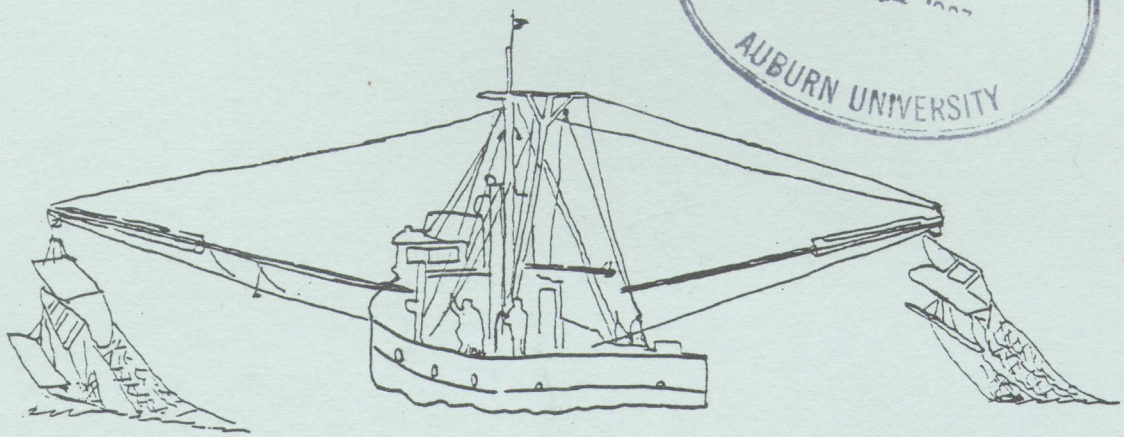
Agricultural Economics
Series #33

July 1979

FEASIBILITY OF SUPPLYING AND PROCESSING NORTHERN GULF OF MEXICO GROUNDFISH IN ALABAMA



Agricultural Experiment Station
of
Auburn University

R. D. Rouse, Director

Auburn, Alabama

TABLE OF CONTENTS

FEASIBILITY OF SUPPLYING AND PROCESSING NORTHERN GULF OF MEXICO GROUNDFISH IN ALABAMA[1]

D. L. Scovell, M. V. Rawson, and E. W. McCoy

Marketing Specialist, Florida Fish and Game Commission, Marine Resource Development Specialist, Alabama Cooperative Extension Service, and Associate Professor, respectively, Department of Agricultural Economics and Rural Sociology, Auburn University.

INTRODUCTION

Increasing demand for edible protein has severely stressed the world's traditional fisheries through over-utilization. Realization that traditional fisheries are not unlimited resources and that many fish stocks are reaching their maximum yields has caused much concern. New emphasis has been placed on increasing yield from the sea by developing previously unutilized or underutilized, but abundant, fish and shellfish species. This task is highly complicated involving development of efficient methods of harvesting these species, creation of technologies to process the species into usable forms, and development of markets for these underutilized resources.

Although the State of Alabama has a relatively small coastline, development of unused fishery resources present in the Gulf of Mexico off the coast of Alabama could have an important economic impact on the local economy of south Alabama and the State as a whole.

[1]Information for this study was derived from Feasibility of Supplying and Processing Northern Gulf of Mexico Groundfish in Alabama, an unpublished master's thesis, Auburn University.

United States Commercial Fish Production from Gulf of Mexico in 1976.

The Gulf of Mexico is one of the most productive fishing areas in the world. In terms of productivity, it is second only to the Peruvian coast (16). For this reason, production from the Gulf of Mexico makes a highly significant contribution to total U.S. fish production. In 1976, Gulf production from U.S. ports amounted to 1.8 billion pounds valued at $382 million. These landing accounted for 33 percent of total U.S. landings and 20 percent of value (41).

Two Major fisheries dominate Gulf of Mexico landings. Shrimp and menhaden make up 83 percent of the total Gulf catch. In 1976, 210.1 million pounds (heads on) of shrimp were produced representing 52 percent of total U.S. production. Menhaden landings amounted to 1,237.8 million pounds in 1976, or 61 percent of total U.S. production (41).

Alabama Seafood Industry

Alabama produced 34.9 million pounds of fish and shellfish in 1976. This represented 2 percent of total Gulf landings and 9 percent of value (38).

Economic value of the seafood industry to the local economy of south Alabama is estimated to be in excess of $70 million while economic value to the state and nation exceeds $120 million (36). The fishing fleet is based in Baldwin and Mobile counties, and most of the seafood industry is located in Mobile County at Bayou La Batre. Bayou La Batre ranked as the eleventh port in the nation in value of seafood landed in 1976 and nineteenth in total landings, while Baldwin County ports ranked twenty-sixth in value and thirty-seventh in landings. Table 1 lists the eight most impor-

tant species, ranked according to value, landed by the seafood fishery of Alabama during 1976 (36).

Resource Development Potential

Juhl described under-utilized and latent resources of the Northern Gulf of Mexico (16). These fish resources can be divided into three groups. Large pelagic fish make up the first group and are composed of billfish, dolphin, mackerel, sharks and blackfin, skipjack and little tuna. Coastal pelagic fish comprise the second group, composed of small, surface, and mid-water schooling fish such as thread herring, Spanish sardine, scad, round herring, cigar fish, and anchovy. The third group of under-utilized fish is demersal, ground fish or bottom fish group, approximately 175 species and probably constituting the second largest resource, by volume, in the Gulf (16). Drums, croaker, spot, and sea trout are dominant species of this group.

Bullis and Carpenter estimated a latent bottomfishery potential of 2.8 million tons in the Gulf of Mexico (4). Also, Waters estimated that after consideration of shrimp fleet discards, industrial and food fish use, recreational use and other mortalities, approximately 165,000 tons of bottomfish are available for expanded use in the Northern Gulf (42).

Although certain coastal pelagic fish are more abundant, some are difficult to catch. Production of such fish as Spanish sardine, round herring or anchovy would require new and innovative harvesting systems (16). Technology for harvesting bottom fish is already in existence, with approximately 21 boats fishing full-time in the industrial bottomfishery and 12 principal croaker foodfishing vessels in the Northern Gulf (11).

Existing processing technology can be utilized. Some foodfish size roundfish, primarily croaker, are boxed, iced, and shipped in the round to

fresh fish markets on the East Coast. Species of bottomfish are used in canned petfoods and are made into fishmeal. In addition, meatbone separator technology, which has recently been developed, makes smaller sizes of groundfish processable into forms suitable for human consumption.

Problem and Objectives of the Study

Problem

Interest has been shown in the development of a seafood industrial park facility in Mobile County, Alabama. Several sites for the proposed facility are now being considered. The industrial park facility would provide convenient access for vessel owners and seafood processors to such things as land, utilities, deep water channelization and waste disposal systems.

Alabama's seafood industry is established and well-developed. Limited use is presently being made, however, of groundfish resources by Alabama seafood producers and processors and much interest has been expressed in the feasibility of increased utilization of these resources. A plant which would use the ground fish resources has, therefore, been proposed for location in the industrial park facility as a viable alternative to established seafood industries.

Prior to the establishment of a ground fish processing plant in the seafood industrial park facility, an evaluation was needed of such a plant's potential profitability. Few plants presently exist which process groundfish and, due to the secretive nature of the seafood industry, few current comprehensive budgets are available on ground fish production and processing plant in a seafood industrial park complex.

Objectives

The primary objectives of the study were:

(1) To estimate costs and returns of processing groundfish in Alabama; and

(2) To estimate costs and returns of operating a groundfish trawler engaged in supplying a ground fish processing plant.

Review of Literature

Bottom fishery in the Northern Gulf of Mexico came from the need to utilize so called "trash" fish caught incidental to shrimp and other food fish trawls. The problem of how to use these unwanted fish was the subject of a report published in 1907 by the U.S. Bureau of Commercial Fisheries (8).

Haskell reported that it was 1952 before a bottom fish industry came into being with the establishment of a petfood plant at Pascagoula, Mississippi (13). Since that time, bottom fishery has been the subject of several governmental reports.

Guthery et. al., Haskell, and Roithmayr, described historical aspects of the industrial bottom fishery, vessel characteristics and operational methods, fishing season and efforts, catch rates, species composition, bottom fish utilization and processing methods (11, 13, 30).

Little economic information was available on vessels or processing. In 1973, Juhl published results of a study on economic costs of production of ground fish and food fish trawlers (15). Information was given for optimum vessels including operating costs, catch rates, and catch composition. Income projections of vessel operators were also included.

Greenfield discussed economics of producing minced fish blocks from six species according to yield from the mincing process and assuming that

packaging, freezing, storage, selling expense, and margin remained constant between species, Greenfield was able to look at effects of varying selling price, purity of catch or ex-vessel prices. At the 1973 price for minced cod and pollock block of $.25 per pound, assuming minced bottom fish are equally comparable in quality, and with 70 percent purity of catch, four species (cutlass fish, mullet, whiting, and white trout) appeared to be feasible for processing. At a minced block price of $.30 per pound and 70 percent purity of catch, all species of ground fish became extremely attractive for processing.

Lea and Roy evaluated the economic feasibility of processing Louisiana ground fish in 1976 (18). Three different size plants capable of producing fishmeal, fish oil, pan dressed fish, frozen minced fish, and frozen fish patties were studied. Capital investment requirements and operating costs were estimated for each product. Contributed cost per pound of producing each product was developed from these data. Production rates, contributed margins for products produced, and estimates of yearly fixed costs were then calculated to obtain an estimate of yearly net income. Return on investment (ROI), internal rate of return (IRR), and payback period were caluclated. Computer analysis indicated that only fish patties should be produced. From production of 2,175,088; 4,522,032, and 9,063,144 pounds of product at a price of $.35 per pound, the following returns were realized:

Plant Size	ROI (%)	IRR (%)	Payback (years)
Small	-8.2	0-1	13.1
Medium	4.4	16-17	4.9
Large	16.8	30-32	3.0

Researchers at Texas A&M University assessed the feasibility of several alternative systems for landing and holding ground fish caught incidental to shrimp trawling operations (24). Five methods were evaluated: installation of a separate freezer unit, brine immersion tank, or fishmeal plant on board the shrimp trawler, hiring of an extra crew member to process the ground fish catch, or the use of an additional vessel to which the incidental catch of ground fish from several shrimp vessels could be transferred. None of the proposed systems appeared to feasible except under very restrictive conditions. The authors concluded that full utilization of the ground fish resources depended on development of a fishing industry separate from current shrimp trawling operation.

