.43	.48	.39	.42	.49	.44	.70	.71	1.01
5. Cost per Metric Ton Landed	82.40	128.65	81.62	72.54	61.47	114.76	143.94	128.69	147.18
6. Cost per Leone of Fish Landed	.44	.44	.48	.25	.48	.57	.72	.64	.73

[a]Valued at ex vessel price.

relative benefit in terms of increased net profits and returns to family labor for the larger firm types.

In Table 4.15 budgets are presented for the case when both the cost of capital to small-scale producers is lowered to 20 percent and the import duty is decreased to ten percent. In spite of the fact that the benefits of such policy changes are biased in favor of the larger, more capital intensive firms (types F through I), it is insufficient to alter their relative ranking with other firms in terms of cost per leone of fish landed.

4.8 Comparison with Large-Scale Fish Production

As previously mentioned, large-scale fish production is concentrated in five firms based in Freetown. Of these five firms producing for the domestic market, three firms are strongly influenced by expatriate management and ownership. These firms have the advantage of ready access to international capital sources. In contrast to the 40 percent estimated cost of capital in the small-scale industry, the large-scale firms have access to ten percent loans from domestic and international credit institutions.

The large-scale survey revealed that of the eleven vessels currently licensed for fishing, two boats were in irreparable condition. Interviews were denied in four of the five firms, but the data obtained from the one cooperating firm represents one third of the total vessels in operation.

Table 4.16 reveals the production budget for the large-scale firm operating three vessels equipped with bottom trawls. In contrast to small-scale production in which the annual costs of capital account

TABLE 4.16

FISH PRODUCTION ENTERPRISE BUDGET FOR LARGE-SCALE FIRMS BASED ON SURVEY OF ONE LARGE-SCALE FIRM IN FREETOWN, SIERRA LEONE

Item	Acquisition Cost		Annual Service Input Costs (10% Cost of Capital)				Annual Service Input Costs (20% Costs of Capital)			
	-----------	-----------	-----------	-----------	Leones	-----------	-----------	-----------	-----------	-----------
EXPENDITURES										
(a) Equipment and Building Capital:										
1. Industrial Buildings	60000 (assume 20 year life)		7048				12321			
2. Buildings Leased for 10 year base	1800 (per year)		1980				2160			
3. 3 trawlers (average tonnage 32.72 m.t.)	165000 (assume 10 year life)		26853				39356			
4. Wooden boxes	7200 (assume 3 year life)		2895				3418			
5. Coolers and refrigerator units	20000 (assume 5 year life)		5276				6688			
6. 3 vehicles	30000 (assume 5 year life)		7913				10031			
7. Office Equipment	1000 (assume 5 year life)		263				334			
8. Nets and Landing Equipment	62500 (assume 10 year life)		10171				14907			
9. Miscellaneous repair Equipment	8500 (assume 5 year life)		2242				2842			
10. Total Equipment and Building Capital Costs		354200		64941				92057		
(b) Working Stock Capital:										
1. Net Inventories and Spares	1000		100				200			
2. Vessel Inventories and Spares	2000		200				400			
3. Total Working Stock Capital Costs		3000		300				600		
(c) Total Equipment, Building and Working Stock Capital Costs				64941				92657		
(d) Labor:										
1. Wages and Salaries										
(i) Sea Skilled			19200				19200			
(ii) Sea Unskilled			92970				92970			
(iii) Shore Skilled			7200				7200			
(iv) Shore Unskilled			10582				10582			
(v) Administrative Skilled			12000				12000			
(vi) Total Salaries and Wages				141952				141952		
2. Other Benefits										
(i) Medical			1000				1000			
(ii) Residential Property Rented			5500				5500			
(iii) Total Other Benefits				6500				6500		
(e) Total Labor Costs				148452				148452		
(f) Purchased Material Inputs:										
1. Ice Purchases (6000 m.t. @ Le15.25 per m.t.)			91500				91500			
2. Insurance (.5% of acquisition cost)			1771				1771			
3. Net Maintenance			2000				2000			
4. Fuel and Oils			19140				19140			
5. Electricity, water, telephone, etc.			6100				6100			
(g) Total Purchased Material Input Costs				120511				120511		
(h) Total Annual Operating Expenditures					333904				361620	
INCOMES[a]										
(i) Peak Season Revenues (Le9160 per week for 30 weeks)				274793				274793		
(j) Slack Season Revenue (Le5760 per week for 22 weeks)				126716				126716		
(k) Total Annual Gross Revenue[b]					401509				401509	
(l) Less Total Annual Operating Expenditures					333904				361620	
(m) Profit for the firm						67605				39889
(n) Cost Per Metric Ton Produced						257.64				279.03
(o) Net Return Per Hour of Labor Employed[c]						2.01				1.75
(p) Net Return Per Leone of Capital Invested						.37				.37
(q) Profit Per Leone of Fish Produced						.17				.10

[a]Valued at exvessel price.

[b]Based on the following production figures derived from interviews with chief accountants. Average of two trips of two days each per week per vessel yielding 375 boxes of 30 pounds each during peak season and 208 boxes during slack season. This results in 208 fishing days per year per vessel as compared with an average of 219 fishing days per year per vessel over the 1971-73 period [Fisheries Division Report, 1967-73; 1975]. Production per vessel: peak season - 375 boxe per trip per vessel @2 trips per week for 30 weeks = 675,000 pounds and slack season - 208 boxes per trip per vessel @30 pounds per box @2 trips per week for 22 weeks = 274,560 pounds, totaling 949,560 pounds (949,560 pounds - 432 m.t. per vessel per year).

[c]Assumes 1500 hours per person per year.

for only 23 percent of total operating expenditures, even when discounted at 40 percent, annual cost of capital in the large-scale production when discounted at only 10 percent, comprise over 43 percent of operating expenditures.

While the value of labor used contributes 52 percent of small-scale production costs, it accounts for only 44 percent in the large scale industry. Approximately 30 percent of total labor costs for large-scale production are due to skilled technical and managerial staff, the majority of which is imported.

Crude measures of labor productivity such as the ratio of value added per leone of labor used take into consideration the differences in skill level employed as well as the differences in quality of catch produced. The ratio of value added per leone of labor for large-scale production is 1.27 while it is 2.60 for small-scale production. This indicates that indigenous labor, can be utilized more productively in small-scale fisheries than in large-scale production. This factor outweighs the influences of more capital equipment used in combination with labor in the large-scale industry.

When the cost of capital for the small-scale and large-scale industries are equalized at the assumed economic opportunity cost of 20 percent, small-scale production generates an average of Le .52 of "pure" economic profit per leone of fish produced by all firm types. In comparison, large-scale production generates only Le .10 of "pure" economic profit per leone of fish landed, in spite of its locational advantage of being based in Freetown, the main urban consumption center.

In summary, the large-scale sector tends to make more intensive use of skilled labor and capital, two resources in extremely limited supply in Sierra Leone, than was evident in the small-scale industry. In addition, virtually all of the capital equipment and much of the skilled labor needed in large-scale production is imported at considerable foreign exchange drain. In contrast, approximately 25 percent of the capital equipment in small-scale production is of indigenous materials and the local labor force supplies all of the labor skill needed in the small-scale industry.

In spite of the fact that output of the large-scale sector contains a greater percentage of high-quality species, and is landed near the Freetown consuming center, under current price conditions it costs approximately 83 cents per leone of fish landed by large-scale techniques in comparison with an average of only 53 cents per leone of fish landed using small-scale techniques. These considerations would indicate that investment in small-scale production might provide a viable alternative to large-scale production when considering possible employment and output results.

4.9 Summary

The analysis of the socioeconomic environment in which the small-scale firm operates revealed considerable variation between the Northern Region with alternative employment in commercial agriculture the Western Area which is largely urbanized and the more economically isolated areas of Southern Region.

Nine homogeneous firm groupings were constructed based on the type of production technology employed. Labor utilization varied by firm type in terms of the amount of labor employed relative to other resources, the type of labor used and the distribution of labor between fishing and nonfishing enterprises. At one extreme, firm type D (Kroo canoe, cast net, paddle) relied exclusively on family labor in fishing activities while those firm types operating salla and fante boats (types G, H, and I) employed hired labor for 75 percent of their total labor inputs. The amount of labor used annually in fish production by the different firm types ranged from 32 man-years for firm type I (fante boat, ring net, >26 HP eng.) to only one man-year in firm type D (Kroo canoe, cast net, paddle). This range partially reflects the greater seaworthiness of the larger boat types which permits continued operation of the craft under more adverse weather conditions. It was found that a high proportion (42 percent) of total male labor was allocated to net repair compared to actual fishing.

The seasonal profiles revealed that the October through March period was the peak fishing season, both in terms of monthly labor employment and output harvested. This period had a 61 percent increase in the monthly fish catch over the six month period between April and September. The annual output produced per firm ranged from 2.3 metric tons for firm type D (Kroo canoe, cast net, paddle) to slightly over 100 metric tons in firm type H (fante boat, ring net, <26 HP eng.).

Initial capital requirements for small-scale fisheries came primarily from retained earnings from previous employment, however noninstitutional credit sources (traders, friends, and relatives) provide almost half of the initial investment capital. The cost of capital for the small-scale firm was calculated at approximately 40 percent in comparison to a ten percent cost of capital for large-scale firms. The largest single item in terms of initial capital investment as well as input costs was the fish net, although for firm types F through I, the cost of operating and repairing the outboard engine accounted for over 85 percent of purchased input costs.

In the enterprise budget analysis of the different firm types, it was found that all small-scale technology types yielded "pure" economic profits. In comparison to the level of economic profits per leone of output produced in agricultural enterprises, the economic profits from small-scale fisheries surpass those attained in most types of rural production activities found in the coastal regions. When comparing the profit per leone of fish produced among the small-scale firm types, firm type D (Kroo canoe, cast net, paddle) had top ranking. In general the more labor intensive types had the higher profits per leone of fish landed. However all small-scale firms had significantly higher profits (lower costs) per leone of fish produced than did the large-scale firms. It was also found that lowering the cost of capital from 40 percent to 20 percent did not change the relative profitability rankings among small-scale firm types.

CHAPTER 5

PROCESSING AND MARKETING OF FISH SUPPLIES

An analysis of processing and marketing is vital to the study of the marine fisheries subsector. Since fish are extremely perishable in a tropical climate, the value of the producer's catch is dependent on the availability of processing facilities or a large number of consumers in the immediate vicinity. Since a majority of Sierra Leone consumers live a considerable distance from fish producing areas, an understanding of the indigenous system of small scale traders and processors is essential to developing fisheries as a low-cost, high-quality protein source.

Field research examined four segments of the processing-marketing system; (1) smoke processing, (2) smoked fresh fish wholesaling, (3) smoked fresh fish retailing and (4) raw frozen fish wholesaling. Descriptions of other minor segments such as small-scale raw fresh fish wholesaling-retailing, which were not covered by the field research will be constructed from available data.[1]

This chapter will provide a brief overview of the processing-marketing system followed by a more detailed examination of costs and returns of smoke processing, smoked fresh fish wholesaling and retailing, and finally raw frozen fish wholesaling. The modified

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[1]These are presented in Appendix 5, 6, and 7 and will be discussed in Chapter 6 where they are used to complete the aggregate model.

altona oven which has been developed by the Rural Fisheries Project in Elmina, Ghana, will be presented as an alternative to traditional smoke processing technologies.

5.1 Overview of Marketing Channels

The domestic fish supply comes from three different sources. Raw fresh fish are landed in relatively smaller catches by a large number of small-scale producers as well as in relatively larger quantities by a few large-scale producers in Freetown. These sources are supplemented by imports of raw frozen fish from foreign trawling fleets. Separate market channels have evolved to accommodate the variability and form of these three sources. A large number of smoke processors, each processing a small quantity, handle the daily catch of the isolated small-scale producers. Smoked fish wholesalers aggregate small-scale catches and deliver them to inland markets where they may be purchased either by other wholesalers who carry the product further inland or by retailers who supply local urban and rural consumers.

The large-scale catch is landed in Freetown where it is quickly retailed in the raw form to nearby urban markets. The large size of the urban population relative to the volume of the large-scale daily catch facilitates immediate sale with little or no processing necessary. In contrast, the frozen fish from foreign producers is imported and wholesaled by a single joint-venture company which owns cold storage facilities in eleven urban centers. The frozen fish must then be either retailed raw within six to eight hours or smoke processed because the retailer does not have frozen storage facilities.

5.2 Description of Smoke Processing

Most of the small-scale domestic catch is preserved and eaten in the smoked form. Usually smoke processing is undertaken by the fisherman's wife as soon as the catch is landed. Larger species are gutted and sectioned to increase the surface area of the fish exposed to the heat and smoke, thus facilitating a faster and more thorough drying process.

The traditional techology of the smoking platform (banda) is almost universally used throughout the coastal areas. The raised smoking platform may vary in size but in general, its efficiency is limited because the heat generated by the fire below is used only once as it passes through the single layer of fish. In contrast, the improved smoking ovens of Nigeria, Ghana, and Mali, layer the fish on six or seven wire racks stacked on top of each other, allowing the heat to pass through several layers before escaping; thus reducing fuel costs.

The traditional banda may be housed in a small corner of the family kitchen or in a separate well-ventilated structure. During the dry season, additional platforms may be constructed out of doors to facilitate processing of the increased seasonal catch. Local hardwoods provide the basic fuel with preference being given to trees of low pitch content. Coconut hulls, rice hulls and other combustible by-products may also be used. Kerosine is frequently used to ignite the fuels in order to create a more even temperature throughout the drying surface when a large catch is being quickly processed.

