Cost-size Relationships in the Processing of Farm-raised Catfish in the Delta of Mississippi
Acknowledgments

We express our sincere appreciation to all who contributed to this research effort. We especially thank the management of the several firms in the farm-raised catfish processing industry in Mississippi who assisted us in this study. They not only provided much needed data but also allowed us to tour their facilities and observe and study their operations, some of which were unique and considered proprietary.

We also especially thank Dr. Joe H. McGilberry, Manager, Food and Fiber Center, Mississippi Cooperative Extension Service, who freely shared with the authors his in-depth knowledge of, and experience with, the catfish processing industry. The data and critical review provided by Dr. McGilberry were invaluable to the conduct of this study.

We thank the numerous suppliers of processing and building equipment who cooperated fully in providing such information as performance rates and prices of their materials, labor and equipment.

Appreciation also is extended to Dr. Charles Shannon and Dr. Gale Ammerman, Food Technologists, Mississippi Cooperative Extension Service and Mississippi Agricultural and Forestry Experiment Station, respectively, for providing data and data sources used in this study.

We also thank Dr. Albert J. Allen, Dr. G. Wayne Malone, Dr. Earl A. Stennis and Dr. John E. Waldrop, Department of Agricultural Economics, Dr. David L. Trammell, Head, Extension Marketing Department and Mr. L. Dow Welch, Agricultural Economist (retired) for their critical review of the manuscript.
Cost - size Relationships in the Processing of Farm - raised Catfish in the Delta of Mississippi

Marty J. Fuller, Assistant Professor and Assistant Agricultural Economist and James G. Dillard, Professor and Agricultural Economist, Department of Agricultural Economics, Mississippi State University
Content

Objectives .................................................................................................................. 1
Procedure ................................................................................................................... 2
The Economic-Engineering Approach ................................................................... 2
Model Plants and Product Mix ............................................................................... 3
Plant Facilities .......................................................................................................... 4
  Real Estate ............................................................................................................ 4
  Waste Treatment Facility ...................................................................................... 5
Building Requirements ............................................................................................. 6
Receiving .................................................................................................................. 7
Parking and Loading ................................................................................................. 7
Equipment Requirements ........................................................................................ 7
  Receiving ............................................................................................................. 7
  Heading and Eviscerating ....................................................................................... 7
  Skinning ............................................................................................................... 8
  Chilling ............................................................................................................... 8
  Sorting ............................................................................................................... 9
  Filleting ............................................................................................................. 9
  Steaking ............................................................................................................ 9
  Ice Packing ..................................................................................................... 9
  Tray Packing ................................................................................................... 9
  Individual Quick Freezing ................................................................................. 9
  Refrigeration ................................................................................................... 9
  Offal ................................................................................................................ 10
Welfare and Offices .................................................................................................. 10
Investment Requirements and Costs .................................................................... 10
  Ownership Costs ............................................................................................... 11
    Depreciation .................................................................................................. 11
    Interest .......................................................................................................... 11
    Insurance ...................................................................................................... 12
    Taxes ........................................................................................................... 13
Operating Costs ........................................................................................................ 13
  Personnel .......................................................................................................... 13
  Utilities ............................................................................................................ 13
    Electricity ...................................................................................................... 13
    Water .......................................................................................................... 13
    Telephone ................................................................................................... 13
    Repairs and Maintenance ............................................................................. 13
    Supplies and Services ................................................................................... 13
    Interest on Operating Capital ..................................................................... 14
  Total Costs ...................................................................................................... 14
  Effects of Varying Wage Rates ......................................................................... 15
Summary, Conclusions and Limitations ................................................................ 17
Appendix Tables ...................................................................................................... 19
References .............................................................................................................. 27
Cost - size Relationships in the Processing of Farm-raised Catfish in the Delta of Mississippi

The increase in commercial production and processing of farm-raised catfish in recent years has been dramatic. Water acres have increased by an average of 20% per year over the last 10 years. More than 65,000 acres of water were used in the production of farm-raised catfish in Mississippi in 1983.1 About 140 million pounds of farm-raised catfish (live-weight) were processed in 1983, most of which was in the Delta area of Mississippi. The annual one-shift capacity of commercial processing plants in Mississippi increased from 8 million pounds in 1979 to an estimated 200 million pounds in 1983.

The catfish industry has grown considerably, but its current size may be only a small proportion of its potential. The per capita consumption of fish and seafood in the United States was about 12.3 pounds annually in 1982, with farm-raised catfish representing about 4% of total consumption. Small increases in per capita consumption likely will bring about large increases in production and processing in Mississippi. A one-pound increase in U.S. per capita catfish consumption would increase total quantity demanded by more than 400 million pounds (live-weight). Such increases will occur as catfish continue to capture a greater share of the market for fish.