Method of Study

Initial assumptions of plant capacity and products to be produced by the plant were made after consultation with Alabama Marine Advisory Service personnel. The size of the ground fish processing plant was established assuming that five vessels with a maximum capacity to hold 104 tons of fish per trip would supply the plant. The ground fish processing plant was assumed to produce five products: fresh fish, pet food, surimi (a Japanese commodity), fish meal, and fish oil.

Information on capital investment requirements and operational costs associated with production and processing of the ground fish catch was collected from secondary sources and contracts with Alabama Marine Advisory Service personnnel, National Marine Fisheries Service personnel, managers of business firms which support the seafood industry, and food processing equipment manufacturers.

Budgets for establishing, operating, and supplying a groundfish pro-

cessing plant were then developed from the information collected to estimate the profitability of ground fish production and processing.

DEVELOPMENT OF GROUND FISH TRAWLER AND PROCESSING PLANT BUDGETS

Ground fish Trawler Catch Composition, Operation, and Processing

Fundamental to any vessel operator or fish processor are the types of fish taken in the catch. Species composition and size affect the price paid to boat operators and the types of products the plant is able to produce.

Catch rates for ground fish are generally higher in summer and fall and lower in winter and spring (31). A catch rate of 2.87 tons per hour is assumed for June through November (period one) and 1 ton per hour for December through May (period two).

This study assumed .25% of the catch is shrimp and 2% is foodfish (15). Fifty percent of the catch is assumed to be croaker. This percentage is lower than what is found in the literature, but more in line with present catch rates (33). The croaker catch is broken down into three size groups by length. Each length group is assumed to make up the following percent of the total croaker catch (34):

Length	Percent of croaker catch
Less than 6"	33
6" to 8"	50
9" or larger	17

Each size group's percentage is then multiplied by 0.5 to obtain the size group's percent representation in the total catch.

Ground fish, other than croaker, are assumed to make up the remaining

47.75% of the catch.

Vessels were assumed to be capable of holding 104 tons of fish per trip and operating 14.5 hours per day (15). One day running time to and from the fishing grounds was required during the summer through fall period and 2 days during the winter through spring period. Off-loading times were assumed to be 1 day during period 1 and 1/2 day during period two.

Based on the above catch rates and operating assumptions, the following vessel schedule was assumed to be followed during the period June through November:

3.5 days at sea

1 day off-loading

2.5 days reprovisioning, repairs, crew leave, etc.

7.0 days total

According to this schedule, each vessel would make twentysix trips during period one.

At sea, operations of vessels during period two were restricted to 5 days to ensure the quality of fish for fresh fish and minced fish production (32). The following schedule was assumed to be followed by vessels during period two:

5.0 days at sea

.5 days off-loading

2.5 days reprovisioning, repairs, crew leave, etc.

8.0 days total

Twenty-two trips could be made during this period by a vessel following this schedule.

Based on vessel trip schedules, operating hours, and catch composition,

Tables 2 and 3 were constructed to obtain the poundages of fish available from each category per production period. Annual production is also given in Table 4.

Ground fish Trawler Capital Investment and Operating Costs

Estimated costs of contructing a vessel of the size used in this study was obtained from a ship building firm in Mobile, Alabama. The vessel was assumed to be made of steel, 90 feet in length, with a total capacity of 150 tons, powered by a 520 horsepower engine and 30-kilowatt generator. It was also assumed to have a refrigerated brine system to preserve the catch giving an estimated total construction cost of 415,000 (35).

The basic outline of operating costs used by Juhl was followed (15). Costs for fuel, lubricants, nets, doors, cable, and insurance were updated by contacts with local businesses in Bayou La Batre, Alabama; Mobile, Alabama; and Biloxi, Mississippi. Interest cost of 8.5% was based on rates presently charged under National Marine Fisheries Service Obligation Guarantee Program of loans for fishing vessels. Remaining costs outlined by Juhl were increased by 30% to account for inflation. Prices paid to vessel owners for shrimp and food fish were obtained from local fishing firms in Bayou La Batre, Alabama. Prices for pet food and surimi quality fish were obtained from Smith (32, 33).

Straight line method of depreciation for an estimated 20 year life was used to depreciate the vessel and zero estimated salvage value was assumed.

Ground fish Processing Plant Operations

The model processing plant was designed on the total utilization of

catch principle. The plant was assumed to produce five products using all fish unloaded at the dock and fish waste from plant production units. Fish were assumed to be sold fresh, ground into pet food, deboned and processed into surimi, or processed into fish meal and oil. Figure 1 illustrates how the catch is handled as it is transferred from a vessel and processed through the plant.

Five vessels were assumed to supply the plant. Vessels were assumed to unload only on weekdays with one vessel unloaded each day during the summer-fall period. Due to longer trips assumed in the winter-spring period, only four vessels would unload most weeks. One vessel unloads each day with the specific day being determined by the vessel's position in rotation. Some weeks during period two vessel rotation is such that all five vessels unload in 1 week. For this reason, an average daily rate was used as a basis for plant capacity calculations in period two. Total availability of raw material for processing amounted to 104 tons per day during period one and an average of 36.8 tons per day during period two.

Unloading and Sorting

Fish were assumed to be removed from the hold of the vessel by means of a pneumatic fish pump which pumps the fish directly into the plant. This system was used instead of the conventional system which uses water as the transporting medium to eliminate expensive waste treatment of water after its use.

Fish, having been pumped into the plant, are deposited onto a conveyor for sorting. As the catch moves down the conveyor, fish are removed by hand and placed into baskets. All fish which are of the species, size, and quality to be sold fresh are removed, weighed, and transferred to the

fresh fish section of the plant. Six through 8-inch size croaker are removed, weighed, and sent to the section for mincing. All remaining fish are weighed and transferred to the pet food station.

Fresh Fish Production

The assumed catch composition of each vessel and the quantities going into each production unit per trip were listed in tables 2 and 3. As indicated 520 pounds of shrimp and 21,840 pounds of fin fish are available for fresh fish processing per day during period one, and an average of 184 pounds of shrimp and 7,730 pounds of fin fish are available for processing per day during period two. Processing in this section was assumed to be simply a matter of placing the fish and shrimp into 100 pound capacity wooden boxes and icing the fish to maintain quality during shipment to local fish markets.

Pet Food Production

Ground fish and croaker less than 6-inches in length were assumed used in the production of pet food. Pet food production involves grinding whole fish and mixing the fish with certain ingredients, vitamins, and water. This mixture is then cooked. Once cooked the product is canned, sterilized, labeled, cased, and stored until it can be sold.

Daily quantities of raw material for this production unit were 133,640 pounds of fish for period one and an average of 47,298 pounds of fish for period two. Based on a pet food formula which is 33% fish (table 5), the plant could produce 404,970 pounds of pet food during the summer-fall period and 143,327 pounds during the winter-spring

period.

In order to translate the plant pet food production into cans per minute (cpm) so the capital investment requirement can be estimated, two assumptions were made. Actual equipment operating time was assumed to be 15.5 hours during period one, and 7.5 hours during period two. The second assumption was that cans hold 1 pound of pet food. Based on these assumptions, the canning equipment must be able to process 436 cpm during the peak summer-fall period and 318 cpm during the winter-spring period.

Surimi Production

Six to 8-inch size croaker were assumed to be used in the production of surimi. Surimi is a semi-processed wet fish protein (22). This intermediate stage product can be frozen and shipped to Japan where it is used in production of Kamaboko, an elastic or rubbery type of fish cake highly prized by the Japanese consumer (21).

Surimi production begins with heading, gutting, and washing of the croaker. Then fish muscle is separated from skin and bones by sending the fish through a deboning machine. The resultant minced fish flesh is washed, dewatered, strained, and transferred to a mixing machine where additives are mixed with the minced flesh. This mixture is then packaged, frozen, and stored in freezer until sold. The complete surimi production process is described by Miyauchi, et al. (22).

Plant capacities for this production unit were 52,000 pounds per day and 18,404 pounds per day of whole fish for periods one and two, respectively. During the heading and gutting stages of production,

fish are assumed to lose 40% of their body weight. In the deboning process, another 65% of the remaining weight is lost. Thus, 21% of the whole fish is assumed to be recoverable in minced fish flesh (33). Daily production of surimi in period one utilized 10,920 pounds of fish flesh per day while period two utilized 3,865 pounds.

Five percent sorbitol and .2 percent sodium tripolyphosphate by weight of minced fish flesh is added to retard denaturation of fish protein during frozen storage (22). Plant production of surimi in period one was 11,488 pounds per day and 4,066 pounds per day in period two. The product was packaged in 25-pound freezer cartons, frozen in a double contact plate freezer, and stored in the plant's freezer storage space until shipped to Japan.

Fishmeal and Oil Production

Fish not suitable for use in any of the other production units can be ground into fish meal. This study assumed, however, that all fish are used in other production processes, and only fish wastes from surimi production were used for fish meal production.

A fish meal production process varies depending on the nature of the raw material. Generally, the process consists of grinding and cooking the material. After cooking, the material is transferred through a strainer and screw press to remove oils and water. Remaining solids are ground into meal.

Liquid oil and water are treated separately. Oil is separated from the water, polished, and stored for sale. The remaining stick-water is concentrated by evaporation and transferred back into fish

meal production during the drying phase where it is mixed with the cake. The resultant product is called whole meal.