The costs and returns per 100 pounds of raw fish equivalents in the traditional smoke processing technique are shown in Table 5.1. All figures are based on raw fish equivalents because it was found that the

TABLE 5.1

COSTS AND RETURNS FOR SMOKE FISH PROCESSING USING TRADITIONAL TECHNOLOGY BASED ON SURVEY OF 93 FIRMS IN SIERRA LEONE (PER 100 POUNDS OF RAW FISH)

Item	Northern Region			Western Area			Southern Region		
	--------	--------	--------	--------	Leones	--------	--------	--------	--------
EXPENDITURES									
A. User Service Capital Costs[a]									
1. Fish Processing Equipment	.05			.05			.05		
2. Fish Smoking Platform	.04			.04			.04		
3. Inventory of Working Capital	.01			.01			.01		
a) Total Capital Costs		.10			.10			.10	
B. Labor Costs:									
1. Male Family .21 hrs.	.032			.019			.023		
2. Female Family 2.48 hrs.	.198			.149			.223		
3. Male Hired .05 hrs.	.008			.005			.006		
4. Female Hired .56 hrs.	.045			.034			.050		
a) Total Labor Cost		.28			.21			.30	
C. Purchased Material Inputs:									
1. Firewood	.27			.27			.27		
2. Kerosine and Miscellaneous Inputs	.01			.01			.01		
a) Total Purchased Material Inputs		.28			.28			.28	
D. Total Operating Expenditures			.66			.59			.68
INCOMES									
1. Value of Smoke Fish	9.86			12.95			10.47		
2. Less Value of Raw Fish	9.15			12.33[b]			9.73		
E. Gross Margins		.71			.62			.72	
1. Less Operating Expenditure		.66			.59			.68	
F. Net Profit to the Firm			.05			.03			.04
G. Return Per Hour Family Labor			.10			.07			.11
H. Cost Per Leone of Smoke Fish Processed			.07			.05			.06
Assuming 20 Percent Cost of Capital:									
A. Total Capital Costs			.08			.08			.08
B. Total Operating Expenditures			.64			.57			.66
C. Net Profit to the Firm			.07			.05			.06
D. Return to			.11			.08			.12

[a]Discount factor of 40 percent.

[b]The average value of raw fish used in smoking is less than the value of raw fish sold because the fresh fish market in Freetown provides an outlet for larger, better quality, raw fish which are more difficult to smoke adequately.

weight loss during the drying process varied with the length of time on the drying platform and the size and species of the fish. Samples of 70 selected catches in the five landing sites were weighed before and after smoking and it was found that species of raw fish weighing less than one pound experienced a 42 percent reduction in weight during the drying process. Species averaging more than one pound per fish had only a 24 percent reduction in weight per fish. Therefore, although the value per smoked fish is on average only 7 percent above its corresponding raw fish value; due to the weight loss factors, the price per pound of dried fish may be 40 to 85 percent greater than the price per pound of raw fish. The traditional technology is similar throughout the coastal regions, but the cost of inputs, particularly labor, varies between regions. Fuels comprise the largest single input cost, covering about 44 percent of all drying costs while labor costs constitute an additional 36 to 44 percent depending on the region.

Returns per hour of family labor in smoke processing are significantly lower than in the fish production sector. However, since female labor comprises over 76 percent of all labor used in processing, the relevant comparison is with the regional wages for females. This reveals that returns to labor in processing are slightly higher than the corresponding female wage rate in each region.

Because the annual service cost of capital constitutes a minor part of the operating costs, a reduction in the cost of capital from 40 to 20 percent has a minor influence on the returns to labor and firm profits. From line H, of Table 5.1 it can be seen that processing costs constitute approximately six cents or six percent of the value of smoke processed fish.

For purposes of comparison, technical efficiency ratios of the modified altona oven were adapted to Sierra Leone resource costs in constructing Table 5.2. The oven consists of seven square wooden-framed trays measuring four feet by four feet with wire mesh across the bottom, which are layered inside the oven. The oven is made of local brick with a thin cement plaster on the inside and has a corregated iron roof. The modified altona oven requires considerably more capital investment than the traditional banda but uses approximately 40 percent less fuel and only one fourth the labor required by the banda per unit of fish processed.

An additional advantage of the altona oven, not reflected in Table 5.2 is that it produces a more uniform product having a longer shelf life than is capable on the traditional banda. Fish, hot-smoked for three-four hours on the traditional banda, frequently need additional re-drying by wholesalers and retailers after four-five days while fish having been smoked a comparable time in the altona oven have an estimated shelf life of six to ten days depending on humidity and initial moisture content. This preliminary examination indicates that the altona oven has distinct advantages over current processing technologies in reducing the required amount of labor and fuel, the two largest cost items in using the traditional banda technique. Therefore the altona oven merits further research and development for Sierra Leone conditions.

5.3 Wholesaling of Smoked Fish in Urban Centers

The relationship between the smoked fish wholesaler and the producing community is many faceted. As previously mentioned, the small-scale producer turns to the fish wholesaler as his major source

TABLE 5.2

COSTS AND RETURNS FOR SMOKE FISH PROCESSING USING MODIFIED ALTONA OVEN (PER 100 POUNDS OF RAW FISH)

Item	Northern Region			Western Area			Southern Region		
EXPENDITURES				- - - Leones - - -					
A. User Service Capital Costs[a]									
1. Fish Processing Toosl	.05			.05			.05		
2. Modified Altona Oven[b]	.08			.08			.08		
3. Inventory of working	.01			.01			.01		
a. Total Capital Costs		.14			.14			.14	
B. Labor Costs									
Female family		.07			.05			.08	
C. Purchased Material Input									
1. Firewood	.15			.15			.15		
2. Kerosine and Miscellaneous Inputs	.01			.01			.01		
a. Total Purchased Material Inputs		.16			.16			.16	
D. Total Operating Expenditures			.37			.35			.38
INCOMES									
1. Value of Smoke Fish	9.86			12.95			10.47		
2. Less Value of Raw Fish	9.15			12.33			9.73		
E. Gross Margin		.71			.62			.72	
1. Less Operating Expenditures		.37			.35			.38	
F. Net Profit to the Firm			.34			.27			.34
G. Return Per Hour Family Labor			.38			.30			.38
Assuming 20 percent Cost of Capital									
A. Total Capital Costs			.10			.10			.10
B. Total Operating Expenditures			.33			.31			.34
C. Net Profit to the Firm			.38			.31			.38
D. Return per hour family labor			.42			.34			.42

[a] Discount factor of 40 percent.

[b] Total cost of oven of 260 lb capacity is 82.92 with expected lifetime of 5 years operating 200 per year.

Sources: [Goverment of Ghana/International Development Research Center Rural Fisheries Project, 1973], Discussions with staff of the Fisheries Division, Government of Ghana.

of short term working capital. Approximately 30 percent of the small-scale producers had a single fish wholesaler from outside their region to whom they regularly sold their catch. In addition, a study of 33 wholesale traders interviewed in the producing regions revealed that 25 percent of them bring other products, including foodstuffs, into the region for sale. Seventy-five percent considered their destination of fish sale as their home locality while only 20 percent originated from within the producing region.

Table 5.3 reveals the cost and returns to smoked fish wholesaling in various market channels based on a study of 20 traders who were monitored enroute throughout the channel from producer to consumer. Since traders could not be identified for some channels data for similar routes were used to construct representative budgets. The constructed budgets revealed several channels in which the gross margins between producing region and wholesaling destination were insufficient to cover labor and, in some cases, non-labor operating costs. Therefore, returns to trader's labor were far below the average female wage rate for that region which explains why no traders could be identified who covered these particular market channels.

Initially, wholesale labor was valued at the unskilled urban wage rate at the respective urban destination. In those routes for which data were actually attained, the simple average returns to the wholesale trader's labor was approximately 55 percent more than their respective urban wage rates. More appropriately returns could be weighted by the actual pounds of fish marketed in each channel which will be determined in the aggregate model in Chapter 6.

TABLE 5.3

COSTS AND RETURNS FOR SMOKED FISH WHOLESALING TO URBAN CONSUMER CENTERS BASED ON TRACER SURVEY OF 20 TRADERS (PER 100 LBS OF RAW FISH EQUIVALENTS)

Item	From Producer Region to Urban Consumer Center											
	Western Area				Northern Region				Southern Region			
	Western Area (20 Miles)	Northern Province[b] (130 Miles)	Eastern Province[b] (207 Miles)	Southern Province[b] (132 Miles)	Western Area (27 Miles)	Northern Province (112 Miles)	Eastern Province (211 Miles)	Southern Province (172 Miles)	Western Area[b] (48 Miles)	Northern Province[b] (118 Miles)	Eastern Province (238 Miles)	Southern Province (110 Miles)
	Leones											
EXPENDITURES												
A. Service Cost of Equipment Capital[a]	.04	.04	.14	.08	.07	.05	.18	.11	.09	.08	.13	.06
B. Service Cost of Working Capital	.01	.05	.13	.09	.03	.05	.16	.11	.06	.06	.09	.05
C. Wholesalers Labor	1.14	1.01	2.96	1.12	1.96	1.11	3.72	1.47	1.65	1.35	2.71	1.13
D. Other Variable Purchased Inputs												
1. Additional Drying Costs	.12	.17	.19	.18	.07	.10	.12	.11	.07	.08	.09	.08
2. Packing Services	.03	.07	.08	.08	.03	.05	.05	.05	.04	.04	.05	.04
3. Round Trip Transport for Trader	.42	.30	.49	.32	.34	.39	.22	.27	.30	.40	.58	.34
4. Round Trip Transport for Containers	.54	.55	.88	.56	.54	.59	.97	.83	1.00	.50	1.01	.50
5. Breakage	.28	.23	.38	.26	.40	.23	.35	.30	.32	.23	.37	.25
6. Seller's Fee		.43	.45	.52	.37	.56	.58	.52	.47	.51	.54	.52
7. Lodging and Storage	.13	.02	.09	.05	.31	.08	.19	.15	.36	.08	.10	.03
8. Market Fee	.08	.01		.01	.08	.01	.01	.01	.13	.01	.01	.01
9. Other	.20	.02	—	.02	.02	.04	—	.02	.15	.03	—	.01
(a) Total Variable Costs	1.80	1.81	2.56	2.00	2.16	2.05	2.49	2.25	2.84	1.88	2.75	1.78
E. Total Operating Expenditures	2.99	2.91	5.79	3.29	4.22	3.26	6.55	3.94	4.64	3.37	5.68	3.02
INCOMES												
1. Wholesale Sales Value	16.14	13.56	15.77	14.78	16.14	13.56	15.77	14.78	16.14	13.56	15.77	14.78
2. Less Wholesale Purchase Value	12.95	12.95	12.95	12.95	9.26	9.86	9.86	9.86	10.47	10.47	10.47	10.47
F. Gross Margin	3.19	.61	2.82	1.83	6.28	3.70	5.91	4.92	5.67	3.09	5.30	4.31
1. Less Total Operating Expenditure	2.99	2.91	5.79	3.29	4.22	3.26	6.55	3.94	4.64	3.37	5.68	3.02
G. Net Profit to the Firm	.20	-2.30	-2.97	-1.46	2.06	.44	-.64	.98	1.03	-.28	-.38	1.29
H. Return Per Hour Wholesaler Labor	.26	-.34	.00	-.06	.45	.38	.35	.35	.36	.21	.36	.45
Assuming 20 Percent Cost of Capital												
A. Service Cost of Capital	.04	.06	.18	.11	.07	.07	.23	.15	.11	.10	.15	.08
B. Total Operating Expenditures	2.98	2.88	5.70	3.23	4.19	3.23	6.44	3.87	4.60	3.33	5.61	2.99
C. Net Profit to the Firm	.21	-2.27	-2.88	-1.40	2.09	.47	-.53	1.05	1.07	-.24	.31	1.32
D. Return per Hour of Wholesale Labor	.26	-.34	.01	-.05	.45	.39	.36	.36	.36	.22	.37	.46

[a]Discount rate reflects computed 40 percent cost of capital

[b]Costs constructed from similar routes in sample because no trader in sample operated this route.

[c]Urban wage rates per hour used in calculations were as follows: Western Area, Le.22; Northern Province, Le.27; Eastern Province, Le.42; Southern Province, Le.21 as adapted from [Byerlee, Tommy, and Fatoo, 1976]

Some variable costs, such as transport, revealed consierable economies of size. Although the total transport cost varied directly with distance, the cost per unit delivered did not always convey this relationship, as a larger volume per trip was carried on longer trips than on shorter distances such as the Northern Region-to-Western Area channel. This was reinforced with the findings that 38 percent of smoked fish retailers in urban Western Area are regularly undertaking wholesaling activities in purchasing small quantities of smoked and raw fish from the Bullom Peninsula or rural Western Area on a twice weekly basis.

Over the sample of 20 traders monitored continuously enroute, it was found that breakage averaged between five to seven percent of the weight carried, depending on distance and the number of vehicle transfers needed in route. The broken fish were sold at a loss of 34 percent of the average retail price of fish in good condition.

In the public's opinion, the fish wholesaler is believed to be extracting unusually high returns due to her monopsonistic position in the fishing community and the opportunity for collusion between traders in the same locality. The findings of the present study would tend to indicate that while the returns to female labor in wholesaling are three or four times the female wage rate in the rural producing region, they are significantly less than the returns which could be earned in alternative entrepreneurial activities such as gara making [Liedholm and Chuta, 1976] in the community from which their labor is drawn.

5.4 Smoked Fish Retailing in Urban Centers

After reaching the urban wholesale market, smoked fish are usually purchased in smaller quantities by urban retailers (averaging ten days' supply). Even when larger quantities are purchased, the fish are completely unpacked from wholesaling containers, counted and examined for spoilage and breakage before being repacked by the retailer. Table 5.4 shows the costs and returns associated with smoked fish retailing in urban centers of the three provinces and Western Area. Variable costs such as market fees, storages, etc., differed between urban centers depending on the facilities available. In the Northern Province all of the retailers stored fish in their personal living quarters but an imputed cost of storage was determined from the wholesaling firms which averaged .08 cents per pound per day on the unsold balance. However, in Western Area 54 percent of the traders stored in commercial storage where average charges were .17 cents per pound per day on the unsold balance. Based on interviews with 81 retail traders dealing with bonga species in seven urban markets over an eight month period, the average retail price was 44 percent higher than the average wholesale price.

The return per hour of retailing labor was considerably below the urban wage rate for the area and approximately one third the returns to labor in wholesaling. While Table 5.4 is based on retailers who purchased locally and undertook retailing activities only, approximately 44 percent of smoked fish retailers were conscious of the higher returns in wholesaling and were purchasing their own supplies directly from producers in the coastal regions.