Rapid growth in processing capacity generally has paralleled the growth in farm production. This expansion in processing capacity occurred with little published research information on the economics of catfish processing. Entrepreneurs have been handicapped by a lack of published information concerning cost-size relationships in catfish processing and costs associated with alternative processing technologies. Consequently, the annual one-shift capacity of commercial processing plants operating in 1983 varied from 7 to 48 million pounds live-weight and reflected a range in technology from highly labor intensive to almost fully automated. As the industry continues to grow and mature, it will become more critical that processing plants of the most efficient size be designed around the most efficient processing technologies available.

The market potential for farm-raised catfish cannot be assessed adequately without some understanding of the consumer demand for the product. In order to plan studies of consumer demand, it is important to know the total costs of placing the product in retail outlets, and it is evident that processing costs represent a significant portion of total costs.

Objectives

The overall objective of this study was to discover cost of processing farm-raised catfish and to discover economics of size exist in the catfish processing industry.

The specific objectives of the study were to (1) identify alternative plant sizes and technologies that are believed to capture most size economies, (2) synthesize efficient catfish processing plants that correspond in size to the plants identified and to determine the costs of processing catfish by phases of the processing cycle for each plant size and (3) determine if economies of size exist by evaluating per-unit cost of processing for plants of different sizes.

1Numbers in brackets refer to items cited by those numbers in References.
Objective 1 was achieved through the use of available information on the capacity of the processing plants in the Delta. From this information alternative plant sizes that generally encompass the plant sizes existing in the Delta were designated. Also, from available information as well as personal interviews with industry leaders, the percentages of various product forms and packaging procedures currently used, along with expectations for the future, were identified for the representative plants.

For objective 2, catfish processing plants similar in size to the representative plants identified in objective 1 were synthesized using the economic-engineering approach. Each phase (or stage) of the processing cycle was identified, and costs for each of the phases were determined. When alternative technology existed for performing functions at each stage, the most efficient was used. Appropriate equipment prices were obtained from processors and suppliers. Installation charges and building needs were estimated through contractors and industry personnel. Labor data were obtained from processors’ input-output records, from engineering and/or time and motion studies and from manufacturers’ specifications. After determining the least-cost method for accomplishing each phase, or each function within a phase, the phases were aggregated into an efficient overall processing plan.

To accomplish objective 3, annual ownership and operating costs for plants of each size were determined using data obtained in objective 1. The total cost of processing was evaluated for each of the plant sizes to determine if economies of size exist in the catfish processing industry.

In order to discover if economies of size exist in the catfish processing industry, it is first necessary to discover cost of processing catfish for alternative plant sizes or processing capacities. To determine this, the data obtained must be consistent with maximum physical and economic efficiency in order to estimate the least-cost combination for chosen plant sizes [2]. Therefore the economic-engineering approach supplemented with a survey of existing plants, was chosen to estimate the cost components of processing catfish in plants of different sizes.

The Economic-Engineering Approach

Alternative technologies exist for performing different phases of catfish processing, and evaluating the cost variation for each of these options is vital. In order to have overall efficiency in the operation, the least-cost method must be determined for each phase of processing. The determined input-output coefficients and cost estimates for each phase then can be aggregated into a minimum total cost function for the catfish processing facility [2].

The economic-engineering approach is well suited for this type of analysis. It allows the production process to be divided into specific phases so that the most efficient technology can be selected for each phase. The most efficient techniques for each of the phases can then be merged into an efficient working firm. The economic-engineering approach is particularly relevant in analyzing industries that exhibit wide variations in firm size, technology utilization, level of management employed and degree of excess capacity. These characteristics generally identify an “infant” industry where the economic-engineering approach may be the only applicable methodology to measure efficiency [2,9].

There are two major advantages of this approach. First, the most efficient technology can be used for each phase of processing as opposed to adopted technology. This offers a more realistic approach to assessing what can actually be achieved. Second, because cost estimates are formulated through a “building block” approach, the effects of price changes for selected inputs can be examined easily [2].

Some criticism of the economic-engineering approach is aimed at the derivation of cost estimates. Some of the costs involved with a particular technique may be overlooked. Problems also may occur in keeping the technology within feasible bounds. For example, performance rates quoted by manufacturers may be in excess of what is actually attainable in the industry. Verification of these rates by processors is certainly mandatory in order to provide sound cost estimates. This means that good judgment coupled with the “checking out” of cost and performance rates is necessary to provide valid cost estimates. An additional criticism is that of time. This involves how to deal with time in regard to resource flows and rewards over time with imperfect knowledge of risk and uncertainty [2, 3].