Yield figures given previously indicate 41,080 pounds of fish wastes were available during period one, and 14,539 pounds were available during period two from heading, gutting, and deboning stages of surimi production. Assuming 5 pounds of raw fish produce 1 pound of fish meal, 8,216 pounds and 2,908 pounds of fish meal are produced daily during the two production periods, respectively (17,18). In addition to the fish meal produced, fish oil is also available as a by-product of the fish meal production process. Fish oil also can be extracted from the skin washing tanks of the surimi production unit. Each ton of fish meal assumed to produce 283 pounds of oil, and 72 pounds of oil are produced for each ton of surimi (6,18). One gallon of oil is assumed to weigh 7.5 pounds (18). Production of fish oil in period one totals 210 gallons and 74 gallons in period two. The fish oil is pumped to a 3,000 gallon storage tank. Fish meal is bagged in 100-pound sacks and stored in the plant warehouse.

Ground Fish Processing Plant Costs

Capital Investment Costs

Capital Investment costs include the cost of equipment, construction of buildings, and purchasing of land.

Tables 6 through 9 list the costs of equipment for each production unit. Size of the equipment used was based on each production unit's maximum capacity. To allow for shipping, unloading, and start-up expenses, an additional 7% was added to the total cost of equipment (17).

Plant space requirements must be known before building costs can be estimated. Space requirements for unloading and pet food, surimi, and fish meal production were obtained from equipment manufacturers representatives. Data on which to base estimates of space requirements to sort and weigh the total catch and to process fresh fish was unavailable. Miller,et al. indicated that 1,800 square feet were necessary to process a mix of fin fish and shrimp in a prototype plant capable of processing 1,000,000 pounds per year (20). The same space requirements were assumed to be adequate to handle sorting and weighing stations as well as processing of fresh fish. Additional space to house offices, restrooms, employee's lounge, quality control, and workshop spaces were estimated at 20% of processing space.

Storage space is also needed to house the inventory of materials necessary for production and to store plant production. Before this space can be estimated, the amount of inventory and production to be kept on hand must be established. Thierauf gives a formula for estimating amounts of inventory a plant should retain on hand (37). Product delivery lead times and inventory reordering costs were not estimated for the plant. Therefore, the formula was not used. The amount of inventory the plant keeps on hand was fixed at a 10 production-day supply. Ten days supply of fish oil was also assumed to be stored. Fresh fish products were assumed to be stored over night and shipped the following day.

Space occupied by each item in inventory or each item of production also must be measured. For dry storage space, ingredients such as salt, iron oxide, soybean meal, fish meal, and corn meal were

assumed to be stored in 100-pound sacks requiring 1.65 cubic feet each (18). Pet food was packed in cases of 48 cans each, occupying approximately 1.4 cubic feet (39,7). Empty cans were assumed to occupy the same space. Space for lids, labels, and fish meal bags was not estimated.

Freezer storage space was estimated based on the assumption that one 25-pound freezer carton occupies 1.2 cubic feet (20). The room necessary to house fresh fish production overnight was based on the assumption that one 100-pound capacity wooden box occupies 3 cubic feet (27). Appendix table 2 illustrates how storage space requirement calculations are made for each storage section of the plant.

Total space requirements and building costs, including such things as plumbing, wiring, and steam pipes, are outlined in table 10. Total space requirements amounted to 20,130 square feet and total cost of plant construction is $669,088.

Land costs for the model plant were not estimated. An initial assumption of the study was that the plant is located in a seafood industrial park facility where such things as land, deep water access docking space, and access to waste disposal systems are available. Land adequate for the plant was, therefore, assumed to be leased from a state or local governmental agency which has developed such a site.

Table 11 lists the total capital investment costs for the plant based on the assumptions outlined, $1,984,521.

Operational Costs

Operational costs were divided into fixed and variable costs. Fixed costs are defined as those costs which remain unchanged regardless of

plant output. Variable costs are those costs which vary depending upon plant output.

Fixed costs are divided into six categories.

Depreciation. Depreciation of buildings and equipment was calculated using the straight line method. Salvage value (S) for a particular item is subtracted from its replacement cost (R), then divided by the expected useful life of the item (L) to obtain annual depreciation (D). Salvage values for buildings and equipment is assumed to be zero. Depreciation is then calculated using the following formula:

$$D = \frac{R-S}{L}$$

Classifications and life expectancies used for buildings and equipment are taken from Greenfield (10). Total annual depreciation on buildings and equipment is $251,950, table 12.

Interest. Interest on capital investment was calculated at 9% of average capital investment. Average capital investment is the total capital investment divided by 2 and represents the average size of the debt throughout the repayment period. Estimated annual interest costs amounted to $89,303.

Insurance. Cost of insuring a plant and its equipment was obtained from an insurance agency in Mobile, Alabama (12). Included in insurance policy costs are fire and casualty coverage, general liability and workman's compensation coverage totaling

.5 days off-loading

2.5 days reprovisioning, repairs, crew leave, etc.

8.0 days total

Twenty-two trips could be made during this period by a vessel following this schedule.

Based on vessel trip schedules, operating hours, and catch composition, tables 2 and 3 were constructed to obtain the poundages of fish available from each category per production period. Annual production is also given in Table 4.

Ground Fish Trawler Capital Investment and Operating Costs

Estimated costs of constructing a vessel of the size used in this study was obtained from a ship building firm in Mobile, Alabama. The vessel was assumed to be made of steel, 90 feet in length, with a total capacity of 150 tons, powered by a 520-horsepower engine and 30-kilowatt generator. It was also assumed to have a refrigerated brine system to preserve the catch giving an estimated total construction cost of $415,000 (35).

The basic outline of operating costs used by Juhl was followed (15). Costs for fuel, lubricants, nets, doors, cable, and insurance were updated by contacts with local businesses in Bayou La Batre, Alabama; Mobile, Alabama; and Biloxi, Mississippi. Interest cost of 8.5% was based on rates presently charged under National Marine Fisheries Service Obligation Guarantee Program of loans for fishing vessels. Remaining costs outlined by Juhl were increased by 30% to account for inflation. Prices paid to vessel owners for shrimp and food fish were obtained from local fishing firms in Bayou La Batre, Alabama. Prices for pet food and surimi quality fish were obtained from Smith (32,33).

Straight line method of depreciation for an estimated 20-year

life was used to depreciate the vessel and zero estimated salvage value was assumed.

Ground Fish Processing Plant Operations

The model processing plant was designed on the total utilization of catch principle. The plant was assumed to produce five products using all fish unloaded at the dock and fish waste from plant production units. Fish were assumed to be sold fresh, ground into pet food, deboned and processed into surimi, or processed into fish meal and oil. Figure 1 illustrates how the catch is handled as it is transferred from a vessel and processed through the plant.

Five vessels were assumed to supply the plant. Vessels were assumed to unload only on weekdays with one vessel unloaded each day during the summer-fall period. Due to longer trips assumed in the winter-spring period, only four vessels would unload most weeks. One vessel unloads each day with the specific day being determined by the vessel's position in rotation. Some weeks during period two vessel rotation is such that all five vessels unload in 1 week. For this reason, an average daily rate was used as a basis for plant capacity calculations, $40,000 per year.

Property Taxes. Property taxes on building and equipment were paid by the plant. Taxes on land were not included since the land was assumed to be leased and the leasee is assumed responsible for payment of land taxes. The building's assessed value was 85 percent of its actual cost. Assessed value of equipment was based on the actual costs of the equipment less shipping and installation charges. To compute property taxes, 25 percent of the assessed value is taxable at a tax rate of 49 mills (23). Assessed value of the building

and equipment were $568,725 and $1,230,949, respectively. Based on these assumed assessed values, $22,046 in property taxes were paid annually by the plant.

Lease. Land required for the plant was estimated as 2.5 times the space requirements of the buildings to allow for such things as employee parking spaces, outside storage spaces, and loading areas (17). Building square footage requirements were estimated at 20,130 square feet. Land necessary to house all plant facilities was estimated at 50,325 square feet or 1.15 acres.

Land leasing costs in the Mobile area for industrial use are approximately $800 per acre per year giving total annual leasing costs of $920 (29).

Miscellaneous Fixed Costs. License fees and contractual services such as refrigeration equipment maintenance were included in this category. These costs were estimated at $1,000 annually (17).

Variable costs were divided into five categories.

Consumables. Consumables refers to items used directly in the production process. Examples of consumables are ingredients such as fish, sodium tripolyphosphate used in surimi production, or items such as cans, labels, and lids used in pet food production. No consumables are necessary in unloading and sorting fish.

Two consumables, fish and fish boxes, are needed for fresh fish production. Plant capacities of 22,360 pounds of fish in period one and 7,814 pounds of fish in period two required 4,472 and 1,563 pounds of ice, and 269 and 9 100-pound capacity fish boxes, respectively (3). Table 13 outlines total consumables costs for each period associated with unloading, sorting of the catch, and fresh fish

processing.

Eleven consumables are necessary for pet food production, table 14. Ingredient quantities necessary in production were calculated based on assumptions outlined in the previous section describing the pet food production process. To obtain ingredient quantities, the percent by weight for each ingredient listed in the pet food formula was multiplied by the total output for each production period. Numbers of cans, lids, and labels, were also based on this output. Case requirements were calculated assuming 48 cans to the case. Prices for ingredients were as indicated in the table. Total costs for consumables for each production period were $48,916 and $17,312, respectively.

Four consumables items are necessary in the production of surimi, table 15. Five percent sorbitol and .2 percent sodium tripolyphosphate by weight of minced flesh are added. The two ingredients calculations were computed on the basis of 10,920 pounds of minced flesh for period one and 3,865 pounds of minced flesh for period two. Freezer carton usage was calculated by dividing total output per production period of 11,488 and 4,066 pounds, respectively, by freezer carton capacity of 25 pounds. Prices for each consumable were as indicated in table 15. Total daily costs for consumables for surimi production during each period were $4,169 and $1,475, respectively.

Fish meal consumables were limited to numbers of 100-pound bags required to hold daily production. Period one production was 8,216 pounds per day and production in period two was 2,908 pounds. Daily bag usage was 83 bags for period one and 29 bags for period two.

Total consumables costs assuming one bag costs $.20, were $17 for the summer-fall period and $6 for the winter-spring period (25).

Energy Requirements. Energy requirements for each unit of the plant fall into two groups. Electrical energy is needed to run pumps, conveyors, grinders, mixers, and other equipment. Steam is needed for pet food and fish meal processing.