TABLE 5.4

COSTS AND RETURNS FOR SMOKED FISH RETAILING IN URBAN CONSUMER CENTERS

BASED ON MARKET SURVEY OF 57 TRADERS (PER 100 LBS. OF RAW FISH EQUIVALENT)

Item	Urban Consumer Centers							
	Western Area		Northern Province		Eastern Province		Southern Province	
	Leones							
EXPENDITURES								
A. Service Cost of Equipment Capital[a]		.12		.15		.17		.17
B. Service Cost of Working Capital[a]		.09		.11		.08		.10
C. Retailers Labor		9.02		14.74		26.46		13.01
D. Other Variable Costs:								
1. Additional Drying			.07		.06		.07	
2. Transport	.33		.17		.08		.26	
3. Storage	.46		.28		.23		.23	
4. Market Fee	.99		1.37		.65		.77	
a) Total Variable Costs		1.78		1.89		1.02		1.33
E. Total Operating Expenditures		11.01		16.89		27.73		14.61
INCOMES								
1. Retail Sales Value	23.24		19.52		22.70		21.28	
2. Less Retail Purchase Value	16.14		13.56		15.77		14.78	
F. Gross Margin		7.10		5.90		6.93		6.50
1. Less Total Operating Expenditure		11.01		16.89		27.73		14.61
G. Net Profit to the Firm		-3.91		-10.99		-20.80		-8.11
H. Return per Hour Retail Labor		.12		.07		.09		.08
Assuming 20 Percent Cost of Capital								
A. Service Cost of Capital		.15		.19		.19		.20
B. Total Operating Expenditures		10.95		16.82		27.67		14.54
C. Net Profit to the Firm		-3.85		-10.92		-20.74		-8.04
D. Return Per Hour of Retailing Labor		.13		.07		.09		.08

NOTE: Sample Size was as follows: Western Area, 13; Northern Province, 11; Eastern Province, 14; Southern Province, 29.

[a]Discount rate reflects computed 40 percent cost of capital.

5.5 Frozen Fish Wholesaling

Imported frozen fish are wholesaled to seven cold storage depots in major provincial cities and four depots located near different markets in the greater Freetown area. Table 5.5 presents the costs per metric ton of frozen fish delivered to the various centers. Higher per capita incomes and larger urban populations combine to make the Eastern Province one of the largest frozen fish outlets followed in rank by Western Area, Northern Province and Southern Province.

Most of the wholesaling operation is administered by the firm's central office in Freetown. Therefore, many of the variable expenses are not locational specific. The firm does not own transportation vehicles but hires private truck operators who are provided with an insulated truck box and are paid a fuel subsidy as well as a flat freight charge per ton delivered to the different centers.

In order to compare the costs of wholesaling smoked fresh fish and raw frozen fish in 1974, it is necessary to secure an accurate estimate of the annual tonnage passing through both channels to various inland areas. While aggregate wholesaling data were obtained in the field research, aggregate small-scale wholesaling weights by destination were generated in the 1974 base run of the aggregate model to be discussed in Chapter 5. A second condition for a meaningful comparison was that the products are uniform. Since a majority of the frozen fish are smoked before retailing, both channels were compared as to the unit costs of transforming raw fish at the coast into smoked fish at the inland wholesale markets.

Using the ton miles of fish transported according to the 1974 base run in Chapter 5, the weighted average cost per ton of

TABLE 5.5

FROZEN FISH WHOLESALING TO URBAN CONSUMER CENTERS, 1974 (COST PER METRIC TON)

Item	Consumer Center				
	Freetown 1,673 m.t.	Makeni 912 m.t.	Sefadu 2,029 m.t.	Bo 648 m.t.	Sierra Leone 5,262 m.t.
	Leones				
Variable Expenses					
Overhead	7.40	7.40	7.40	7.40	7.40
Staff Labor	24.99	24.99	24.99	24.99	24.99
Fuel Subsidy for Transport	.09	2.27	3.73	3.11	1.67
Road Freight Hire	.53	11.20	21.87	17.07	13.75
Other Hire Services	47.57	47.57	47.57	47.57	47.57
Administrative	2.95	2.95	2.95	2.95	2.95
Public Relations	1.68	1.68	1.68	1.68	1.68
Risk	.84	.84	.84	.84	.84
Total Variable Expenses	86.05	98.90	111.03	105.61	100.85
Capital Service Expenses[a]	12.42	12.42	12.42	12.42	12.42
Frozen Fish Purchase Including 10 Percent Duty	269.34	269.34	269.34	269.34	269.34
Total Cost Per Metric Ton Delivered at 10 Percent Cost of Capital	367.81	380.66	392.79	387.37	382.61
Total Cost Per Metric Ton Delivered Assuming a 20 Percent Cost of Capital	375.65	388.50	400.63	395.21	390.45

[a]Discount factor reflects 10 percent cost of capital.

transforming raw fish at the coast into smoked fish at the inland wholesale market for frozen imported fish was approximately 18 percent less than the cost for fresh domestically produced fish. The actual cost per ton mile of transportation and operation of the wholesaling firm was Le .79 per ton mile for frozen fish versus Le 1.18 per ton mile for fresh fish or approximately 60 percent greater for fresh fish. Because frozen fish are processed in the urban centers where higher wage rates are paid, the smoke processing costs accounted for 26 percent of the total wholesaling costs. Fresh fish, being harvested in the rural coastal communities, is smoke processed paying low rural wage rates. Consequently, processing costs contribute only nine percent of total marketing costs for fresh domestically produced fish.

5.6 Summary

In conclusion this chapter has examined the costs and returns to resources used in smoke processing, wholesaling and retailing of smoked fresh fish as well as wholesaling raw frozen fish. It was found that smoke processing using the traditional banda resulted in a 40 to 85 percent increase in the value of raw fish, partially due to the extreme perishability of raw fish. Fuel and labor costs involved in traditional smoke processing constitute 80 to 90 percent of the total costs of processing. It was found that these costs could be drastically reduced by introducing the modified altona oven which because of its improved heat circulation, uses 40 percent less fuel and only one fourth the labor per unit of fish compared to the traditional banda processed.

The analysis of the wholesaling and retailing industries for smoked fish revealed that the fish wholesaler does not obtain unusually high returns when compared with alternative enterpreneurial activities possible in the urban center. The returns to urban retailers were considerably below that earned by wholesalers. Lastly a comparison of the costs per ton for wholesaling fresh versus frozen fish revealed that total wholesaling costs per ton were 18 percent less for frozen fish than for fresh fish. However because of the necessity for processing much of the frozen fish in urban centers, the proportion of total wholesaling costs incurred because of processing the frozen fish was nearly triple the share incurred by processing fresh fish.

CHAPTER 6

AN AGGREGATE MODEL OF THE FISHERIES SUBSECTOR

The economic operations of nine small-scale production firm types and a large-scale production firm were described and analyzed in Chapter 4. Their associated smoke processing, wholesaling, and retailing industries were evaluated in Chapter 5. Building on these preceding analyses, this chapter will present an aggregate linear programming model representing the combination and interaction of each of the various types of production, processing and marketing agents in the fisheries sector. The purpose of the model will be to evaluate alternative development strategies which will maximize the returns to the subsector subject to regional equipment, labor, and capital and demand constraints. A diagrammatical explanation of the production-processing-delivery systems is followed by a mathematical formulation of the model describing the interactions of the system. Basic assumptions, constraints and activities in the model are discussed before the various runs of the model depicting the 1974 and the projected 1980 situations are analyzed.

6.1 Description of the Model

The country was stratified into three small-scale production regions, with large-scale production and importation being located at Freetown. Consumption demand was identified for the rural and urban populations in the three Provinces and Western Area. Figure 6.1 provides a description of the alternative production-processing-marketing channels incorporated in the aggregate model.

Demand for raw and smoked fish in rural and urban areas (activities 15 through 17) must ultimately be met from three sources of supply; small-scale producers, large-scale domestic producers or imported from large-scale foreign producers. This transfer from producer to consumer is accomplished through six basic channels. Smoke fish may be delivered from (a) small-scale producers (activities 1-4-9-12-17) or from (b) raw frozen fish imports (activities 3-7-8-10-14-17). Raw fish in urban areas may originate either from (c) small-scale producers whose output is wholesaled-retailed directly (activities 1-5-11-16) or from (d) large-scale producers delivering directly to Freetown markets (activities 2-6-11-16) or from (e) raw foreign fish imports (activities 3-7-8-10-13-16). Finally, raw fish in the rural coastal regions may be purchased directly from the small-scale producing firms (activities 1-5-15). Processing of the domestic catch is primarily done at the place of catch while frozen imports remain raw, ungutted until after thawing by the urban retailer who may gut, section (activity 13) and/or smoke process (activity 14) depending on the demand. Because of the rapid putrification of raw fresh fish, wholesaling and retailing (activity 11) is vertically integrated with the same agent carrying the product from producer to consumer.

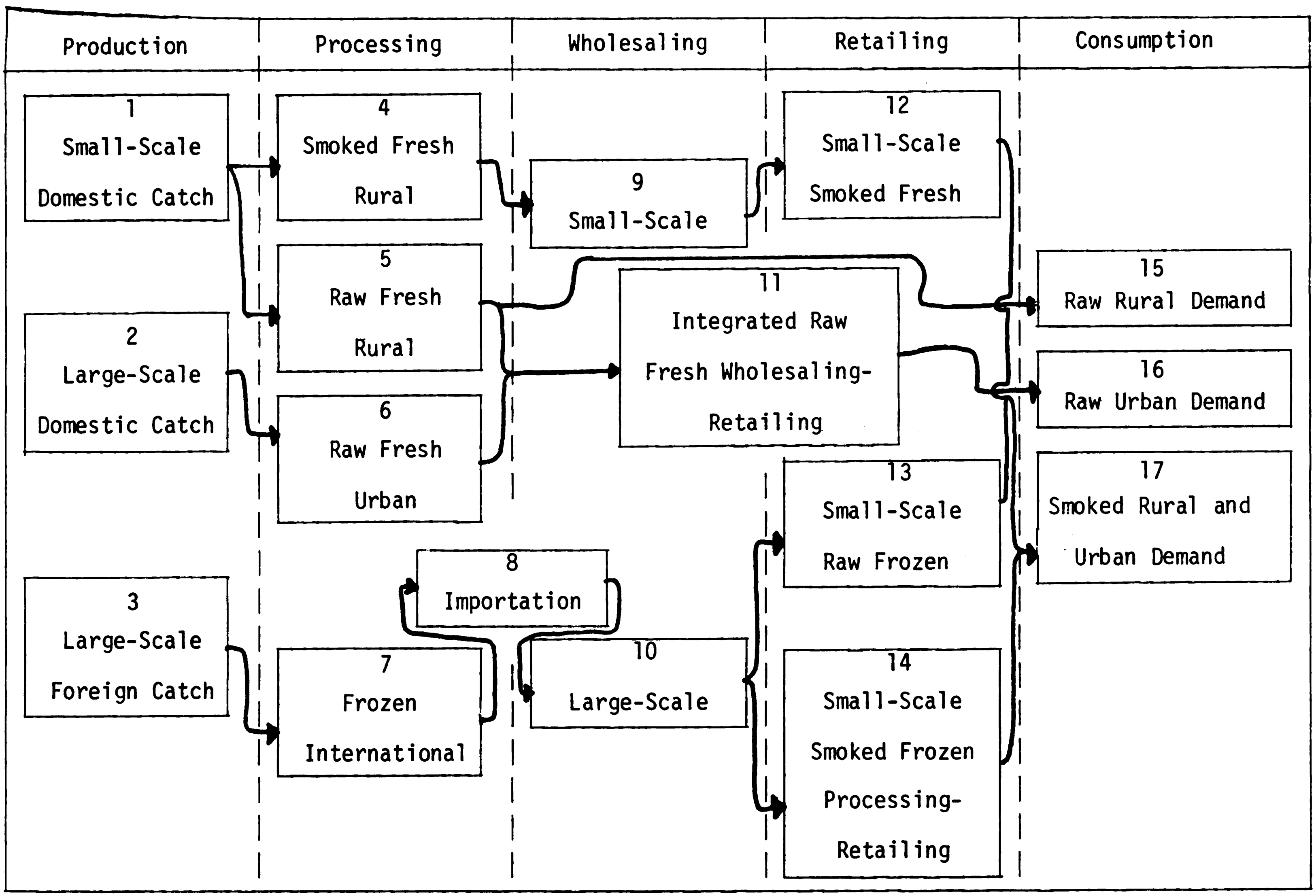

Figure 6.1 Commodity Flow Diagram of Fisheries Subsector

In defining the costs and revenues involved, the following symbols, subscripts and superscripts are used:

Symbols

Z = net returns to the subsector or total "economic" profit

T = total cost

M = purchased material input costs per unit of output

W = wage rate per unit of labor

L = units of labor per unit of output; man-hours for small-scale industries, man-years for large-scale industries

$\bar{L}$ = fixed labor constraint; man-hours for small-scale industries, man-years for large-scale industries

Q = quantity in 100 pound raw fish equivalent units

P = price per 100 pound raw fish equivalent unit

F = boat equipment unit consisting of boat with associated net and propulsion equipment

$\bar{F}$ = fixed constraint on number of boat equipment units available

K = annual capital cost of equipment and working capital stocks per unit of output where,

$$K = \frac{rV}{1 - (1+r)^{-n}}$$

with r = discount rate of capital,

n = average life expectancy of capital item,

and V = the original acquisition cost of the capital item

$\bar{K}$ = fixed constraint on annual capital costs.

Superscripts

o = production

i = import

n = smoke processing

h = wholesaling

r = retailing

d = demand

Subscripts

i = form of fish product delivered, i.e., raw fresh, raw frozen, smoked fresh, or smoked frozen

a = demand area

j = type of technology employed by either production or processing firms

k = production region

s = sex group for labor in small-scale industries and skill level for labor in large-scale industries

ka = interregional transfer from production region "k" to demand area "a"

6.1.1 Objective Function

In mathematical formulation, the aggregate model consists of the following set of equations.

$$\text{maximize } Z = \Sigma_i \Sigma_a P_{ia} Q^d_{ia} - (T^o + T^i + T^n + \Sigma_i T^h_i + \Sigma_i T^r_i) \qquad (1)$$

The objective function may be defined as maximizing the difference between total revenue from sales in activities 15 through 17 and total cost incurred in activities 1 through 14 excluding activities 3 and 7 in Figure 6.1.

6.1.2 Activity Vectors

Domestic Production (Figure 6.1, activities 1 and 2)

$$T^o = \left[\Sigma_j \Sigma_k M^o_{jk} + \Sigma_s \Sigma_j \Sigma_k W_{sk} L^o_{sjk} + \Sigma_j \Sigma_k K^o_{jk} \right] F_{jk} \qquad (2)$$

In the case of large-scale production, only one (j) type of technology, i.e., trawling, is available which is operated in one (k) region, i.e., Western Area. The interest rate (r) used in calculating the annual capital cost (K_j^o), cost is held constant for different technology types within any one industry but usually differs between large and small-scale industries due to the fragmented capital market in Sierra Leone.

Foreign Importation (Figure 6.1, activity 8)

$$TC^i = PC^i Q^i \tag{3}$$

The purchased material costs of imports consists of the international price of frozen fish plus the import duties levied per 100 pounds of fish.