Horsepower ratings for each piece of equipment are shown in Appendix table 3 through 6. Horsepower was converted to kilowatts by multiplying by .76 since electricity costs are based on kilowatt hours (KWH). To obtain plant electricity consumption, all equipment was assumed to operate 15.5 hours per day during period one and 7.5 hours per day during period two. Assuming electricity costs of $0.45/KWH, daily costs for electricity in each period were $266.00 and $129.00, table 16 (2).

Eleven hundred pounds of steam were assumed to be needed for each ton of raw material used in fish meal production (6). Canning of fisheries products requires approximately ½ boiler horsepower per case of production (14). This equates to approximately 15 pounds of steam per case if initial temperature of water used to generate steam is 21.1°C, table 17. Total steam requirements for each period were 149,149 pounds for period one, and 52,787 pounds for period two.

To estimate steam generating costs water used in steam production was assumed to have an initial temperature of 21.1°C. Energy necessary to convert 1 pound of water at 70°F to steam assuming a gauge pressure of 70 pounds per square inch is 1,187 BTU's. Boiler efficiency was assumed to be 81 percent requiring 1,465 BTU's to produce 1 pound of

steam (5). Natural gas which was assumed to be used as fuel contains 1,030 BTU's per cubic foot, therefore, 1.42233 cubic feet of natural gas was required to produce 1 pound of steam (26). Daily natural gas consumption was estimated to be 212.14 thousand cubic feet (MCF) of gas for period one and 75.1 MCF for period two.

The rate charged to large commercial users of natural gas for uninterruptable service is $1.711 per MCF in Alabama giving costs for steam production in period one of $363.00 per day (1). Steam generating costs in period two are $128.00 per day, table 18.

Labor. Little highly skilled labor was assumed to be necessary, thus minimum wage was assumed to be paid all workers except management. During period one, the plant was assumed to operate on two 8-hour shifts per day with one 8-hour shift being sufficient during period two because of lower catch rates of vessels.

Labor requirements to unload the catch were provided by the equipment manufacturer. No information was available on personnel requirements necessary to sort and weigh the catch or to process the fresh fish. Therefore, the personnel requirements were estimated based on discussions with Alabama Marine Advisory Service personnel (28). Labor requirements to unload, sort, weigh the total catch, and process the fresh fish for each 8-hour shift are shown below:

Personnel	Summer (number)	Winter (number)
Unloader	4	2
Sorter	40	28
Weigher	2	1
Fresh Fish processor	8	4
Total	54	35

Labor requirement estimates were obtained from a canning equipment manufacturer familiar with pet food operations (44). Labor requirements for pet food processing for each 8-hour shift are as follows:

Personnel	Summer (number)	Winter (number)
Grinder	1	1
Blender-cooker	1	1
Canfiller and closer	1	1
Retort	5	3
Labeler	1	1
Case set-up and caser	1	1
Palletizer	1	1
Total	11	9

Davis (6) estimated the labor requirements for an 8-hour shift of surimi production as follows:

Personnel	Summer (number)	Winter (number)
Filleter	2	2
Deboner	1	1
Dewaterer	1	1
Strainer	1	1
Stuffer	1	1
Freezer	3	3
Total	9	9

Three men were assumed to be needed per shift to handle fishmeal production (17). In addition, two men were estimated to be needed in the warehouse per shift.

Management personnel include one plant manager who is responsible for overall plant operation, a shift supervisor for each 8-hour shift, one secretary, and one clerk.

Fringe benefits were estimated at 12 percent of the total wage costs (18), FICA tax was based on a rate of 6.05 percent of daily wages making total daily labor costs amount to $4,232 for period one and $1,665 for period two, table 19.

Water, Sewage, and Maintenance. Water, other than water used as an ingredient in production, is required in ice production, steam generation, and for the proper operation of some machinery used in surimi production.

Ice requirements for fresh fish processing were 4,472 pounds per day in period one and 1,563 pounds per day in period two. Assuming 1 gallon of water weighs 8.3 pounds, approximately 539 gallons of water would be needed daily during period 1 and 188 gallons during period two.

Steam requirements were 149,149 pounds per day for period one and 52,787 pounds per day for period two. Water necessary to generate the steam was 17,970 gallons and 6,360 gallons, respectively, for each production period.

Water is required for the fish washing machines, the fish filleting machine of the surimi production unit and in the skin washing tank. Daily water usage rates for the machinery were 30,885 per day in period one and 14,948 gallons per day in period two, table 20. Total plant consumption of water by ice machines, surimi processing equipment, and for steam production is 49,394 gallons in period one and 21,496

gallons in period two. With water cost per gallon assumed to be $0.0008 (43), daily cost for water usage was $39 in period one and $17 in period two.

Liquid wastes from surimi production and recondensed water from steam production were assumed to utilize the sewage disposal system provided at the site. Cost of using the sewage disposal system was assumed to be $.60 per 1,000 gallons (28). Wastes entering the system were 48,855 gallons per day in period one and 21,308 gallons in period two for a daily waste disposal cost of $29 and $13, respectively.

Maintenance costs were assumed to be 5 percent of initial equipment investment annually (17). Investment in plant equipment was $1,315,433 giving annual maintenance costs of $26,309 or daily average maintenance cost of $104 assuming 254 days of annual operating time.

Miscellaneous Variable Costs. Miscellaneous costs include such items as lubricants for machinery, cleaning utensils and supplies, and various office supplies such as stationary, typewriter ribbons, and telephones. These costs were estimated at 5 percent of daily variable costs for each production period. Daily average miscellaneous costs were estimated at $3,035 per day for period one and $1,087 per day for period two.

GROUND FISH PROCESSING PLANT AND VESSEL COSTS AND RETURNS

Processing Plant Total Costs

Total variable costs associated with each of the plant's production periods are summarized in table 21. Daily variable costs for

the peak production period of June-November amounted to $63,743. Daily variable costs for period two amounted to $22,836. Based on 127 operating days for each production period, total annual variable costs were $10,995,533. Fixed costs, Table 22, were computed on an annual basis and totaled $405,219, giving total annual operating expenses of the ground fish processing plant of $11,400,752.

Processing Plant Revenue

Estimated revenue for each production unit was based on the following prices for finished productions.

Fresh fish	$ .30 per pound
Fresh shrimp	1.90 per pound
Pet food	.14 per pound
Surimi	.80 per pound
Fish meal	.05 per pound
Fish oil	.15 per pound

Price for fresh fish was based on the February 17, 1978, price of large croaker (40) since croaker was estimated to make up 81 percent of the fresh fish catch. No data were available on the quantity by size of the shrimp found in the catch of groundfish trawlers. After discussions with Alabama Marine Advisory Service personnel, $1.90 was selected as a representative price (28).

A pet food wholesale price of $.14 per pound was derived by assuming that one can of pet food sells in the grocery store for $.17 and there is a 21 percent markup from the wholesale price.

The surimi wholesale price was taken from information promulgated

by Smith (32). Fish meal price was based on prices received on November 23, 1977 and November 30, 1977, for fish meal processed from tuna scrap and which contained 50 percent protein (40). Fish oil prices were assumed to be the same as used by Kummnerow, et al. (17).

Revenue computations for the ground fish processing plant are given in table 23. Annual revenue for the ground fish processing plant amounts to $12,712,700.

Processing Plant Returns

Net returns after deduction of total costs and estimated federal and state income taxes amounts to $616,616, table 24. This amounts to a 62 percent return on average investment. Assuming that all the costs of capital investment were financed over a period of 5 years and repayment of the loan principal is made at a rate of 20 per year, an annual principal payment of $396,904 would be required. Money used to meet the principal payment came from cash spendable income and also from the $242,854 allocated as depreciation. Assuming all depreciation goes to meet the principal payment, an additional sum of $144,954 was required from net spendable income, making $471,622 available to the owners as cash spendable income.

Vessel Costs and Return

Competition for ground fish resources used by a new processing plant is already in existence. Several pet food plants are located in Mississippi and Louisiana which utilize ground fish. Prices paid to the vessel owners for the catch must be highly competitive in

order to stimulate new investment in vessels by potential suppliers. Vessel owners will also have to receive additional compensation for their catches due to the necessary restrictions required to maintain the increased quality of the catch. Higher prices will have to be paid to compensate for less total time spend fishing and the lower total annual production which results.

Estimated annual operating expenses are shown in table 25 for the ground fish trawler supplying the plant. Operating or variable costs account for 70 percent of total costs and total $84,322. Ownership costs make up 40 percent of total costs and total $55,246. Fuel costs, fishing gear maintenance and repair, and insurance make up the major portion of operating costs. Fuel costs alone account for 65 percent of operating costs and 39 percent of total costs. Interest and depreciation account for 19 percent and 15 percent of total costs, respectively.

Estimated total annual production amounts to 7,322,000 pounds. Table 26 gives the breakdown of annual production going into each product line and the resulting vessel owners expected revenue.

Costs and returns for the hypothetical ground fish trawler are shown in table 27. Owner's net returns after deduction of total costs and crew shares amounted to $75,809, representing a 36.5 percent on average investment. Depreciation on vessel and equipment of $20,750 is included in the ownership cost segment. It is actually a non-cash expense item and is available for use by the owner. Theoretically, no principal payment need by included as it does not alter the scope of the business (19). Practically, however, a por-

tion of owner's net returns must be used to repay loans for capital investment. A principal payment of $31.125 is used which represents a 10 percent annual amortization of the original loan. An additional $10,375 is required after use of money allocated to depreciation to meet the principal payment. Money is substracted from owners net returns to obtain the funds required to meet the loan payment. Thus, the owner has $65,434 available as net spendable income.

The average price received by the ground fish trawler owner is $88 per ton. This is considerably higher than the $55-$60 per ton which can be obtained in the pet food industry. For this reason, a breakeven price is calculated to give the boat owner an idea of the price range within which he can operate and still meet expenses and principal payment but have minimal cash spendable income. To calculate breakeven price the following formula is used:

$$P = \frac{TC + PP}{.6 \times TP}$$

where

P = Minimum price in dollars and cents per ton,

TC = total costs of $139,568,

PP = principal payment of $10,375, and

TP = total production of 3,661 tons.