Smoke Processing (Figure 6.1, activity 4 and 14)

$$T^n = \left[\Sigma_j \Sigma_k M_{jk}^n + \Sigma_s \Sigma_j \Sigma_k W_{sk} L_{sjk}^n + \Sigma_j \Sigma_k K_{jk}^n \right] Q_{jk}^n \tag{4}$$

In the initial 1974 model only one (j) type of smoke processing is incorporated in the model, i.e., the traditional banda. However in the 1980 model the modified Altona oven may be activated to an equivalent of 30 percent of the total smoked fish produced in each region k in 1974. The Altona oven uses only two labor types (s), i.e., female family and female hired as compared to four labor types in traditional smoke processing technologies. In Equation 6 below frozen fish are smoked by the retailer (activity 14); only the traditional technology is available and all processing labor is valued at the wage rate in the demand area (a) where the processing occurs rather than production region (j).

Raw processing (activities 5 and 6) does not involve investment of material, labor or capital costs as the fish are already in this form when harvested. Market channel 1-5-15 depicts direct consumption including subsistence consumption in the producing regions and as a result it does not incur any processing-marketing costs.

Wholesaling (Figure 6.1, activities 9, 10, and 11)

$$\Sigma_i T_i^h = \left[\Sigma_i \Sigma_{ka} M^h_{ika} + \Sigma_i \Sigma_s \Sigma_{ka} W_{isa} L^h_{iska} + \Sigma_i \Sigma_{ka} K^h_{ika}\right] Q^h_{ika} \tag{5}$$

When the form of fish product (i) being considered is smoked or raw fresh (activities 9 and 11), the labor type (s) refers to the female labor invested at the unit cost of the small-scale industrial uneducated urban wage in the demand area (a) served. Otherwise when "i" indicates frozen fish (activity 10), labor types (s) refers to skill level and is valued at that large-scale industrial skill level salary in urban Western Area (a). The same small-scale versus large-scale distinction applies when considering interest rate (r_i) and expected equipment life (1_i).

Retailing (Figure 6.1, activities 12, 13 and 14)

$$\Sigma_i T_i^r = \left[\Sigma_i \Sigma_a M^r_{ia} + \Sigma_i \Sigma_s \Sigma_a W_{isa} L^r_{isa} + \Sigma_i \Sigma_a K^r_{ia}\right] Q^r_{ia} \tag{6}$$

Costs of transport from urban market to rural consumers are included in purchased material costs M^r for retailing smoked fish to rural demand areas. Since all retailing is undertaken by the small-scale industry, the interest rate (r_i) and life expectancy (l_i) remain constant for all firms. However the amount of equipment required varies by type of retailing.

6.1.3 Resource and Demand Constraints

Demand Constraints

$$\Sigma_i \Sigma_a Q^d_{ai} \equiv \Sigma_j \Sigma_k Q^o_{jk} + Q^i \qquad (7)$$

Imports are allowed to compete with domestic production in satisfying area demands and all effective demand must be met.

Production Equipment Constraints

$$F_{jk} \leq \overline{F}_{jk} \qquad (8)$$

The total number of available boat/net/propulsion units ($\overline{F}_{jk}$) is fixed in the 1974 model but in the 1980 model is allowed to adjust with the varying flexibility constraints of 50 percent more and 50 percent less than the 1974 "$\overline{F}_{jk}$" in particular runs or 100 percent more and 50 percent less in alternative runs depending on the assumed rate of new boat construction. The only exception to the 50 percent lower flexibility constraint was in the case of large-scale production equipment. Because large-scale firms can dispose of non-profitable equipment stocks through international sales or transfers, the lower flexibility constraint was established at 66 percent less than the 1974 "$\overline{F}_{jk}$".

Regional Labor Constraints

$$\overline{L}_{sk} \geq \Sigma_j \left(L^o_{sjk} + L^n_{sjk} \right) \qquad (9)$$

Small-scale production and smoke processing labor was unconstrained in the 1974 base run model but was then constrained by sex by region in the 1980 base run at a level permitted by a 4.6 percent compound annual growth rate in the quantity used in the 1974 base run. However, female labor in rural Western Area was left unconstrained in the 1980 model because it is primarily used to prepare meals for hired labor, a task which can easily be augmented by labor from other enterprises or from nearby urban labor pools. Large-scale labor was assumed unconstrained in both models as the higher skilled labor (sea captains, managers) are frequently recruited abroad and lower skilled labor can be easily drawn from urban unemployed in Freetown.

<u>Small-scale Annual Production Capital Constraints</u>

$$\overline{K} \geq \Sigma_j \Sigma_k K_j^o Q_{jk}^o + \Sigma_j \Sigma_k K_j^n Q_{jk}^n \qquad (10)$$

Like labor, capital was unconstrained in the 1974 base run but was constrained nationally for production and processing industries in the 1980 model at a level attained by a 5.4 percent compounded annual growth rate in the quantity required by the 1974 base run. This corresponds to the annual growth in new productive capacities in the agricultural sector proposed for the current planning period.

<u>Large-scale Annual Production Capital Constraints</u>

$$\overline{K} \geq K_{jk}^o F_{jk} \qquad (11)$$

Large-scale production capital was constrained in the same manner as small-scale capital described above, except in the closed-economy run of the 1980 model where an annual growth rate of 10.8 percent was required to attain a feasible solution given the other constraints. This can be justified since international capital supplies are accessible through joint-venture corporate ownership arrangements for large-scale firms.

6.2 Parameters of the Model

Since the aggregate model was based on the microeconomic survey described in previous chapters, Table 6.1 presents the sources for the various model parameters.

The present survey analyzed the cost and returns for smoked fresh and raw frozen fish wholesaling as well as smoked fresh fish urban retailing. These channels encompass a major portion of the total fish marketed. However a minor share of the total fish consumed are marketed in other forms through alternative markets such as raw whole-saling-retailing and rural smoked retailing not covered directly in the survey data. Based on data obtained in the surveyed channels and the author's familiarity with the other markets, activity vectors were constructed for these alternative channels to complete the aggregate model (see Appendices 5, 6, and 7).

The model is used to determine the following aggregate variables: (a) the quantity of output produced by both small-scale and large-scale industries as well as imports needed to meet domestic de-mand, (b) the number of establishments by type of technology producing, (c) the number of people employed in the production-processing-

TABLE 6.1

SOURCES FOR PARAMETERS OF THE AGGREGATE MODEL

Activity	Parameter	Source
Production	F_{jk}	Appendix 3
	M^b_{jk}	Tables 4.12 and 4.16
	W_{sk}	Table 4.5 and Appendices 5, 6, and 7
	L^o_{sjk}	Table 4.4
	K^o_j	Tables 4.12 and 4.16
Processing	$M^n_{jk}, L^n_{sjk}, K^n_j$	Table 5.1 and 5.2
Wholesaling	$M^h_{ika}, L^h_{iska} K^h_i$	Tables 5.3, 5.5 and Appendix 5
Retailing	$M^r_{ia} L^r_{isa} K^r_i$	Table 5.4 and Appendices 6 and 7
Total Revenue	Q^d_{ia}	Appendix 4
	P_{ia}	Table 5.4 and Appendices 5, 6, and 7

marketing system by region, (d) the quantity of smoked and raw fish marketed by each region through the various market channels (see Figure 6.1). In addition the model solves for the net economic returns to the subsector after paying the market price for all resources. The final aggregate statistic generated is the subsector's contribution to the country's Gross Domestic Product.

6.3 Modeling of the 1974 Situation

The activity vectors presented in the preceding sections compose the model describing the situation in 1974. The maximum number of boat units available were set as less than or equal to the number available in 1974. Table 6.2 provides a comparison of the base run with the actual 1974 conditions.

Base Run 1974. Since smoked and raw fish are close substitutes, one would expect their demand schedules to be closely interrelated. Retail sales of smoked fish compete with raw fish sales in satisfying domestic demand. For this reason, the base run integrates inland urban demand for smoked and raw fish supplied from both fresh and frozen sources. This is done by creating a single smoked fish demand in inland areas and allowing both fresh and frozen fish to compete in the markets after it is smoked. However, at the coastal urban areas (Freetown) fresh domestic and frozen imported fish supplies compete in satisfying both raw and smoked urban demands. In the rural coastal areas, raw fish demand is met by intraregional production only.

The result of this run is an optimal solution closely replicating the actual 1974 conditions yet allowing imported frozen and domestic fish supplies to compete freely in smoked and raw fish markets. Frozen imports which are required to meet domestic demand rose to 6,700 metric tons in the base run, just 12 percent more than actual reported imports for 1974. Conversely, domestic small-scale production industries were operating at over 91 percent of capacity while large-scale producers were operating at over 45 percent capacity. Because

TABLE 6.2

COMPARISON OF ALTERNATIVE RUNS OF 1974 MODEL WITH ACTUAL 1974 SITUATION

	Actual 1974 Situation[a]	Base Run Frozen Fish Competing With Fresh Fish
1. Parameters		
Cost of Capital in Small-Scale Industries	.40	.40
Cost of Capital in Large-Scale Industires	.10	.10
Import Duty on Frozen Fish	.10	.10
Import Duty on Small-Scale Equipment	.36	.36
Import Duty on Large-Scale Equipment	.10	.10
2. Number of Establishments:		
Type A, Std. Canoe, Ring Net, Paddle & Sail	569	569
Type B, Std. Canoe, Set Net, Paddle & Sail	1222	785
Type C, Std. Canoe, Drift Net, Paddle & Sail	2542	2542
Type D, Kroo Canoe, Cast Net, Hook & Line, Paddle	234	234
Type E, Salla Boat, Beach Seine, Paddle	147	147
Type F, Salla Boat, Ring Net, < 15 HP Eng.	203	203
Type G, Salla Boat, Ring Net, > 15 HP Eng.	79	79
Type H, Fante Boat, Ring Net, < 26 HP Eng.	114	114
Type I, Fante Boat, Ring Net, > 26 HP Eng.	51	51
Large-Scale trawlers	9	4
3. Small-Scale Fisheries Employment (man-years)[b]		
Production-Processing	n.a.	
Western Area		4149
Northern Province		7413
Southern Province		5045
Wholesaling-Retailing		
Western Area		10421
Northern Province		12731
Southern Province		8005
Eastern Province		8352
4. Large-Scale Fisheries Employment (man-years)		
Production	n.a.	
Unskilled Labor		196
Skilled Labor		13
Wholesaling		
Unskilled Labor		23
Semi-Skilled Labor		79
Skilled Labor		5
5. Output of Small-Scale Industries (metric tons)	n.a.	46205
6. Output of Large-Scale Industries (metric tons)	n.a.	1751
7. Frozen Fish Import Requirements (metric tons)	5980	6703
8. Net Economic Returns to the Subsector (million Leones)	n.a.	1.87
9. Value Added to Gross Domestic Product by the Subsector[c] (million Leones)	n.a.	17.28

[a]Derived from secondary sources discussed in Chapter 2.

[b]Assumes 1500 working hours per man year in small-scal subsector.

[c]Calculated as value of output less purchased inputs except labor and capital costs.

n.a. means not available.

this closely approximates the actual 1974 situation this was used as the base run for projections to 1980.

This base run indicates that the small-scale production-processing industry employed approximately 16,600 full time employees while large-scale producers employed 209 people. This derived employment level is about 25 percent more than other previous estimates of rural small-scale fisheries employment [Aubray, 1971,--10,000; FAO, 1973-b,-11,500; Government of Sierra Leone, 1973-b,--11,000]. Wholesaling and retailing of smoked and raw fish provide incomes for an additional 39,000 people. In total, the base run indicates that the fisheries subsector employs approximately 56,000 people or five percent of the labor force, in some aspect of the fish production-delivery system and contributes about 17 million leones to Gross Domestic Product, or nearly four times the subsector's estimated contribution in the early 1970s.

The interregional flows of fish indicated by the base run of the model in 1974 are shown in Table 6.3. All of 1974 small-scale production in Western Area was marketed raw to Western Area rural and urban markets. In addition to satisfying intraregional subsistence consumption, the Northern Region marketed 18.4 thousand metric tons of which 85 percent was smoked-processed in the region. This smoked output was then wholesaled to Freetown (36 percent) and to Northern Province inland markets (64 percent). The remaining 15 percent of marketed production from Northern Region was wholesaled raw to Freetown. Northern Region was the primary center for small-scale production, yielding 44 percent of all small-scale output. Marketed output from Southern Region small-scale producers was smoke processed and

TABLE 6.3

INTERREGIONAL COMMODITY FLOW IN 1974 AND 1980

To Demand Area / From Supply Area	Western Area		Southern Province		Northern Province		Eastern Province		Total Supply
	Raw	Smoked	Raw	Smoked	Raw	Smoked	Raw	Smoked	
	--Metric Tons--								
1974 Base Run									
Frozen Imports						2701		4002	6703
Large-Scale Western Area	1751								1757
Small-Scale Western Area	12070								12070
Small-Scale Southern Region			1808	6388		978		4498	13672
Small-Scale Northern Region	2797	5656			2092	9918			20463
Total Demand	16618	5656	1808	6388	2092	13597	0	8500	54659
1980 Base Run									
Frozen Imports				2688		3702		5485	11875
Large-Scale Western Area	1858								1858
Small-Scale Western Area	16090								16090
Small-Scale Southern Region			2867	6098		3029		6166	18160
Small-Scale Northern Region	4028	7753			2478	11906			26165
Total Demand	22776	7753	2867	8786	2478	18637	0	11651	74948
Run 1:									
Frozen Imports		5926		2688		3702		5485	17801
Large-Scale Western Area	2419								2419
Small-Scale Western Area	14755								14755
Small-Scale Southern Region			2867	6098		1285		6166	16416
Small-Scale Northern Region	5602	1827			2478	13650			23557
Total Demand	22776	7753	2867	8786	2478	18637	0	11651	74948
Run 4:									
Frozen Imports				2224		3702		5485	11411
Large-Scale Western Area	1295								1295
Small-Scale Western Area	17021								17021
Small-Scale Southern Region			2867	6562		3029		6166	18624
Small-Scale Northern Region	4460	7753			2478	11906			26597
Total Demand	22776	7753	2867	8786	2478	18637	0	11651	74948
Run 5:									
Frozen Imports				1176		3702		5485	10363
Large-Scale Western Area	3240								3240
Small-Scale Western Area	16882								16882
Small-Scale Southern Region			2867	7610		2751		6166	19394
Small-Scale Northern Region	2654	7753			2478	12184			25069
Total Demand	22776	7753	2867	8786	2478	18637	0	11651	74948
Run 6:									
Frozen Imports		137		2688		3702		5485	12012
Large-Scale Western Area	1721								1721
Small-Scale Western Area	16882								16882
Small-Scale Southern Region			2867	6098		3029		6166	18160
Small-Scale Northern Region	4173	7616			2478	11906			26173
Total Demand	22776	7753	2867	8786	2478	18637	0	11651	74948
Run 7:									
Frozen Imports									0
Large-Scale Western Area	1295								1295
Small-Scale Western Area	21481	755							22236
Small-Scale Southern Region			2867	8786				11651	23304
Small-Scale Northern Region		6998			2478	18637			28113
Total Demand	22776	7753	2867	8786	2478	18637	0	11651	74948

then wholesaled to other areas within Southern Province (54 percent), Eastern Province (38 percent) and Northern Province (8 percent). The marginal values per leone of fish produced through increased production equipment are shown for each technological type and each region in Table 6.4. This table reveals that under 1974 price and resource conditions, an additional leone of fish produced by the salla boat with beach seine technology will pay for all resources used plus a "pure" profit to the subsector of Le 1.22 if it is produced in Western Area and Le .71 or Le .64 if produced in Southern or Nothern Regions respectively. It is apparent that the salla boat with beach seine and the standard canoe with either the ring or drift nets yield the highest marginal values per leone of fish landed.

Considerable differences also exist in the level of marginal value of additional production of any one firm type when comparing across regions. Because of their closer proximity to higher income urban populations in Freetown and Eastern Province; Western Area and Southern Region are the most profitable regions for operating additional small-scale boats. However, increased production in the large-scale industry would not increase the level of "pure" profits to the subsector as it would be displacing production from other more profitable technologies including foreign imports.

6.4 Evaluation of Alternative Development Strategies in 1980

Based on the results of the 1974 base run, projections of the subsector's performance under alternative development strategies were made up to 1980, the end of the current planning period as shown in Table 6.5. Over this period it was assumed that the 1974 demand for

TABLE 6.4

MARGINAL VALUE PER LEONE OF FISH PRODUCED FOR ADDITIONAL EQUIPMENT UNITS BY TYPE OF FISHING TECHNOLOGY AND BY REGION IN 1974 BASE RUN

Type of Technology	Region		
	Western	Northern	Southern
	-----------	---Leone---	-----------
Std. Canoe, Ring Net, Paddle & Sail	.76	.35	.42
Std. Canoe, Set Net, Paddle & Sail	.18	0	.03
Std. Canoe, Drift Net, Paddle & Sail	.82	.38	.46
Kroo Canoe, Cast Net and Hook & Line, Paddle	.53	.23	.31
Salla Boat, Beach Seine, Paddle	1.22	.64	.71
Salla Boat, Ring Net, < 15 H.P. Engine	.60	.21	.25
Salla Boat, Ring Net, > 15 H.P. Engine	.32	.08	.12
Fante Boat, Ring Net, < 26 H.P. Engine	.48	.16	.22
Fante Boat, Ring Net, > 26 H.P. Engine	.24	.05	.05
Trawler	0		

TABLE 6.5

LEVEL OF RESOURCE UTILIZATION AND AGGREGATE RESULTS OF ALTERNATIVE 1980 RUNS

	Unit	Open Economy Runs							Closed Economy Run
		Varying Resource Availability				Favorable To Small-Scale	Favorable To Large-Scale	Unfavorable To Large-Scale	
		Base	1	2	3	4	5	6	7
1. Parameter	Percent								
Cost of Capital for Small-Scale Production Industries		40	40	40	40	20	40	40	40
Cost of Capital for Large-Scale Production Industries		10	10	10	10	10	10	20	10
Cost of Capital for Small-Scale Marketing Industries		40	40	40	40	40	40	40	40
Cost of Capital for Large-Scale Marketing Industries		10	10	10	10	10	10	20	10
Import Duty on Frozen Fish		10	10	10	10	10	40	10	--
Import Duty on Small-Scale Equipment		36	36	36	36	10	36	36	36
Import Duty on Large-Scale Equipment		10	10	10	10	10	10	20	10
Annual Growth in Labor Supply		4.6	2.3	4.6	2.3	4.6	4.6	4.6	7.5
Annual Growth in Small-Scale Capital		5.4	5.4	2.7	2.7	5.4	5.4	5.4	7.9
Annual Growth in Large-Scale Capital		5.4	5.4	5.4	5.4	5.4	10.8	5.4	-4.9
Maximum Growth in Capital Stock of Boats		50	50	50	50	100	50	50	100
Maximum Decline in Capital Stock of Boats		50	50	50	50	50	50	50	50
2. Number of Establishments	Number								
Type A, Std. Canoe, Ring Net, Paddle & Sail		855	855	855	855	1139	855	855	1139
Type B, Std. Canoe, Set Net, Paddle & Sail		758	612	612	612	609	758	758	609
Type C, Std. Canoe, Drift Net, Paddle & Sail		3812	3812	3812	3812	5083	3812	3812	5083
Type D, Kroo Canoe, Cast Net and Hook & Line, Paddle		319	117	351	117	117	223	319	468
Type E, Salla Boat, Beach Seine, Paddle		223	223	223	223	294	223	223	294
Type F, Salla Boat, Ring Net, <15 HP Engine		305	305	121	293	405	305	305	405
Type G, Salla Boat, Ring Net, >15 HP Engine		76	49	60	49	39	63	76	74
Type H, Fante Boat, Ring Net, <26 HP Engine		174	152	174	152	133	174	174	188
Type I, Fante Boat, Ring Net, >26 HP Engine		39	26	39	26	24	52	39	51
Large-Scale Trawlers		4.3	5.6	5.6	5.6	3.0	7.5	4.0	3.3
3. Labor Employment	Man-years[a]								
Small-Scale Production/Processing									
Western Area		5453	4765	5392	4765	5435	5453	5453	7143
Northern Region		9273	8218	8443	8217	9250	9275	9268	10274
Southern Region		6645	5809	6127	5808	6646	6714	6645	8164
Small-Scale Wholesaling/Retailing									
Western Area		14308	12810	13265	12797	14365	14126	14286	13735
Southern Province		10236	10236	10236	10236	10369	10668	10236	11003
Eastern Province		11450	11450	11450	11450	11450	11450	11450	13152
Northern Province		17470	17446	17457	17446	17470	17466	17470	17995
Large-Scale Production		223	287	287	287	155	388	206	155
Large-Scale Wholesaling/Retailing		190	285	247	285	182	165	192	
4. Capital	Thou. Le.								
Small-Scale Production/Processing Capital		1751	1577	1571	1571	1129	1762	1751	2115
Large-Scale Production Capital		94	120	120	120	65	162	132	65
Small-Scale Wholesaling/Retailing Capital		444	442	442	441	445	445	444	454
Large-Scale Wholesaling Capital		147	221	191	222	142	129	243	---
5. Aggregate Results									
Output of Small-Scale Industries	M. Tons	61215	54728	57117	54682	62240	61345	61215	73652
Output of Large-Scale Industries	M. Tons	1858	2419	2419	2419	1295	3240	1721	1295
Frozen Fish Import Requirements	M. Tons	11875	17801	15412	17847	11411	10363	12012	---
Net Economic Returns to the Subsector	Mil. Le.	2.81	2.09	2.45	2.09	4.05	2.06	2.66	3.54
Value Added to Gross Domestic Product by the Subsector	Mil. Le.	23.32	21.71	22.59	21.70	23.80	22.87	23.28	26.10

[a]Assume 1500 working hours per man year on small-scale industries.

Note: Altona Oven Capacity for smoke processing was used to maximum in all regions except Western Area where small-scale catch was marketed raw to Freetown.

fish would continue to grow at a compound annual rate of 5.0 percent per annum based on (a) a population growth rate of 2.3 percent per annum, (b) an annual increase in per capita income of 3.6 percent, and (c) an income elasticity of demand for fish of .74 as derived from a household budget study [Byerlee and King, 1976]. Other constraining resources (labor and capital) are allowed to grow at varying rates depending on the development strategy. Capital constraints in the 1980 models took two forms, (a) a total capital constraint for each production industry, both small-scale and large-scale, and (b) flexibility constraints on the number of boat and associated production equipment units available thus limiting the growth in new establishments. The level of capital constraints vary among the different runs.

The various runs of the 1980 model will trace the consequences of alternative assumptions on (a) the number of establishments, (b) the level of output produced by each industry as well as frozen fish imports required, (c) the level of employment by industry by region, (d) the capital requirements by industry and (e) the subsector's contribution to Gross Domestic Product. The assumptions or parameters governing the model will deal with changes in the (a) cost of capital, (b) import duty on frozen fish and imported fishing equipment, (c) annual growth in labor supply, (d) level of investment and (e) the annual growth in the capital stock of boats.

6.4.1 Policies Varying Resource Availability

Base Run 1980. If current import policies with respect to frozen fish and fish equipment as well as capital policies regarding small and large-scale capital costs are continued, the results are represented in the base run of the 1980 model. Although the actual growth in labor supply for small-scale fisheries is not known, the fact that returns were higher in fisheries than in other agricultural enterprises in the several rural coastal regions and that a considerable share of the respondents interviewed had migrated to the coastal communities would indicate a growth in labor supply greater than the 2.3 percent due to natural population growth alone. This run assumes an annual 4.6 percent growth rate in labor supply. Such an accelerated growth in fisheries manpower is possible only through a continuation of an active informal apprenticeship training program supplemented by more formal training proposed for implementation by the Fisheries Division in the current development plan. The current indigenous practice of four years of apprenticeship under a skilled fisherman, would most likely not facilitate the required growth in skills. The annual growth in small and large-scale capital is established at 5.4 percent, the rate of growth in new productive capacities proposed for the agricultural sector over the current planning period. Other parameters are assumed as specified in Table 6.5.

In comparing Base Run 1974 (Table 6.2) with the Base Run 1980 (Table 6.5), it is evident that certain more profitable technologies have established new firms at the maximum growth rate[1] possible (types A, C, E, F and H) while others have increased less rapidly and in some cases have declined over the period (types B, G, and I). At the same time, Table 6.3 shows that small-scale production increased by 33 percent in Western Area and Southern Region followed by 28 percent in Nothern Region. These results are confirmed by the relative magnitudes of marginal values per leone of fish produced by additional boat production units when comparing across technologies and across regions in Table 6.6.

Total employment in small-scale production-processing increased from 16,607 man-years in 1974 to 21,371 in 1980 or 4.3 percent annually according to the 1980 base run. Additional male labor commanded a higher marginal value in Southern Province than in Northern Province, but both were lower than the value attained in Western Area. If the growth in female labor supplied in rural Western Area was constrained to the natural population growth rate of 2.3 percent annually, additional female labor had a marginal value nearly 20 times the urban unskilled wage rate. This would be quite unlikely as labor would easily flow from alternative enterprises into fish production activities. Because of the ease of this transfer in Western Area, the supply of female labor was considered unconstrained in the 1980 model.

Small-scale output rose from 46,205 metric tons in 1974 to 61,344 metric tons in 1980 or approximately 5.5 percent annually while

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[1]Flexibility constraints on the construction of production equipment units permitted a maximum of 50 percent increase over the number of boat units available in 1974.

TABLE 6.6

MARGINAL VALUE OF ADDITIONAL RESOURCES BY TYPE BY REGION IN ALTERNATIVE 1980 RUNS[a]

Resource Type	Run														
	Base			1			4			5			6		
	West	North	South	West	North	South	West	North	South	West	North	South	West	North	South
1. Equipment Units (per leone of fish produced per unit)															
Std. Canoe, Ring Net, Paddle & Sail	.23	.21	.39	.18	.11	.11	.10	.13	.13	.32	.19	.55	.30	.20	.51
Std. Canoe, Set Net, Paddle & Sail	-.39	-.21	0	-.55	-.42	-.41	-.53	-.29	-.28	-.46	-.15	-.01	-.44	-.34	0
Std. Canoe, Drift Net, Paddle & Sail	.30	.24	.45	.23	.14	.14	.13	.15	.15	.38	.59	.62	.34	.23	.56
Kroo Canoe, Cast Net and Hook & Line, Paddle	0	.08	.28	-.11	-.07	-.07	-.17	-.03	-.02	0	-.02	.35	0	.01	.33
Salla Boat, Beach Seine, Paddle	.64	.48	.68	.67	.45	.44	.52	.41	.41	.85	.58	.96	.80	.56	.90
Salla Boat, Ring Net, <15 HP Engine	.27	.12	.24	.31	.13	.12	.24	.13	.13	.44	.21	.44	.39	.20	.39
Salla Boat, Ring Net, >15 HP Engine	.02	0	.11	0	-.05	-.05	-.05	-.05	-.05	.08	-.01	.20	.07	0	.18
Fante Boat, Ring Net, <26 HP Engine	.10	.06	.19	.08	0	0	0	0	0	.18	.07	.32	.16	.07	.30
Fante Boat, Ring Net, >26 HP Engine	.01	-.01	-.01	-.01	-.06	-.07	-.07	-.06	-.07	.07	-.01	0	.04	-.01	-.00
Trawler	0			0			-.00			0			0		
2. Production/Processing Labor (hours)															
Female[b]		0	0		0	0		0	0		0			0	0
Male	.23	.06	.01	.35	.20	.23	.31	.12	.15	.34	.21	.09	.30	.17	.08
3. Altona Oven Capacity (100 pounds)	0	.31	.30	0	.34	.36	0	.34	.36	0	.34	.32	0	.35	.34
4. Capital (Leone)															
Small-Scale Production/Processing	0			0			0			0			0		
Large-Scale Production	0			.93			0			1.39			.18		

[a]Positive marginal values increase the objective function while negatives decrease the objective function with the addition of resources.

[b]Female labor in Western Area was unconstrained.

the absolute level of large-scale output declined slightly over the period. The subsectors' contribution to Gross Domestic Product in terms of total leones increased by 5.1 percent annually over the period as shown in Table 6.5. In contrast, the absolute quantity of imports rose by 10 percent annually and the relative share of domestic supply coming from foreign imports increased from 12.3 percent in 1974 to 15.8 percent in 1980.

Analysis of the marketing pattern in the 1980 base run shown in Table 6.3, revealed that a greater proportion of Northern Regions' output supplies Freetown markets than in 1974 while smoked frozen imports are now necessary to meet demands in Southern Region which was self-sufficient in 1974.