To breakeven, the boat owner must receive an average price of $68.26 per ton.

Also of interest to the potential ground fish trawler owner is the earnings which can be received in the pet food industry. Table 28 lists updated estimated costs for an optimum pet food trawler. A vessel trawling in the pet food fishery is paid almost exclusively for

fish used in pet food production. Fish used in pet food production represent 98 percent of the catch by weight and 89 percent of the value. Ownership and operating costs are assumed to be the same as for the ground fish trawler with the exception of fuel and lubricant costs. These costs are increased to account for the additional 460 hours per year the pet food trawler can spend fishing. Expected annual production for the pet food trawler is 8,295,000 pounds and the expected revenue totals $274,140, table 29.

Costs and returns for the pet food trawler are shown for comparison purposes in table 27. Net returns to the owner amount to $17,723 which represents an 8.5 percent return on average investment. Net spendable income after principal payment is $7,348.

SUMMARY AND CONCLUSIONS

Summary

Development of under-utilized fisheries resources in the Gulf of Mexico can have an important impact on the local economy of south Alabama and the State as a whole. To assess the economic feasibility of increasing the use of under-utilized ground fish resources of the Gulf, the feasibility of supplying and operating a processing plant was determined by using capital budgeting techniques.

Quantities of fish available for processing were estimated by assuming that five vessels, each with the capacity to catch a maximum of 104 tons of fish per trip, could supply the plant. The catch of each vessel was broken down into six categories. The categories and their percent representation of the total catch were derived based on available secondary data concerning catch composition of ground fish

trawlers of the Gulf of Mexico. The production year was also divided into two periods to simulate the peak production months of June through November and the slack production period of December through May which is characteristic of the ground fish fishery. Vessel schedules of inport and at-sea time were then constructed based on a high catch rate for production period one and a low catch rate for production period two. From the vessel schedules and expected catch composition of each fishing vessel in each period, an estimate of total raw material available for each category was obtained.

Five product lines were hypothesized for the plant. Fish of the proper kind, size, and quality, and any shrimp caught were assumed to be sold fresh and in the round. Six to 8-inch size croaker were assumed to be of the proper size or be minced and then used to make surimi which is exported to Japan. All remaining ground fish were assumed to be canned as pet food. In addition, in keeping with the principle of total utilization of catch, fish wastes from the surimi production unit were assumed to be used in the production of fish meal and oil.

The processing plant facilities were assumed to be located in a seafood industrial park facility near the city of Mobile, Alabama. Several sites for such a complex are currently under study. Capital investment in buildings and equipment required to unload, sort, weigh, process, and store the ground fish catch and the products produced were estimated. Operational costs associated with plant operation were also estimated and include estimates of plant and equipment depreciation, interest on capital investment, insurance, leasing cots, costs

for items needed in the production process, energy costs, labor costs, and water and sewage costs. Total capital investment in plant and equipment to process 36,610,000 pounds of ground fish per year were $1,934,521. Annual operating expenses were $11,400,742.

Estimates of expected revenue from plant operations were based on wholesale prices which were close to current market conditions. Estimates of wholesale price for fresh fish and shrimp were $.30 per pound and $.90 per pound, respectively. A pet food wholesale price of $.14 per pound was used, and a wholesale price of $.80 per pound was used for surimi. Fish meal and fish oil prices were estimated at $.05 per pound and $.15 per pound, respectively. Annual revenue from ground fish processing amounted to $12,712,700.

Net returns amounted to $1,311,948, and net returns after taxes were $616,616. Return on average investment was used as a measure of the project's profitability. Return on average investment was 62 percent. Net cash spendable income after deductions of a principal payment on total capital investment amounted to $471,662.

A ground fish processing plant requires a higher quality product than is normally needed in a plant which produces only pet food because some of the production is eventually used for human consumption. If refrigerated brine is used as the means of preserving the catch. Shorter trips with less than full capacity loads must be made during the winter months when the average pet food trawler trip lasts 9 days.

To indicate the feasibility of supplying a ground fish processing plant under these conditions, costs and returns for operating a ground

fish trawler were estimated. The vessels used in the study were assumed to be 90 feet in length with a gross carrying capacity of 150 tons. Estimated capital investment requirements for this size vessel were $415,000. Ownership and operating costs were also estimated and include such things as interest on capital investment depreciation, fuel, repair and maintenance, fishing gear replacement, and insurance. Estimated annual ownership and operating expenses totaled $139,568.

Based on prices of $.10 per pound for foodfish, $.70 per pound for shrimp, $.07 per pound for surimi-size fish, and $.03 per pound for pet food quality fish, and an estimated total annual production of 7,322,000 pounds, a ground fish trawler owner realized 36.5 percent return on average investment after allowing for crew shares and operating costs. Net cash spendable income after allowance for a principal payment amounted to $65,434.

In contrast, a vessel operating under optimum conditions in the pet food industry averages a total annual production of 8,295,000 pounds of fish, but realizes only $.03 per pound for 98 percent of the catch. Return on average investment for a pet food trawler is 8.5 percent and a pet food trawler owner realizes a net spendable income of $7,348.

This study assumed the ground fish trawler owner receives an average price of $88 per ton for the catch. To complete the analysis a breakeven price was calculated to indicate the lower price limit a ground fish vessel owner can receive. The calculated breakeven price was $68.25 per ton.

Conclusions

Increased utilization of ground fish resources appears to be highly profitable for the processor and the vessel owner. Although every effort has been made to base the feasibility analysis on assumptions which realistically fit the ground fish fishery, potential investors should realize profitability is restricted to conditions exactly as outlined. Adjustments should be made to fit individual investor requirements and the investor's own knowledge and experience of the industry should be utilized to modity the study conditions to meet specific situations. This study does indicate, however, that increased utilization of ground fish resources can be a feasible fishery resource development alternative.

BIBLIOGRAPHY

1. Alabama Gas Corporation, February 1978. Private interview with representative via telephone. Mobile, Alabama.

2. Alabama Power Company. February 1978. Private interview with representative via telephone. Birmingham, Alabama.

3. Brown, Rich and Robert Palmateer. 1976. Seafood plant design, some planning considerations for the small processor. Washington Sea Grant Marine Advisory Program, University of Washington, Seattle, Washington 46 pp.

4. Bullis, H. R. and J. S. Carpenter. 1968. Latent fishery resources of the central west Atlantic region. In D. W. Gilbert (editor) The future of the fishing industry of the United States, P. 61-64. University of Washington Publications in Fisheries, New Series Volume IV, Seattle.

5. Cleaver-Brooks Boilers. January 1978. Private interview with representative via telephone. Birmingham, Alabama.

6. Davis, J. W. January, 1978. Unpublished Data. Nasua Nova Scotia Corporation, New York, New York.

7. Dessert, Fred. January 1978. Private interview via telephone. Winn Dixie Food Stores. Montgomery, Alabama.

8. Field, Irving. 1907. Unutilized fishes and their relation to the fishing industries. Bureau of Fisheries Document 622. 50 pp.

9. Greenfield, J. E. 1976. The economics of the commercial development of Gulf of Mexico bottom fish. Proceedings of the First Annual Tropical and Subtropical Fisheries Technological Conference. 2:631-644.

10. _____. 1973. The Japanese surimi market, opportunity for minced croaker. Notes supporting presentation made in New Orleans, Louisiana, October 31, 1973.

11. Gutherey, E. J., G. M. Russell, A. F. Serra and B. A. Rohr. 1975. Synopsis of the Northern Gulf of Mexico industrial and foodfish industries. Marine Fisheries Review. 39 (7):1-11.

12. Hall, Wayne. October 1977. Private interview via telephone . Bauhauer-Croom Insurance Agency, Mobile, Alabama.

13. Haskell, W. A. 1961. Gulf of Mexico trawl fishery for industrial species. Commercial Fisheries Review 23 (2):1-6.

14. Jarvis, N. D. 1943. Principles and methods in canning of fishery products. U.S. Department of Interior Fish and Wildlife Service Research Report 7. 366 pp.

15. Juhl, Rolf. 1974. Economics of Gulf of Mexico industrial and foodfish trawlers. Marine Fisheries Review. 36(11):39-42.

16. _____. 1976. Notes on the underutilized fishery resources of the Gulf of Mexico. Proceedings of the First Annual Tropical and Subtropical Fisheries Technological Conference. 2:538-547.

17. Kummerow, Max, Richard Velstrup, Davis Stuiber, Robert Lindsay. 1977. A preliminary study of the fishmeal industry, feasibility of expanding fishmeal production from Lake Michigan alewives. Department of Food Science and Department of Meat and Animal Science. University of Wisconsin, Madison, Wisconsin. 104 pp.

18. Lea, J. D. and E. P. Roy. 1976. Economic feasibility of processing ground fish from the Gulf of Mexico. D.A.E. Research

25. Ralston Purina Company. March 1978. Private interview with representative via telephone. Montgomery, Alabama.

26. Ramer, R. H. 1976. Energy--An introduction to physics. San Francisco, W. H. Freeman and Company. 528 pp.

27. Ramsey, V. E. December 1977. Private interview via telephone. Boca Raton, Florida.

28. Rawson, M. V. February 1978. Private interview via telephone. Alabama Marine Advisory Service. Alabama Cooperative Extension Service. Mobile, Alabama.

29. _____. September 1977. Personal communication. Alabama Marine Advisory Service. Alabama Cooperative Extension Service. Mobile, Alabama.

30. Roithmayr, C. M. 1965. Review of industrial bottomfish fishery in northern Gulf of Mexico. Commercial Fisheries Review. 27(1):1-6.

31. Russel, Michael and C. D. Neal. 1977. An atlas for industrial bottomfish fisherman in the northern Gulf of Mexico. Sea Grant Advisory Service. Mississippi Cooperative Extension Service.

32. Smith E. M. 1977. Market trends for fish and surimi in Japan. Unpublished data. National Marine Fisheries Service, Pascagoula, Mississippi.