Run 1--Slow Growth in Labor Supply. The 1980 base run assumed a growth in trained and untrained labor supply of 4.6 percent annually facilitated by some form of active recruitment and training program as proposed in the development plan. Run 1 traces the aggregate effects if such a program is not effectively implemented and the annual growth in manpower is the same as the population growth rate of 2.3 percent. The results of Run 1 reveal that frozen imports rose by nearly 50 percent above the level required in the Base run and increased approximately 18 percent annually from 1974. At the same time due to the relative labor scarcity, domestic production shifts to the more capital intensive large-scale firms. A greater proportion of the small-scale catch is now sold raw rather than smoked which requires scarce rural labor (see Table 3.6). This is compensated for by smoking frozen fish using urban retail labor, a resource not constrained in the model.

In summary, Run 1 confirms the importance of developing an extension-manpower training program as well as the economic incentives necessary to increase the supply of trained manpower available to small-scale producers above the population growth rate of 2.3 percent.

Run 2--Reduced Investments in Small-Scale Fisheries. A second assumption in the 1980 base run, was a 5.4 percent annual growth rate in capital as projected in the development plan--a growth rate considerably higher than in recent history. Run 2 presents the model results if such a capital growth rate does not materialize and the capital stock grows at a rate of 2.7 percent.

In this run imports increased by 30 percent over the 1974 level as compared with a 50 percent increase in Run 1 when the labor supply was constraining. Also evident is the 7 percent drop in employment in small-scale production occurring primarily in Northern Region and a shift among the small-scale firms to the more labor intensive types as exemplified by firm type D and to large-scale production for which the rate of investment was not reduced.

In comparing Run 1 and Run 2, it is clear that a reduced growth in trained manpower for fisheries has a stronger impact in inhibiting domestic fisheries development than does the projected slow growth in capital stock.

Run 3--Slow Growth in Both Labor and Capital Stock Supply. Run 3 combines the worst assumptions of both Runs 1 and 2 by assuming that neither available capital nor trained manpower grow at the projected rates as in the base run but rather grow at 2.7 and 2.3 percent respectively.

This run conforms more closely to investment and manpower performance of the 1960s and assumes a continuation of the past trends in resource use in fisheries. The net result in terms of domestic catch, labor employment, Gross Domestic Product and choice of production technology utilized, differs very little from the results of run 1. This again supports the evidence that an adequate supply of trained manpower is more critical to expanding domestic production than is increased access to capital.

6.4.2 Policies More Favorable to Small-Scale Production

Run 4--Reduced Capital Costs and Increased Growth in Capital Stock. In an effort to design a development strategy favorable to small-scale production, several alternative runs were examined which are not shown in Table 6.5. As mentioned earlier, the indigenous trader provides small-scale producers with their major source of operating and medium term investment credit at an annual cost of capital of over 40 percent in 1974. If this source is augmented by 1980 through an institutional credit program so as to reduce the cost of capital to its assumed economic opportunity cost of 20 percent, while leaving all other parameters unchanged, the first alternative run indicated that no change would occur in either the level or composition of technological firm types in operation, or the level of employment, output or Gross Domestic Product from the 1980 base run. The fact that no change occurred in the optimum choice of small-scale technology type is partially due to the relatively small amounts of capital used

by small-scale firms and the considerable differences in profitability between technology types. This indicates relatively little potential for capital-labor substitution between small-scale technologies over this range of interest rates.

However if small-scale capital costs are reduced to 20 percent and the construction of profitable boat types accelerated so that their population doubles by 1980 while leaving all other parameters at their 1980 base run levels, Run 4 shows that domestic production shifts from large-scale to small-scale firms due to the relatively cheaper capital in the small-scale sector and the available boats of firm types which are more profitable than large-scale firms. Within small-scale production, Table 6.6 indicates that only firm types A, C, E, and F yield positive marginal values per leone of fish produced by additional equipment resources. The population of these firm types doubled over the 1974-1980 period the maximum rate possible under the assumed flexibility constraint while the population of firm types B, D, G, H and I remain constant or decline over the period.

Total output by the small-scale industries and the subsector's contribution to Gross Domestic Product increases by nearly 20 percent over the base run and imports and large-scale output drop to their lowest level of any run considered thus far. Table 6.4 shows that the largest increase in small-scale production occurs in Southern Region followed closely by Northern Region. The increased production in Southern Region replaces part of the frozen imported fish previously required by Southern Province, while the increased production in Northern Region is marketed raw to Freetown replacing large-scale production.

Further policies designed to benefit capital intensive small-scale firms such as subsidizing petrol and oil costs at 25 and 40 percent rates were not sufficient to alter the small-scale production performance achieved in Run 4.

6.4.3 Policies More Favorable to Large-Scale Production

Run 5--Increased Growth in Large-Scale Capital and Increased Import Duties on Foreign Fish. Large-scale firms can obtain access to external capital from international markets. Therefore runs were executed which assumed an annual growth in large-scale production capital of 10.8 percent in contrast to the 5.4 percent previously assumed. Since some large-scale production capital was unused at a 5.4 percent growth rate, this change by itself did not produce results which differed from the base run.

When the import duty on frozen fish was increased from 10 to 20 percent in conjunction with the accelerated large-scale capital growth rate, three additional large-scale trawlers were activated to replace 1290 metric tons of frozen imports. Large-scale capital became constraining with a marginal value on additional capital of .42 leones. No change occurred in the small-scale industrial operation.

However, if the import duty on frozen fish was further increased to 40 percent, as is reported in Run 5, not only are the three large-scale trawlers activated but there is a shift within small-scale production from the labor intensive firms (type D) to firm type I (fante boat, ring net, >26 HP engine), in Western Area, which is a more capital intensive firm containing slack boat resources in the base run. Large-scale production capital becomes even more constraining. An additional leone of large-scale production capital would repay the borrowed leone and increase the economic profits of the subsector by Le 1.39. The increased large-scale production from the three additional trawlers replaces raw fish being marketed in Freetown from the Northern Region production within Northern Province which in turn frees more of Southern Region production for meeting demands within Southern Province.

In summary a policy of increasing the annual growth of large-scale production capital to 10.8 percent as well as increasing the import duty on frozen fish to 40 percent results in a 13 percent reduction in frozen fish imports, a 75 percent increase in large-scale production and a slight increase in small-scale production over the base run results. However, the subsector's annual contribution to Gross Domestic Product actually declines by two percent as compared to an increase of two percent when small-scale firms were favored in Run 4.

6.4.4 Policies Unfavorable to Large-Scale Production

Run 6--Increased Capital Costs and Increased Import Duties on Production Equipment. Due to the high import requirements of large-scale producers and the scarcity of foreign exchange earnings, or because of the greater economic profitability and employment potential in small-scale industries, a policy aimed at shifting production away from the large-scale industry may be justified. Run 6 is designed to approximate such a shift.

The cost of capital for the large-scale industry is increased from 10 percent to 20 percent, the assumed economic opportunity cost of capital. At the same time, the import duty on large-scale equipment is increased to 20 percent. All other parameters affecting the small-scale industry and the frozen fish imports remain unchanged from their 1980 base run levels.

The result of these changes is that large-scale production declined from 1,858 metric tons in the 1980 base run to 1,721 metric tons or by nearly eight percent. This was replaced by an off-setting increase in frozen fish imports from 11,875 metric tons in the 1980 base run to 12,012 metric tons. Small-scale production remained constant as those firms which were more economically profitable than frozen imports were already fully utilized; therefore frozen imports increase rather than small-scale production. This run would indicate that a policy of increased large-scale capital costs and increased import duties on large-scale equipment would have little effect on small-scale employment or output unless it is accompanied by policies aimed at increasing the productive resources available in the small-scale industry. The result of Runs 5 and 6 indicate that frozen fish imports compete primarily with large-scale production and that there is little competition between small-scale fish production and frozen fish imports.

6.4.5 A Policy of Self-Sufficiency

Run 7--Increased Growth in Labor Supply, Investment Capital, and Capital Stock of Boats. The last run of the 1980 model determines one possible means of attaining self-sufficiency by the end of the current planning period. It is assumed in Run 7 that policies affecting the cost of capital and import duties for both small-scale and large-scale firms remain unchanged from the actual 1974 situation. The flexibility constraints on the growth in the capital stock of boats are relaxed so that the population of profitable boat types can double over the 1974-1980 period if necessary. Labor supply as well as small-scale and large-scale production capital were left unconstrained so that the actual growth rate required would be derived by the model. This permits the more efficient technology types to completely utilize their capital stock of boats before activating less efficient types.

The results of this run reveal that while self-sufficiency is possible, the level of resources necessary to achieve the goal make its attainment in the 1974-1980 period highly improbable. Trained labor supply employed in small-scale production would be required to grow at 7.5 percent annually, or nearly three times the growth in labor supply due to population growth alone. Total labor employed in the fisheries subsector grows from 56,432 in 1974 to 81,621 in 1980 if self-sufficiency is attained.

Among the different small-scale technologies, firm types A, C, D, E, and F increased their number of establishments at the maximum growth rate of 100 percent over the six year period. The other small-scale firm types (B, G, H, and I) either experienced a moderate increase in the number of firms or declined. The population of large-scale trawlers declined from 4.3 to three trawlers over the 1974-1980 period, which the lowest level permitted by the flexibility constraints. Consequently, large-scale production fell from 1,751 metric tons in 1974 to 1,295 metric tons in 1980 or approximately five percent annually. Conversely, small-scale production grew by nearly 8.2 percent annually, rising from 46,205 metric tons in 1974 to 73,652 metric tons in 1980. In order to achieve this increase in small-scale production, invested capital available for production purposes was required to grow at nearly eight percent annually, or nearly 50 percent faster than is projected in the development plan.

In summary this run would indicate that self-sufficiency in fish by 1980 is highly unlikely unless there is a considerable increase in several essential resources. The rate of increase in resources available to fisheries would require considerable transfer from other productive employment. Should such resources become available fisheries' contribution to Gross Domestic Product would increase to 26.10 million leones, over 50 percent more than the contribution attained by the base run 1974.

6.5 Summary

This chapter has developed an aggregate model closely replicating the 1974 situation in the fisheries subsector and has then used that model to evaluate the effects of alternative development strategies on the level of employment, output, frozen fish imports, contribution to Gross Domestic Product and the choice of small-scale technology. The model was presented as a series of total cost equations for various activity vectors and resource constraints covering six basic production-processing-marketing channels.

The 1974 base run closely replicated the number of firms actually producing in 1974 as well as the level of frozen fish imports required to meet domestic demand. However the 1974 model shows that the level of employment and the subsector's contribution to Gross Domestic Product are considerably more than past estimates would indicate. According to the 1974 base run, nearly five percent of the labor force derive income from some aspect of the fisheries production-delivery system as compared with two percent estimated by Propesca [1974]. The subsector's total contribution to Gross Domestic Product was placed at about 17 million leones or nearly four times its estimated contribution in the official national accounts in 1972.[1]

A series of eight runs of the 1980 model were reported which were used to evaluate five alternative development strategies: (a) varying the resources available while maintaining the 1974 policies on cost of capital and imports, (b) encouraging small-scale fishing industries, (c) encouraging large-scale fishing industries, (d) actively discouraging large-scale fishing industries, and (e) closing the economy to frozen fish imports to force self-sufficiency by 1980.

The first strategy of varying resource availability revealed that an inadequate labor supply impeded small-scale production to a greater extent than did an inadequate growth in capital. A policy of changing the cost of capital from 40 percent to 20 percent by itself produced negligible affects on the level of production by small-scale firms. This indicates that even though there are different small-scale technologies, there are few possibilities for capital-labor substitutions over the changes in capital costs examined. The implications of this finding for credit policy will be discussed in Chapter 7. In order for domestic production to be able to maintain its 1974 relative share of total fish supply with respect to frozen fish imports, the level of trained manpower would need to grow at approximately 4.6 percent annually. The 1980 base run indicates that if present policies

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[1]Much of the increase in Gross Domestic Product originates from the wholesaling-retailing industries where nearly 70 percent of the fisheries labor force is employed.

are continued and if the supply of trained manpower fisheries grew at the accelerated rate of 4.6 percent annually, then firm types A (standard canoe, ring net, paddle & sail), type C (standard canoe, drift net, paddle & sail), type E (salla boat, beach seine, paddle), Type F (salla boat, ring net, <15 HP engine), and type H (fante boat, ring net, <26 HP engine) are chosen as the most economically profitable technologies. When comparing the same technology type across regions, it was found that Southern Region and Western Area yielded higher marginal values per leone of fish produced than did Northern Region. This is due to the locational advantages of the Western Area and Southern Region near the high income consumption areas of Freetown and Eastern Province respectively. Other possible locational advantages such as greater access to richer fishing grounds could not be incorporated into the model as the survey sample did not yield sufficient numbers of identical firm types in different regions to adequately assess the regional specific production equations.

If the labor supply grows at less than the 4.6 percent rate of the 1980 base run, domestic production fell and according to Run 1, frozen imports increased by 50 percent over the 1974-80 period. If the rate of invested capital were insufficient, domestic production fell slightly and imports rose by 30 percent.

The strategy of developing policies more favorable to small-scale production yielded the highest level of "pure" economic profits for the total fisheries subsector of any strategy tested and the highest level of subsectoral contributions to Gross Domestic Product of any strategy except for the last strategy of forced self-sufficiency.

The two strategies of encouraging and discouraging large-scale production showed that large-scale and foreign frozen fish imports are strongly competitive so that policies favorable or unfavorable to large-scale production primarily affected the level of imports with small-scale production remaining relatively constant as its resources remain near full utilization.

Lastly, a strategy of forced self-sufficiency by 1980 revealed that attainment of such a goal is highly improbable in the current planning period as it requires a mobilization of resources considerably greater than recent performance would indicate is possible. Trained manpower would need to grow at 7.5 percent annually; small-scale invested capital would need to grow at 7.9 percent annually (50 percent greater than is projected in the development plan) and the population of profitable small-scale boats would need to double over the six year period.

In conclusion, a comparison of all the strategies reveals that the policy of increased small-scale production would be most profitable from the point of view of the entire economy and would yield the greatest contribution to Gross Domestic Product of any strategy examined except for the apparently unrealistic strategy of self-sufficiency.

CHAPTER 7

SUMMARY AND POLICY IMPLICATIONS

Several alternative protein sources have been unable to provide an adequate quantity of high-quality protein to satisfy a broad-based effective demand in Sierra Leone. Consequently Sierra Leone remains dependent on imported frozen fish to meet domestic needs while local stocks of pelagic species are under-exploited. Given the government's goal of self-sufficiency in fish, this study examines alternative strategies aimed at developing the domestic fisheries industry.

This research is the first micro-economic survey of small-scale marine fisheries in Sierra Leone and one of the first fishery surveys undertaken in West Africa which combines the micro-economic operations of small-scale producers, processors, wholesalers, and retailers into an integrated fish delivery system. The objectives of the study were to: (1) describe the micro-economic operations of alternative technologies currently practiced in fish production, processing and marketing enterprises, (2) identify major constraints on improved performance of the fisheries production-delivery system, (3) examine aggregate impacts of policies affecting marine fisheries production including improved credit systems, increased manpower training and extension programs and alternative import policies affecting duties on capital equipment as well as frozen fish imports, and on the basis of the above to (4) evaluate alternative strategies for fisheries development in Sierra Leone.

The field research was conducted over a 12 month period in five randomly selected small-scale production sites along the coast of Sierra Leone. Interviews were also conducted with one large-scale production firm. Processors and traders were surveyed covering the major wholesaling-retailing channels between the selected producers and the four largest urban consumption centers. The present chapter will summarize the basic findings of the study and identify alternative policies for Sierra Leone fisheries development.

7.1 Summary of Findings

The domestic marine fisheries subsector is divided into the small-scale and the large-scale production industries with their associated processing-marketing channels. The small-scale industry is composed of over 5,000 fishing firms which employ approximately 16,000 people and produce over 90 percent of total domestic production. The large-scale industry consists of nine trawlers operated by five firms based in Freetown and produces about six percent of domestic production

7.1.1 Micro-Economic Analysis

The small-scale production industry employs nine distinct types of technologies which vary considerably in their capital intensity. Firm type E (salla boat, beach seine, paddle) had the highest capital-labor ratio of .14 while at the other extreme, firm type D (kroo canoe, cast net, paddle) had the lowest capital-labor ratio of .02. Firm type A (standard canoe, ring net, paddle), type B (standard canoe, set net, paddle), type C (standard canoe, drift net, paddle), type F (salla boat, ring net, <15 HP engine), type G (salla boat, ring net, >15 HP engine), type H (fante boat, ring net, <26 HP engine) and type I (fante boat, ring net, >26 HP engine) were closely clustered around the midpoint with an average capital-labor ratio of .05. In contrast, the capital-labor ratio of the large-scale production industry was .44.

It was also found that generally, as labor intensity increased across firm types, the seasonality of labor employment decreased and a larger proportion of total labor was supplied by hired labor. Female labor comprised a larger proportion of total labor used in fish production and the more labor intensive firms because they prepare meals for hired labor. The sexual roles of male and female labor in fish enterprises were clearly delineated with female labor concentrated in processing activities and male labor in production. Nearly half of all male labor was employed in net maintenance and repairs.

The acquisition of capital by small-scale firms appeared particularly constraining in several respects. The survey revealed that initial capital for establishing new firms came primarily from earnings saved from the entrepreneur's previous employment. Small-scale firms borrowed capital primarily from noninstitutional sources at a discount rate of approximately 40 percent while institutional sources provide capital to large-scale firms at a discount rate of 10 percent. In considering the foreign exchange cost of equipment it was found that over 75 percent of small-scale equipment was imported at a 36 percent import duty while virtually 100 percent of large-scale equipment was imported at a duty of only 10 percent. Imported net equipment accounted for over 57 percent of investment costs. Net mending accounted for over 20 percent of total variable material input costs.

Levels of investment in equipment stock varied considerably between the nine technology types, ranging from a low of Le 57 for the firm with a Kroo canoe with cast net, hook and line and paddle to over Le 4000 for the firm owning a fante boat powered by an engine of greater than 26 horsepower and operating a ring net. Firm profits ranged from Le 475 for firm type D (Kroo canoe, cast net, paddle) to Le 6185 for firm type H (fante boat, ring net, <26 HP engine).

Small-scale production was more concentrated than the distribution of firm types would indicate. Approximately 30 percent of total small-scale output by weight was produced by firm type H (fante boat, <26 HP engine, ring net) which represented 3 percent of the total small-scale firm population. Bonga was the single most important species caught accounting for over 67 percent of total weight harvested by all firm types. Labor use and fish harvests were seasonally concentrated in the October-March period which yielded 61 percent larger harvests than the six month period of April-September.

In evaluating the traditional smoke processing technology returns per hour to total labor used were approximately one third that achieved in small-scale fish production enterprises. Yet it is comparable to the wage rate for rural women who supply most of the processing labor. Average total costs were approximately Le .67 per 100 lbs. of raw fish processed. The modified Altona Oven as developed in Ghana, but with construction and operational costs adopted to conditions in rural Sierra Leone, used one fourth the labor and one fifth the fuel required per 100 lbs. of fish processed using traditional technologies and was significantly more profitable than the traditional banda.

The small-scale fish wholesaler has been traditionally accused of obtaining "excessive" profits. However, the present study indicates that while the returns to the wholesaler's labor were approximately three to four times (the returns to the wholesaler's labor were approximately three to four times) the female wage rate in the rural processing enterprises from which they purchased supplies, they were considerably less than could be earned in alternative entrepreneurial activity such as gara dying in the urban center from which they originated. Returns to labor in smoked fish urban retailing were comparable to the rural female wage rate in the sales region and below the established urban unskilled wage.

An examination of the average annual fish price by species revealed considerable locational advantage for production in Western Area largely due to direct access to nearby markets in Freetown. This same locational factor is evident in comparing the marginal value of additional production units in the aggregate analysis.

7.1.2 Aggregate Analysis

A linear programming model was constructed in order to integrate the micro-economic operations of each of the production-processing-marketing activities examined. The purpose of the model was to examine the effects of alternative development strategies on output, employment, capital and boat utilization and type of technology chosen as well as the subsector's contributions to Gross Domestic Product.

The model of the 1974 situation revealed that, based on survey data, employment in fish production is approximately 40 percent higher than previously estimated. The major employment in fisheries occurs in the wholesaling and retailing industries with roughly 39,000 people employed. Approximately five percent of the national labor force derive income from the fisheries subsector. The model also confirmed that at current costs of production, large-scale trawlers receive strong competition from frozen fish imports while there is relatively little competition between frozen fish imports and small-scale production.

Among the small-scale firms, types A (standard canoe, ring net, paddle), type C (standard canoe, drift net, paddle), type E (salla boat, beach seine, paddle), type F (salla boat, ring net, <15 HP engine), and type H (fante foat, ring net, <26 HP engine) had the highest marginal values per leone of fish produced.

Shifts between different technological firm types in small-scale production occurred as relative resource availability was altered. When capital was relatively more scarce than labor as in Run 2, production shifted to more labor intensive technologies such as firm type D (Kroo canoe, cast net, paddle). When small-scale firms were encouraged through decreased capital costs and accelerated growth in new boat capacities, small-scale production shifts from either the extremely labor intensive or extremely capital intensive technologies towards firm type A (standard canoe, ring net, paddle), firm type C (standard canoe, drift net, paddle & sail) and type E (salla boat, beach seine, paddle) which have relatively high returns to both labor and capital. When a strategy unfavorable to large-scale production is implemented, the composition of small-scale firm types comprising the industry remain relatively unchanged while the major increase occurs in frozen fish imports.

A comparison of alternative aggregate model runs reveal that two major paths are open for checking the dependency on frozen fish imports over the 1974-1980 period. First, a strategy favoring the small-scale industry through decreased capital costs and increased boat construction lowered imports by four percent from the 1980 base run and at the same time yielded the highest level of "pure" economic profits for the total fisheries subsector of any strategy tested. Economic profits for the subsector under this strategy were nearly double that attained from a strategy of favoring large-scale production. It also yielded a subsectoral contribution to Gross Domestic Product of 23.8 million leones, larger than any other open economy strategy. However previous runs indicated that a key factor in expanding small-scale production was an increase in skilled manpower at an annual rate of 4.6 percent or approximately double the rate expected from population growth alone.

This strategy illustrated that given a reduced cost of capital to its economic opportunity cost (20 percent) a program of accelerated boat and equipment construction (doubling the population of the most profitable firm types) and an increased growth rate in labor supply the small-scale subsector is capable of responding rapidly by increasing output, decreasing imports and increasing the subsector's total contribution to the nation's Gross Domestic Product.

Alternatively large-scale production can be encouraged through increasing import duties on frozen fish, its closest substitute product, to 40 percent and increasing the capital available for large-scale expansion by 10.8 percent annually. Large-scale production does respond by decreasing imports by 12 percent but the subsector's total contribution to the Gross Domestic Product falls four percent below the level attained when small-scale firms were favored. Such an increase in import duties would, at least in the immediate future, raise the cost of fish to consumers.

Although the current national development plan aims for self-sufficiency in fish production by the end of the current planning period, the closed economy strategy of the present study would indicate that this is highly unlikely unless (a) wage rates in rural fishing areas rise sufficiently to attract labor from other industries at a rate more than triple the natural population growth rate and (b) the growth in small-scale capital is nearly double the rate of investment in new productive capacity projected for the entire agricultural sector in the current planning period and (c) the number of available boat and associated equipment units increases by 100 percent above its 1974 level.

Should these resources be mobilized to this extent, female labor would still be constraining in both Southern and Northern Regions. This could be partially relieved by more rapid introduction of improved smoke processing ovens. Additional drying capacity has a high marginal value in both Northern and Southern Regions if the self-sufficiency strategy is implemented.

When comparing the marginal value per leone of fish produced by additional boat and equipment units across different production regions, Southern Region usually produced the highest marginal value followed by Western Area and Northern Region. However, such cross regional comparisons should be viewed with caution as they reflect locational advantages due to transportation and labor costs but they do not adequately consider locational advantages arising from the region's relative proximity to more productive fishing grounds as the survey sample did not yield a sufficient number of identical firms of each type to compute both region and technology specific production costs and returns.

An important finding of the model was that in the different runs, changes in pricing policy such as changes in the cost of capital and import duties on frozen fish and fishing equipment, where implemented in isolation from other policies which altered resource availability, have some effect on large-scale production but little effect on small-scale production.

7.2 Policy Implications

This study indicated that all small-scale firm types yield "pure" economic profits and are capable of producing fish with greater profits per leone of fish produced than is possible with large-scale technologies. The aggregate model confirmed the relative economic advantages of small-scale production by revealing that strategies which are favorable to small-scale industries result in greater "pure" economic profits to the subsector and greater subsectoral contributions to Gross Domestic Product. Because of the considerable potential which small-scale industries have for fisheries expansion, a majority of the policy implications will be concerned with the expansion of small-scale production.

7.2.1 Small-Scale Fisheries Policies

A package of interrelated policies will be developed in this section which are consistent with the goal of stimulating expansion of the small-scale sector and shifting production away from the higher cost large-scale industries toward those small-scale technologies which are most economically profitable. Such a shift could be facilitated by reducing the 36 percent import duties on small-scale equipment to the 10 percent level now imposed on large-scale equipment. This would reduce the barriers to new firms from entering the small-scale industry which arise from high initial investment costs necessary to establish firms of the more profitable technology types.

The aggregate model repeatedly indicated that an adequate supply of labor, knowledge of boat, or engine maintenance and training in general fishing skills was a crucial factor in the development of marine fisheries. The current reliance on an indigenous four year apprenticeship program is unlikely to produce the necessary increase in trained fishermen. However a program to establish a regional fisheries development center for each of the three regions is currently being considered by the Fisheries Division of the Ministry of Agriculture and Natural Resources. If implemented it could provide a focal point where manpower training in equipment construction, maintenance, and operation would be readily available to the entrepreneur. A trained cadre of extension staff in such centers could offer the practical and technical advice necessary in encouraging the more profitable technological equipment types.

Other services could be developed at these regional centers which stimulate small-scale production. The high cost of borrowed capital facing small-scale firms and the slow process by which savings from previous employment is accumulated as a source of initial investment capital tend to inhibit investment in new productive capacities and improved technologies. An improved credit delivery system in rural fishing communities would stimulate investment in small-scale productive capacities. This could be accomplished in several ways. Maximum lending rates permitted by lending institutions could be increased to cover the added costs of providing and supervising loans in more isolated coastal communities. To assure that credit was actually used for fish production purposes and to facilitate input delivery and the introduction of new technologies, a program offering credit-in-kind to the fishing entrepreneur could be implemented through the proposed regional centers. Using this method of credit administration, the IDA Agricultural Development Project in Eastern Province has been relatively successful in loan repayment among rice farmers. This form of credit would have the added benefit of being able to consolidate the large variety of different brand name engines and equipment available into a few more uniform types, facilitating the availability of spare parts and supplies. Likewise greater influence could be exercised over the type and rate of introduction of improved technologies. An expanded extension staff at the regional centers could administer the selection, supervision, and repayment of credit to prevent the reoccurrence of the ill-fated 1961 subsidized credit scheme.

This study revealed that rapid expansion of small-scale production in the 1974-1980 period requires that the population of new boats be doubled over the period. The proposed regional development centers could not only make available the necessary tools and supplies required by indigenous boat builders but could itself test and demonstrate improved boat construction of the most profitable boat types. Among the small-scale boat types, the standard canoe, the salla boat and the fante boat as found in firm types A, C, E, F, and H had the highest marginal values per leone of fish produced indicating that under current conditions these technologies could be more profitably encouraged both from a financial and economic point of view in future fisheries development than could large-scale production or other small-scale types. The high returns to these firm types when valued from a private or social point of view indicates that they would be profitable ventures for public investment by national development credit institutions or international financial sources.

In the present survey several key production-marketing points along the coast have been identified as possible sites for regional centers. Rural Western Area, the area surrounding the mouth of the Scarcies River of Northern Province and the Shenge-Bonthe region of Southern Province appear to possess distinct locational advantages for future fisheries development in terms of close access to rich fishing grounds as well as consumer markets.

7.2.2 Large-Scale Fisheries Policies

The aggregate model indicated that frozen fish imports strongly compete with large-scale production and that neither competes effectively with the low-cost production of small-scale industries. Although emphasis has been given thus far to policies which stimulate small-scale production, the current stock of large-scale equipment already available could be more fully utilized in replacing frozen fish imports. A policy of increasing the import duties on frozen fish from 10 percent to 40 percent could stimulate increased fresh fish production by large-scale firms but this decision would need to be carefully weighed against the resultant short-run increase in retail prices paid by consumers and possible decrease in the Gross Domestic Product. Any policy which would encourage the expansion of new productive capacities by large-scale firms could not be justified by the findings of the present survey.

7.2.3 Future Research Needs

At the same time as small-scale production is expanding, an active program of applied research and development needs to be centered on improved smoke processing technologies. There is evidence in this study to indicate that as production expands, the traditional smoke processing technology will become an even greater constraint on the processing-delivery system. The micro-economic analysis of this study has shown that the modified Altona Oven has considerable potential in alleviating the female labor constraint anticipated for processing and increased output for the small-scale sector.