33. _____. October 1977. Private interview. National Marine Fisheries Service, Pascagoula, Mississippi.

34. Status report oceanic resource surveys and assessment task. 1976. Presented to Coordinating Committee, Gulf of States Marine Fisheries Commission. pp. 28-33.

35. Stinson, Wayne. October 1977. Private interview via telephone. Bender Shipbuilding Company. Mobile, Alabama.

36. Swingle, Wayne. 1975. Analysis of commercial fisheries catch data for Alabama. Alabama Marine Resources Bulletin. 1:26-50.

37. Thierauf, R. J. and R. A. Grosse. 1970. Decision Making Through Operations Research. New York: John Wiley and Sons, Inc. 570 pp.

38. U.S. Department of Commerce. 1977. Alabama landings annual summary, 1976. Current Fisheries Statistics 7220. National Oceanic and Atmospheric Administration. 5 pp.

39. U.S. Department of Commerce. 1977. Canned Fishery products annual summary, 1975. Current Fisheries Statistics 6901. National Oceanic and Atmospheric Administration. 12 pp.

40. U.S. Department of Commerce. 1977-78. Fisheries Market News Reports. Commercial Development Services Branch. National Marine Fisheries Service, New Orleans, Louisiana.

41. U.S. Department of Commerce. 1977. Fisheries of the United States, 1976. Current Fisheries Statistics 7200 National Oceanic and Atmospheric Administration. 96 pp.

42. Waters, Melvin. 1977. Notes from presentation given at Gulf States Marine Fisheries Committee meeting. Mobile, Alabama.

43. Water Works Board. January 1978. Private interview with representative via telephone. Mobile, Alabama.

44. Yourgalite, Ray. December 1977. Private interview via telephone. FMC Corporation, Westminster, Maryland.

Table 1. Eight Most Valuable Seafood Species Landed In Alabama, 1976

Species	Dollars	Pounds
Shrimp (heads on)	30,393,075	18,689,887
Oysters (meats)	1,155,475	1,236,058
Croaker	873,337	6,313,486
Red snapper	387,670	634,855
Blue crab (hard)	281,108	1,298,653
Flounder	195,868	803,273
White sea trout	153,014	1,344,708
Mullet	92,492	865,093

SOURCE: Alabama Landings, Current Fisheries Statistics of the United States (38).

Table 2. Assumed Catch Composition Of Alabama Northern Gulf Of Mexico Groundfish Trawler, Period One, 1977

Product	Percent of Catch	Pounds Per Trip	Pounds 26 Trips	Use
Shrimp	0.25	520	13,520	Fresh fish market
Food fish (other than croaker)	2.00	4,160	108,160	Fresh fish market
Ground fish (other than croaker)	47.75	99,320	2,582,320	Petfood
Croaker				
6" (33%)	16.50	34,320	892,320	Petfood
6-8" (50%)	25.00	52,000	1,352,000	Minced fish
9" (17%)	8.50	17,680	459,680	Fresh fish market
Total	100.00	208,000	5,408,000	

Table 3. Assumed Catch Composition Of Alabama Northern Gulf Of Mexico Ground Fish Trawler Period Two, 1977.

Product	Percent of catch	Per trip	22 Trips	Use
Shrimp	0.25	217.5	4,785	Fresh fish market
Fod fish (other than croaker)	2.00	1,740.0	38,280	Fresh fish market
Groundfish (other than croaker)	47.75	41,542.5	913,935	Petfood
Croaker				
6"	16.50	14,355.0	315,810	Petfood
6-8"	25.00	21,750.0	478,500	Minced fish
9"	8.50	7,395.0	162,690	Fresh fish market
Total	100.00	87,000.0	1,914,000	

Table 4. Assumed Annual Production Of Alabama Northern Gulf Of Mexico Ground Fish Trawler, 1977

Product	Tons	Pounds
Shrimp	9.15	18,305
Food Fish	384.40	768,810
Pet Food size fish	2,352.20	4,704,385
Surimi size fish	915.25	1,830,500
Total	3,661.00	7,322,000

Figure 1. Relationships Of Ground Fish Processing Plant Production Units

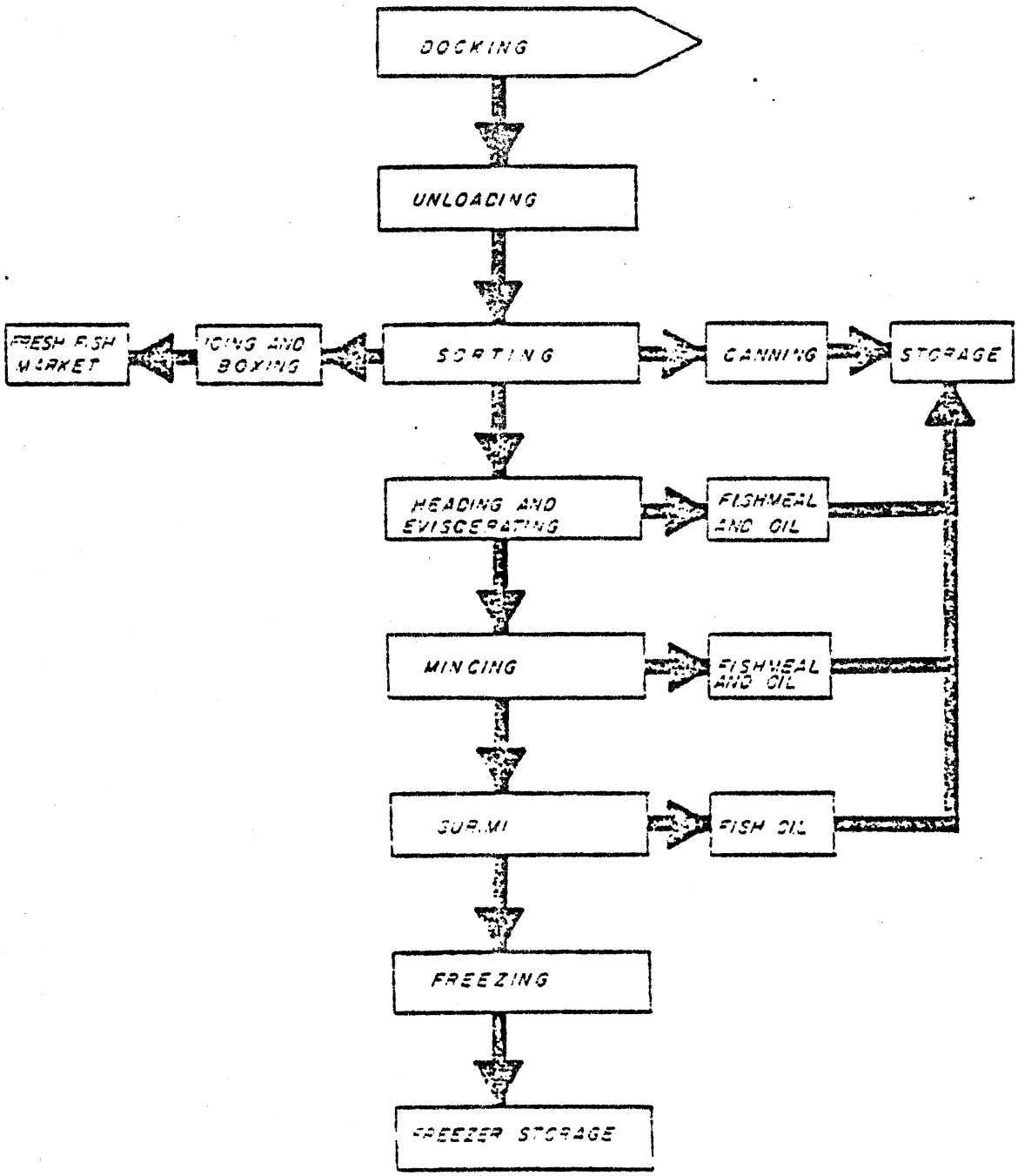


Table 5. Formula Used In Pet Food Production Unit of Ground Fish Processing Plant

Ingredient	Percent by weight
Water	49.10
Fish	33.00
Corn meal	9.80
Soybean meal (49% protein)	7.50
Salt	.40
Vitamin pre-mix	.17
Iron oxide	.03
Total	100.00

SOURCE: R. T. Lovell, Professor, Department of Fisheries and Allied Aquacultures, Auburn University, Auburn, Alabama.

Table 6. Capital Investment Requirements And Costs For Unloading, Sorting and Fresh Fish Production Units, Of Ground Fish Processing Plant, Alabama, 1977

Item[1/]	Unit	Cost/Unit	Units	Total
		dollars		dollars
Unloading pneumatic fish pump	each	25,000	1	25,000
Sorting conveyor	each	2,625	1	2,625
Sorting baskets	each	18.75	120	2,250
Industrial platform scales	each	1,615	1	1,615
Fresh fish ice machine	each	11,000	1	11,000
Initial cost				42,490
7% shipping and handling				2,974
Total cost				45,464

[1/] See Appendix Table 1 for description and source of equipment.

Table 7. Capital Investment Requirements and Costs For Petfood Production Unit Of Ground Fish Processing Plant Alabama 1977

Item[1/]	Unit	Cost/Unit dollars	Units	Total dollars
Grinder	each	15,000	1	15,000
Mixer/cooker	each	42,500	2	85,000
Can filler	each	86,000	1	86,000
Can closer	each	75,000	1	75,000
Retort	each	15,000	5	75,000
Gondola cars	each	700	30	21,000
Labeler	each	13,210	1	13,210
Case set up	each	19,000	1	19,000
Caser	each	21,000	1	21,000
Case palletizer	each	33,000	1	33,000
Conveyor system	each	25,000	--	25,000
Forklift	each	14,290	1	14,290
Boiler	each	75,000	2	150,000
Initial cost				632,500
7% shipping and installation				44,275
Total cost				676,775

1/ See Appendix Table 1 for description and source of equipment.

Table 8. Capital Investment Requirements And Costs For Surimi Production Unit Of Ground Fish Processing Plant Alabama, 1977

Item[1/]	Unit	Cost/Unit	Units	Total
		dollars		dollars
Washer	each	15,808	1	15,808
Filleter	each	42,269	1	42,269
Washer	each	11,556	1	11,556
Deboner	each	79,622	1	79,622
Washer	each	1,500	2	3,000
Dewatering sieve	each	5,000	1	5,000
Press	each	25,000	1	25,000
Strainer	each	14,000	1	14,000
Holding tank	each	500	1	500
Mixer	each	20,000	1	20,000
Stuffer and weigher	each	40,400	1	40,400
Stuffing table	each	500	1	500
Plate freezer	each	19,000	1	19,000
Block pans	each	8	600	4,800
Miscellaneous Flumes and conveyors				3,700
Initial cost				285,155
7% shipping and installation				19,961
Total cost				305,116

1/ See Appendix Table 1 for description and source of equipment.

Table 9. Capital Investment Requirements And Costs For Fish Meal And Oil Production Units Of Ground Fish Processing Plant Alabama 1977

Item[1/]	Unit	Cost/Unit dollars	Units	Total dollars
Fishmeal and oil plant	each	245,000	1	245,000
Oil storage tank	each	1,195	1	1,195
Initial cost				246,195
7% shipping and installation				17,234
Total cost				263,429

[1/] See Appendix Table 1 for description and source of equipment.

Table 10. Space Requirements And Building Costs For Ground Fish Processing Plant, Alabama, 1977

Item	Square feet	Cost/ square foot[1] dollars	Cost dollars
Production area			
Dock	64[2]	21	1,344
Fresh fish	1,800[3]	41	73,800
Petfood	1,740[4]	41	71,340
Surimi	4,200[5]	41	172,200
Fishmeal	1,400[6]	41	57,400
Office employee work-shop, quality control	1,841[7]	32	58,912
Storage area			
Dry storage	8,322[8]	21	174,762
Holding freezer	649[8]	80	51,920
Holding cooler	1148[8]	65	7,410
Total	20,130		669,088

[1] Brown et al. (3).

[2] Temco Inc., Bellevue, Washington, December, 1977.

[3] Miller et al. (20).

[4] Petfood equipment space requirement of 1,450 sq ft plus 20 percent.

[5] Nassau Nova Scotia Co., New York, NY, January, 1978.

[6] Kammerow et al. (17).

[7] Twenty percent of production area total space of 9,204 sq ft.

[8] From Appendix Table 2.

Table 11. Total Capital Investment Costs Of Ground fish Processing Plant, Alabama, 1977

Item	Cost dollars
Building	669,088
Equipment	
Unloading, sorting and fresh fish units	45,464
Pet food	676,775
Fish meal	263,429
Surimi	305,116
Office equipment (estimated	5,000
Subtotal	1,964,872
Miscellaneous equipment and tools (1%)	19,649
Total capital investment	1,984,521

Table 12. Annual Depreciation Costs Of Ground fish Processing Plant Buildings And Equipment, Alabama, 1977.

Item	Cost	Life	Depreciation
	dollars	years	dollars
Buildings	669,088	33 1/	20,275
Processing equipment	877,355	5 1/	175,471
Office equipment	5,000	4 1/	1,250
Miscellaneous equipment and tools	19,649	6 1/	3,275
Fishmeal plant and storage tank	263,429	8 1/	32,929
Boilers	150,000	8 2/	18,750
Total depreciation			251,950

1/ Greenfield (10).

2/ Assumed.

Table 13. Estimated Daily Consumables Usage And Costs For Unloading, Sorting And Fresh Fish Production Units, By Period, 1977

Item	Unit	Cost/ unit	Summer units	Winter units	Summer cost	Winter cost
		dollars			dollars	dollars
Fish boxes	each	1.25[1/]	269[1/]	94	336	117
Fish	pounds	.10[2/]	22,360[2/]	7,814	2,236	781
Total cost					2,572	898

1/ Veron E. Ramsey, Inc., Boca Raton, Florida, December 1977.

2/ Quality Seafoods, Bayou La Batre, Alabama, November 1977.

Table 14. Estimated Daily Consumable Usage And Costs For Pet food Production Unit, By Period, 1977

Item	Unit	Cost/ unit	Summer units	Winter units	Summer cost	Winter cost
		dollars			dollars	dollars
Water	gallon	.0008[1/]	23,957	8,479	19	7
Cornmeal	pound	.10 [2/]	39,687	14,046	3,969	1,405
Soybean eal	pound	.1015[2/]	30,373	10,749	3,083	1,091
Vitamin premix	pound	.45 [3/]	688	244	310	110
Salt	pound	.032 [2/]	1,620	573	52	18
Iron oxide	pound	.10 [3/]	121	43	12	4
Lids	each	.01551[4/]	404,970	143,327	6,281	2,223
Cans	each	.06826[4/]	404,970	143,327	27,643	9,783
Labels	each	.00383[5/]	404,970	143,327	1,551	549
Cases	each	.2355[4/]	8,437	2,986	1,987	703
Fish	pound	.03 [6/]	133,640	47,298	4,009	1,419
Total					48,916	17,312

1/ Water Works, Mobile, Alabama, January 1978 (43).

2/ "The Ingredient Market", Feedstuffs, June 27, 1977.

3/ Mountaire Coporation, North Little Rock, Arkansas, December 1977.

4/ Continental Can Company, New Orleans, Louisiana, December 1977.

5/ Vallee Corporation, New Orleans, Louisiana, December 1977.

6/ E. Moret Smith, Fishery Marketing Specialist, National Marine Fisheries Service, November 1978.

Table 15. Estimated Daily Consumables Usage And Costs For Surimi Production Unit, By Period, 1977

Item	Unit	Cost/ unit	Summer units	Winter units	Summer cost	Winter cost
		dollars			dollars	dollars
Sodium tripolyphosphate		0.335[1/]	22	8	7	3
Sorbitol		0.680[2/]	546	193	371	131
Freezer cartons	each	0.328[3/]	460	163	151	53
Fish	each	0.07 [4/]	52,000	18,404	3,640	1,288
Total					4,169	1,475

1/ FMC Chemical Division, Philadelphia, Pennsylvania, March 1978.

2/ ICI United States, Wilmington, Delaware, March 1978.

3/ Consolidated Box Company, Birmingham, Alabama, March 1978.

4/ Smith (32).

Table 16. Estimated Daily Ground fish Processing Electrical Requirements And Costs, By period, 1977

Production unit	Kilowatts per hour number	Summer usage kwh	Winter usage kwh	Cost/KWH dollars	Summer cost dollars	Winter cost dollars
Unloading, sorting and fresh fish	50	775	375	.045	35	17
Pet food	62	961	465	.045	43	21
Surimi	208	3,224	1,560	.045	145	70
Fish meal	61	945	457	.045	43	21
Total	381	5,905	2,857		266	129

Table 17. Estimated Daily Ground fish Processing Steam Requirements By Period, 1977

Item	Steam requirement pounds/unit	Unit	Units		Steam requirement	
			Summer	Winter	Summer	Winter
Fish meal	1100	ton[1/]	20.54	727	22,594	7,997
Pet food	15	case[2/]	8,437	2,986	126,555	44,790
Total					149,149	52,787

1/ Input of raw material per day.

2/ Output per day.

Table 18. Estimated Daily Groundfish Processing Steam Costs, By Period, 1977

Period	Steam requirement pounds	Cubic Feet Gas/ pound steam	Gas (MCF)	Cost dollars	Total cost dollars
1	149,149	1.42233	212.14	1.711	363
2	52,787	1.42233	75.10	1.711	128

Table 19. Estimated Daily Ground fish Processing Labor Requirements And Costs, By Period, 1977

Item	Laborers[1/]		Work time		Hourly rate	Summer cost	Winter cost
	Summer	Winter	Summer	Winter			
	number	number	hours	hours	dollars	dollars	dollars
Production Workers							
Unloading, sorting, weighing & fresh fish	54	35	16	8	2.65	2,290	742
Pet food	11	9	16	8	2.65	466	191
Surimi	9	9	16	8	2.65	382	191
Fish meal	3	3	16	8	2.65	127	64
Warehouse Workers	2	2	16	8	2.65	85	42
Management Workers							
Plant manager	1	1	8	8	8.37	67	67
Shift supervisor	1	1	16	8	6.89	110	55
Secretary	1	1	8	8	4.10	33	33
Clerk	1	1	8	8	3.20	26	26
Total Wages						3,585	1,410
Fringe Benefits						430	169
FICA (6.05% of total wages)						217	85
Labor Costs						4,232	1,665

[1/] Laborers working 8 hr shifts.

Table 20. Daily Water Usage Rates Of Surimi Production Machinery By Period

Machinery	Water usage	
	Period 1	Period 2
	gallons	gallons
Raw fish washer	8,193	3,968
Fish filleter	6,510	3,150
Filleted fish washer	4,092	1,980
Skin washing tank	12,090	5,850
Total	30,885	14,948

Table 21. Estimated Ground fish Processing Plant Variable Costs, Alabama, 1977

Variable costs	Period 1 dollars	Period 2 dollars
Consumables		
Unloading, sorting & fresh fish	2,572	899
Pet food	48,916	17,312
Surimi	4,170	1,476
Fish meal	17	6
Energy		
Electricity	266	129
Seam	363	128
Labor	4,232	1,665
Water	39	17
Waste disposal	29	13
Maintenance	104	104
Subtotal	60,708	21,749
5% Miscellaneous	3,035	1,087
Total variable costs (per day)	63,743	22,836
Total variable costs (127 days production)	8,095,361	2,900,172
Total annual variable costs	10,995,533	

Table 22. Estimated Groundfish Processing Plant Annual Fixed Costs, Alabama, 1977

Fixed costs	Amount
	dollars
Depreciation	251,950
Insurance	40,000
Interest	89,303
Property taxes	22,046
Leasing costs	920
Miscellaneous costs	1,000
Total fixed costs	405,219

Table 23. Estimated Ground fish Processing Plant Production And Revenue, Alabama, 1977

Unit	Production Period 1	Production Period 2	Price	Revenue Period 1	Revenue Period 2
			dollars	dollars	dollars
Fresh fish					
Fish	21,840	7,730	.30	6,552	2,319
Shrimp	520	84	1.90	988	160
Pet food	404,970	143,327	.14	56,696	20,066
Surimi	11,488	4,066	.80	9,190	3,253
Fish meal					
Meal	8,216	2,908	.05	411	145
Oil	1,576	558	.15	236	84
Total daily revenue				74,073	26,027
Total revenue					
Per production period (based on 127 days)				9,407,271	3,305,429
Annual revenue				12,712,700	

Table 24. Estimated Ground fish Processing Plant Annual Costs And Returns, Alabama, 1977

Item	Amount
	dollars
Costs	
Fixed	405,219
Variable	10,995,533
Total	11,400,752
Total revenue	12,712,700
Net Returns	1,311,948
Net returns after taxes[1/]	616,616
Percentage return on average investment	62
Principal payment (less depreciation)[2/]	144,954
Cash spendable income	471,662

[1/] 48 percent federal, 5 percent state.