The economic feasibility of developing facilities for freezing part of the domestic small-scale catch for supplying raw fish demands inland should be examined in future economic research. The present research indicates that wholesaling costs for small-scale output can possibly be reduced if it is stored and transported in larger quantities as is currently done with frozen fish wholesaling. While the present study primarily concentrated on evaluating alternative production technologies in small-scale fisheries, alternatives to technologies within the large-scale production and processing industries remain unexamined.

This survey being the first micro-economic study of small-scale fisheries in Sierra Leone has laid the basic framework for future micro-economic research in the fisheries subsector and provides a bench mark analysis of the subsector which can later be used to determine the rate and direction of change in the subsector. This study has firmly established the vital role of small-scale fisheries in Sierra Leone both as a current source of employment, income and dietary protein for much of the Sierra Leone population and as an economically profitable industry for potential expansion in the future.

APPENDICES

APPENDIX 1

MAJOR COMMERCIAL FISH SPECIES OF SIERRA LEONE

Creole Name	Genus & Species	Average Weight Lbs. Per Fish
Awefu	Ethmalosa fimbriata (juvenile)	.12
Bonga	Ethmalosa fimbriata (adult)	.42
Catfish (marine)	Arius Spp.	1.57
Coureh (Horse Mackerel)	Caranx carangus	6.61
Couta (Barracuda)	Sphyraena dubia	5.10
Crocus	Pomadasys jubelini	1.81
Grouper (rose or red)	Lutjanus agenes	2.32
Gwangwa	Pseudotolithus elongatus	1.01
Herring (round)	Sardinella aurita (or Cameronensis)	.15
Hognose	Plectorhinchus macrolepis	1.84
Joe-fish	Trachinotus goreensis	1.49
Ladyfish	Pseudotolithus senegalensis	2.11
Mackerel	Scomber japanicus	1.20
Flat Mollit (mullet)	Mugil falcipinnis	.84
Record (red cod)	Epinephelus aeneus	1.25
Shark (Selachians)	Scolodion Spp.	3.72
Sheephead	Drephane africana	2.08
Shinenose	Galeoides decadactylus	.81
Skeet (sting ray)	Dasyatis Spp.	1.43
Black Snapper	Dentex angolensis	1.49
Spanish	Polydactylus quadrifilis	2.02
Whiting	Pseudotolithus brachygnathus	1.99

APPENDIX 2

ADMINISTRATION OF THE SURVEY

Selection and Training of Enumerators

Enumerators were recruited by advertising on the national radio and by word of mouth. An initial interview was conducted with each applicant reviewing his past employment record, areas of study and school certificates. An attempt was made to evaluate the applicant's language capability, maturity and basic mathematical skills. Based on these interviews, a select group of applicants were invited for a 10-day period of intensive training. During this period the purpose and design of the questionnaires was explained; practice interviews were conducted and homework exercises and examinations given. This period of close interaction between potential enumerator and the author permitted exceptional talents and attitudes to be detected. At the end of the training period a final selection was made based on performance in oral and written examination and homework exercises, alertness during training, general personality and attitude toward work. Those enumerators which were finally hired were then issued equipment such as raincoats, clipboards, lantern, and water containers where needed. Other equipment such as bicycles were purchased by the enumerator if desired through a salary advance and an additional monthly bicycle maintenance was paid.

Field Establishment and Supervision

Letters of introduction were sent to the Paramount Chief[1] of each selected landing site explaining the purpose of the survey, soliciting their support and establishing an expected arrival date in his area. Immediately after enumerator selection was completed, a series of meetings were held in each area with the respective Paramount Chief, Section Chief and lastly with the general fishing population at the landing site. During these meetings, the purpose of the survey and the selection process were explained, and the enumerator introduced. The presence and support of local and regional authorities at these meetings aided in securing local cooperation at the site.

Several important issues and questions were commonly raised during these meetings. First, the idea that their community was randomly chosen to represent all the fishing communities in their region universally received a positive response. However an issue usually raised immediately was: "How do we know that your research will help us? We have had many people from Fisheries Division and others come to ask questions but have seen no helpful results." Other concerns were: "Will the information be used for taxes or to license our boats? Will the data on individual households be revealed to the government?"

After the initial interviews were conducted and the sample of respondents selected, the author would go with the enumerator to each individual household to again explain the purpose, answer questions,

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[1] Sierra Leone's three provinces are divided into 13 districts which are subdivided into 146 chiefdoms. The Paramount Chief holds a life-time position as the top executive officer of the chiefdom.

solicit cooperation as well as give the enumerator criticism and guidance in improving his interviewing technique.

The actual timing of the interview with the respondent varied from site to site depending on the type of equipment operated, the tide schedule and the relative importance of nonfishing enterprises. Usually interviews were held immediately after fishermen had returned from the sea and had disposed of the catch.

Once initially established in the field, each enumerator was visited on an unannounced basis at least once or twice a month. During each visit, the forms were individually checked for completion, accuracy and inconsistencies between different sections of the questionnaire. If inconsistencies occurred, or peculiar uniform trends began to surface, the form was returned by the author and cross checked with the fishermen.

Frequent visits and overnight stays by the author at the enumeration site helped establish good rapport with the enumerator, made the field staff more alert and generally contributed to better village response as the author's presence conveyed an air of importance to the project.

APPENDIX 3

NUMBER OF BOAT UNITS AVAILABLE IN EACH REGION

Combination Type	REGION			National Total	Number of Combination Units Used per Firm
	Northern Region	Western Region	Southern Region		
Kroo Canoe/Cast net and Hook and Line/paddle	96	62	76	234	1.00
Standard Canoe/Ring net/paddle	232	163	254	649	1.14
Standard Canoe/Drift net/paddle	1026	722	1124	2872	1.13
Standard Canoe/Set net/paddle	563	396	617	1576	1.29
Salla Boat/Beach Seine/paddle	121	44	7	172	1.17
Salla Boat/Ring net/Outboard < 15 H.P.	162	58	9	229	1.13
Salla Boat/Ring net/Outboard > 15 H.P.	101	36	6	143	1.80
Fante Boat/Ring net/Outboard < 26 H.P.	69	39	49	157	1.38
Fante Boat/Ring net/Outboard > 26 H.P.	51	30	37	118	2.33
Large-scale trawler with bottom or midway trawl		9		9	1.00

SOURCE: Regional Totals [Government of Sierra Leone, 1974-a], combination type breakdown based on survey data.

APPENDIX 4

MARINE FISH DEMAND BY TYPE AND REGION

Type of Demand	REGION				National Total
	Northern Province	Western Area	Southern Province	Eastern Province	
	-----------hundred pound raw equivalent units------------				
Rural Demand for Raw Fish	39,773	66,105	46,017		151,895
Urban Demand for Raw Fish		328,324			328,324
Rural Demand for Smoked Fish	239,715		97,885	98,956	436,556
Urban Demand for Smoked Fish	36,672	124,436	26,533	39,069	226,710
Total Demand	338,910	518,865	186,560	187,000	1,231,335

Source: Raw and smoked fish urban consumption adapted from [Government of Sierra Leone, 1968] and [Government of Sierra Leone, 1971]; rural consumption adapted from [Byerlee and King, 1976].

APPENDIX 5

CONSTRUCTED COSTS AND RETURNS FOR RAW FISH WHOLESALING-RETAILING IN FREETOWN

(PER 100 POUNDS OF RAW FISH)

Item	SOURCES							
	Small-Scale Fresh Fish Production in Western Area[a]		Small-Scale Fresh Fish Production in Northern Region[b]		Small-Scale Fresh Fish Production in Freetown[c]		Frozen Fish Imports	
	Leones							
EXPENDITURES								
A. Service Cost of Equipment Capital[e]		.16		.16		.16		.18
B. Service Cost of Working Capital[e]		.01		.02		.01		.02
C. Wholesaling-Retailing Labor	27 hrs @ Le .22/hr	5.94	36 hrs @ Le .22/hr	7.92	27 hrs @ Le .22/hr	5.94	27 hrs @ Le .22/hr	5.94
D. Other Variable Costs								
1. Transport	1.67		3.64		1.80		1.33	
2. Spoilage	.50		.51		.27		.22	
3. Market Fee	.67		.73		.67		.68	
a) Total Variable Costs		2.84		4.88		2.74		2.23
E. Total Operating Expenditures		8.95		12.98		8.85		8.37
INCOMES								
1. Retail Sales Value		20.29		20.29		20.29		22.89[d]
2. Less Purchase Value		13.29		9.14		14.09		17.08
F. Gross Margin		7.00		11.15		6.20		5.81
1. Less Total Operating Expenditures		8.95		12.98		8.85		8.37
G. Net Profit to the Form		(1.95)		(1.83)		(2.65)		(2.56)
H. Return Per Hour of Wholesale-Retail Labor		.15		.17		.12		.13
Assuming 20 Percent Cost of Capital								
A. Service Cost of Capital		.14		.15		.15		.17
B. Total Operating Expenditures		8.92		12.95		8.83		8.36
C. Net Profit to the Firm		(1.92)		(1.80)		(2.49)		(2.53)
D. Return Per Hour of Retailing Labor		.15		.17		.12		.13

[a] **Assumes the frequent practice of two trades working together, alternating their supply trip to producer regions with 260 supply trips per year each transporting 60 lbs per trip with 10% spoilage at 25% reduced price for spoiled per trip.**

[b] **Assumes same as (a) above except due to frequent change of vehicles and headloading, only 55 lbs per supply trip is transported.**

[c] **Assumes one large-scale box of raw fish (30 lbs) retailed per market day with only 5% spoilage by weight.**

[d] **Assumes a 34 percent markup over wholesale price, i.e. slightly less than computed for smoked fresh fish retailing.**

[e] **Assume a 40 percent cost of capital.**

APPENDIX 6

CONSTRUCTION COSTS AND RETURNS FOR SMOKED FROZEN FISH RETAILING IN URBAN CONSUMER CENTERS (PER 100 LBS OF FROZEN FISH)

Item	Urban Consumer Centers							
	Western Area		Northern Province		Eastern Province		Southern Province	
	Leones							
EXPENDITURES								
A. Service Cost of Equipment Capital[a]		.27		.30		.35		.31
B. Service Cost of Working Capital[a]		.03		.03		.03		.03
C. Retailers Labor	30.3 hrs @ Le .22/hr	6.67	48.3 hrs @ Le .27/hr	13.04	48.3 hrs @ Le .42/hr	20.29	48.3 hrs @ Le .21/hr	10.14
D. Other Variable Costs								
1. Transport	1.23		.50		.75		.50	
2. Spoilage	.32		.32		.32		.32	
3. Market Fee	.68		.91		.23		.45	
4. Material Inputs	—		.28		.28		.28	
a) Total Variable Costs		2.51		2.01		1.58		1.55
E. Total Operating Expenditures		9.48		15.38		22.25		12.03
INCOMES								
1. Retail Sales Value[b]		23.98		24.92		26.16		25.27
2. Less Retail Purchase Value		17.08		17.66		18.21		17.96
F. Gross Margin		6.90		7.26		9.95		7.31
1. Less Total Operating Expenditures		9.48		15.38		22.25		12.03
G. Net Profit to the Firm		(2.58)		(8.12)		(14.30)		(4.72)
H. Return Per Hour Retail Labor		.13		.09		.10		.10
Assuming 20 Percent Cost of Capital								
A. Service Cost of Capital		.17		.20		.23		.20
B. Total Operating Expenditures		9.45		15.35		20.62		11.99
C. Net Profit to the Firm		(2.55)		(8.09)		(14.17)		(4.68)
D. Return Per Hour of Retailing Labor		.13		.09		.10		.10

[a]Assumes a 40 percent cost of capital.

[b]Assumes a 34 percent markup over wholesale price, as in raw frozen retailing plus the costs of processing.

APPENDIX 7

CONSTRUCTED COSTS AND RETURNS FOR SMOKED-FRESH AND SMOKED-FROZEN FISH RETAILING TO RURAL CONSUMERS (PER 100 POUNDS OF SMOKED FISH)

Item	SMOKED FRESH FISH						SMOKED-FROZEN FISH[b]					
	Northern Province		Eastern Province		Southern Province		Northern Province		Eastern Province		Southern Province	
	Leones											
EXPENDITURES												
A. Service Cost of Equipment Capital[a]		.07		.08		.10		.30		.33		.30
B. Service Cost of Working Capital		.13		.24		.13		.09		.09		.09
C. Retailers Labor	63 hrs @ Le .07/hr	4.44	77 hrs @ Le .08/hr	6.18	88 hrs @ Le .11/hr	9.68	50 hrs @ Le .07/hr	3.50	50 hrs @ Le .08/hr	4.00	50 hrs @ Le .11/hr	5.50
D. Other Variable Costs												
1. Transport[c]	.16		.35		.23		.25		.34		.25	
2. Spoilage	.34		.40		.38		.34		.41		.38	
3. Additional Drying Expenses	.04		.07		.05		.29		.28		.28	
a) Total Variable Costs		.54		.82		.66		.88		1.03		.91
E. Total Operating Expenditures		5.18		7.32		10.57		4.77		5.45		6.80
INCOMES												
1. Retail Sales Value		20.22		23.81		21.98		20.22		23.81		21.98
2. Less Retail Purchase Value		13.56		15.77		14.78		17.66		18.21		17.96
F. Gross Margin		6.66		8.04		7.20		2.56		5.60		4.02
1. Less Total Operating Expenditures		5.18		7.32		10.57		4.77		5.45		6.80
G. Net Profit to the Firm		1.48		.72		(3.37)		(2.21)		.15		(2.78)
H. Return Per Hour Retail Labor		.09		.09		.07		.03		.08		.05
Assuming 20 Percent Cost of Capital												
A. Service Cost of Capital		.12		.19		.15		.30		.32		.30
B. Total Operating Expenditures		5.10		7.19		10.49		4.68		5.35		6.71
C. Net Profit to the Firm		1.56		.85		(3.29)		(2.12)		.25		(2.69)
D. Return Per Hour of Retailing Labor		.09		.09		.07		.03		.09		.06

[a] Assumes a 40 percent cost of capital.

[b] Assumes retailing of 3 cartons (120 lbs) frozen fish per market trip.

[c] Assumes average transport distance into rural area of 12 miles for Northern Province and Southern Province and 19 miles for Eastern Province, based on radius of area served by a market as being one fourth distance to nearest market of comparable size.

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