[2/] Based on 5 year loan.

Table 25. Alabama Ground fish Trawler Annual Ownership And Operating Costs

Estimate, Alabama, 1977

Item	Description		Amount
			dollars
Ownership costs			
Boat interest (loan of 311,250)	8.5 percent		26,456
Opportunity cost	25 percent down at 7.75 percent		8,040
Boat depreciation	20 year life		20,750
Total ownership costs			55,246
Operating costs			
Fuel	44¢/gallon; 1,580 hours at 35 gallons/hour		55,132
Lubricants	1.75/gallon; 488 gallons		854
Repair and maintenance			
Vessel			
Hull			4,550
Refrigeration & power plant			455
Spare parts & supplies			520
Fishing gear			7,474
Nets	2½ per year	4,500	
Doors	2 sets per year	1,500	
Twine, webbing, chaffing gear		455	
Cable	400 fathoms every 2 years	564	
Block, lines, etc.		455	
Deck working supplies			357
Administrative costs			780

Table 25. (Continued)

Item	Description		Amount
			dollars
Insurance	Hull	9,500	
	Liability	3,350	
	Breach of warranty	1,350	
			14,200
Total operating costs			84,322
Total costs			139,568

Table 26. Alabama Ground fish Trawler Annual Production And Revenue Estimate, 1977

Product	Quantity pounds	Price/ pound dollars	Revenue dollars
Shrimp	18,305	.70	12,813
Food fish	768,810	.10	76,881
Pet food	4,704,385	.03	141,132
Minced fish	1,830,500	.07	128,135
Total	7,322,000		358,961

Table 27. Comparison Of Alabama Ground fish And Pet food Trawler Annual Costs And Returns, 1977

Item	Ground fish trawler		Pet food trawler	
	dollars		dollars	
Total costs	139,568		146,760	
Returns	358,961		274,140	
(less 40% crew share)	143,584		109,656	
Owner's returns	215,377		164,484	
Net Returns to owner	75,809		17,723	
Percentage return on average investment		36.5		8.5
Principal payment (less depreciation)	10,375		10,375	
Cash spendable income	65,434		7,348	

Table 28. Alabama Pet food Trawler Annual Ownership And Operating Costs Estimate, Alabama, 1977

Item	Description		Amount
			dollars
Ownership Costs			
Boat interest (loan of 311,250)	at 8.5 percent		26,456.00
Opportunity cost	25 percent down at 7.75 percent		8,040.00
Boat depreciation	20 year life		20,750.00
Total Ownership Costs			55,246.00
Operating Costs			
Fuel	44¢/gallon; 4,040 hours at 35 gallons/hour		62,216.00
Lubricants	1.75/gallon--550 gallons/year		962.50
Repair and maintenance			
Vessel			
Hull			4,550.00
Refrigeration & power plant			455.00
Spare parts & supplies			520.00
Fishing gear			
Nets	2½ per year	4,500	7,474.00
Doors	2 sets per year	1,500	
Twine, webbing, chaffing gear		455	
Cable	400 fathoms every 2 years	564	
Block, lines, etc.		455	
Deck working supplies			357.00
Administrative costs			780.00

Table 28 (Continued).

Item	Description		Amount
			dollars
Insurance	Hull	9,500	
	Liability	3,350	
	Breach of warranty	1,350	
			14,200
Total operating costs			91,514
Total costs			146,760

Table 29. Alabama Pet food Trawler Annual Production And Revenue Estimate, 1977

Product	Quantity pounds	Price/Pound dollars	Revenue dollars
Industrial Fish	8,112,000	.03	243,360
Food Fish	162,200	.10	16,220
Shrimp	20,800	.70	14,560
Total	8,295,000		274,140

Appendix Table 1. Equipment Manufacturers And Selected Equipment Specifications For Ground fish Processing Plant Production Units

Item	Equipment manufacturer or representative	Capacity	Approximate Dimensions	Other
Unloading, sorting & fresh fish				
Pneumatic unloader	Tempco, Inc. Bellevue, Wa.	15 ton/hr	8'x25'x25'	8" dia. hose
Sorting conveyor (model TW)	Turner Supply Co. Mobile, Al.	1200 lb	40'x24"	Wire mesh belt
Sorting buckets	Delta Net & Twine Greenville, Mx.	8 pecks	22" dia. 14" depth	Galvanized wire
Ice Machine	Alabama Beverage & Ice Mobile, Al.	5,000 lb/day	Unavailable	
Industrial platform Scales	Ebbert & Kirkman Birmingham, Al.	200 lb	N/A	
Pet food Unit				
Grinder	Edward Renneburg & Sons Baltimore, Md.	15 ton/hr	Unavailable	
Ribbon blender-cooker (model G)	Day Mixing Co. Cincinnati, Oh.	465 gal	11'x4'x6'	
Can filler (c-210 M&S)	FMC Corp. Hoopeston, Il.	600 CPM (Max)	8.5'x5'x6'	
Can closer (652)	FMC Corp. Hoopeston, Il.	250-600 CPM	7'x3'x7'	
Horizontal retort with instruments	Reid Boiler Works Bellingham, Wa.	6 cars	23"x6"x8"	
Gondola cars	Reid Boiler Works Bellingham, Wa.	1,560 cans (loose)	5"x4.5'x3.5'	
Labeler (model 915)	Standard Knapp Portland, Ct.	700 CPM (Max)	8x3x6.5	
Case set up (model E43)	FMC Corp. Hoopeston, Il.	20 ca/min	14x7.5x8.5	1.9 CFM air

Appendix Table 1. (continued)

Item	Equipment manufacturer or representative	Capacity	Approximate dimensions	Other
Fish meal production				
Fish plant	Stord Bartz Ab Bergen, Norway	33 ton/raw/ material/24 hr	17x6x9.5	1,100 lb steam per ton/raw material
Fish oil plant	Stord Bartz Ab Bergen, Norway	Not listed	5.5x6.5x8	
Concentrating plant	Stord Bartz Ab Bergen, Norway	Not listed	9.5x7x10	
Fish oil storage	Birmingham Tank Co. Birmingham, Al.	3,000 gal	64" dia 18' long	3/16 inc. steel

Appendix Table 2. Ground fish Processing Plant Storage Space Requirements

Calculations

Item	Unit	10 day supply	Cubic feet/Unit	Cubic feet
Ingredients				
Sorbitol	pound	6,580	.0165	109
Sodium tripolyphosphate	pound	260	.0165	4
Cornmeal	pound	396,900	.0165	6,549
Soybean meal	pound	303,700	.0165	5,011
Vitamin premix	pound	6,900	.0165	114
Salt	pound	16,200	.0165	267
Iron oxide	pound	1,220	.0165	20
Cans	case	84,370	1.4	118,118
Subtotal				130,192
Output				
Petfood	case	84,370	1.4	118,118
Fishmeal	pound	82,160	.0165	1,356
Surimi	carton	4,595	1.2	5,514
Fresh fish	box	324	3.0	972
Cubic feet				
Dry storage space (ingredients plus petfood & fishmeal)		249,666		
Freezer space		5,514		
Cooler space		972		
Square footage dry storage (30 ft walls)		8,322		
Square footage freezer (8.5' walls)		649		
Square footage cooler space (8.5' walls)		114		

Appendix Table 3. Unloading, Sorting, And Fresh Fish Production Equipment Horsepower Requirements

Item	Horsepower
Unloading	
Pneumatic fish pump	60.0
Sorting	
Sorting conveyor	0.3
Fresh fish	
Ice machine	5.0
Total	65.3

Appendix Table 4. Pet food Production Equipment Horsepower Requirements

Item	Horsepower
Grinder	10.00
Blender-cooker (2)	30.00
Can filler	2.50
Can closer	10.00
Labeler	2.50
Case set-up	2.75
Caser	1.00
Pailetizer	8.00
Compressor	5.00
Conveyor ystem	10.00[1/]
Total	81.75

[1/] Estimate

Appendix Table 5. Surimi Production Equipment Horsepower Requirements

Item	Horsepower
Raw fish washer	0.75
Filleter	4.50
Fillet washer	0.75
Meat bone separator	5.75
Dewatering seive	5.00[1/]
Press	5.00[1/]
Strainer	5.00[1/]
Mixer	10.00
Stuffer	10.00
Plate freezer	217.00
Conveyors and pumps	10.00
Total	273.75

[1/] Estimate

Appendix Table 6. Fish meal And Oil Production Equipment Horsepower Requirements

Item	Horsepower
Fishmeal plant	
Feed screw conveyor	3.00
Indirect cooker & screw motor	5.00
Tearing & mixing conveyor	2.00
Drier motor	20.00
Centrifugal fan motor	4.00
Presswater transfer pump	1.00
Milling & bagging plant motor	20.00
Subtotal	55.00
Fish oil plant	
Vibrating screen motor	0.50
Presswater pump	1.00
Oil separator motor	10.00
Stickwater transfer pump	2.00
Subtotal	13.50
Stickwater plant	
Stickwater feed pump	2.00
Vacuum pump	5.50
Condensate discharge pump	.75
Solubles discharge pump	1.50
Solubles dosing pump	1.50
Subtotal	11.25
Total	79.75