These weaknesses exist in the economic-engineering approach, but it may be the only feasible way to determine the costs for this new and unique industry. It is believed that this approach, coupled with careful and rigorous scrutiny of the elements of the processing facility provides sound estimates of cost.
Four plant sizes (models) were selected for analysis. Daily one-shift capacities of the plants were 8,000, 64,000, 96,000 and 160,000 pounds live-weight, for Models I, II, III and IV, respectively. Plant sizes were determined primarily on the basis of performance rates of the most efficient technology presently available for heading and eviscerating catfish. The most efficient technologies for other supporting phases of processing were based on capacities consistent with the heading and eviscerating equipment selected.

The particular product mix that a catfish processing plant produces is important in determining that plant's processing cost. For instance, a plant that processes a high percentage of fillets obviously has a higher processing cost per unit of output than does a plant that processes a high percentage of whole fish. This is true because the actual processing cost per pound live-weight is higher for fillets, and a lower yield of saleable product is obtained. The product mix chosen for this study was based on industry averages, adjusted to reflect trends.

The actual product mixes were obtained from personal interviews with management representatives of cooperating plants. Also, leaders in the processing industry expressed their opinions as to what product mix changes seem to be forthcoming in the industry. Based on this information, a product mix believed to be representative of what the industry will be producing over the next few years was designated for this study. This mix (in terms of output) consisted of about 60% whole fish, 35% fillets and 5% steaks. To achieve this output mix, live fish entering the plant must be allocated to the three product forms approximately as follows: 50% to whole fish, 45% to fillets and 5% to steaks. It was further assumed that 50% of each category in the mix is processed for sale in the fresh market, and 50% is allocated to the frozen market. Of the 50% in fresh form, one half is processed as ice-packed fish, and one half is in tray pack (chilled) form. This product mix is illustrated in Figure 1.

Dressing percentage or yield obtained when processing live fish

---

**FIGURE 1. ILLUSTRATED PRODUCT MIX FOR THE MODEL CATFISH PROCESSING PLANTS.**
into various product forms varies among existing plants. For instance, the dressing percentage for whole fish has ranged from 59 to as high as 62. This range is largely explained by variations in size of fish processed and by whether the dorsal fin is removed. As the size of fish increases, dressing percentages increase. Also, some plants elect to remove the dorsal fin, and some do not.

The yield of whole fillets generally varies from 38 to 42% of live weight. Again, the size of fish plays a major role in this variation. Fillets are processed into two individual forms—whole or shank. Shank fillets are whole fillets with belly flap ("nugget") removed. The yield of shank fillets ranges from 80 to 89% of the whole fillet, the remainder being nuggets. These variations arise from the method of filleting and/or the amount of nugget left on the shank fillet. In essence, some plants sell more of the fillet as a nugget than do others.

For the purposes of this study, it was assumed that the average size of a catfish for processing was 1 pound. Based on this assumption, the dressing percentages used for the various product forms were: whole fish 60%, whole fillets 41%, and steaks 55%. The annual dress weight distributions for the four model plants, based on the given product mix and the assumed dressing percentages, are presented in Table 1.

### Plant Facilities

**Real Estate**

Selection of a plant site is critical, and making this decision requires careful consideration. The foremost consideration should be proximity to the catfish farms. Other factors include (1) site accessibility, including convenient connections with highway systems and railroad lines; (2) size, shape and cost of the site, including preparation and development; (3) availability and cost of utilities at the site; (4) industrial zoning status of the site, existing easements and other legal considerations; (5) availability of suitable labor; (6) availability of fire protection and police security and (7) annual taxes and insurance rates for the site.

All model plants were assumed to be in the Delta of Mississippi. Plants were assumed to be located on a paved road where three-phase electricity and a water system capable of supplying 500 gallons per minute were available. Availability of existing sewage system was assumed; thus, cost of a waste treatment system adequate for treatment and discharge of plant effluent was included in the study. Let meeting these requirements have an estimated average value of $2,000.

---

### Table 1. Annual dressed weight distribution of product mix for four model catfish processing plants, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Product Form</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole (ice pack)</td>
<td>576.0</td>
<td>1,152.0</td>
<td>1,728.0</td>
<td>2,880.0</td>
</tr>
<tr>
<td>Whole (tray pack)</td>
<td>576.0</td>
<td>1,152.0</td>
<td>1,728.0</td>
<td>2,880.0</td>
</tr>
<tr>
<td>Whole (frozen)</td>
<td>1,152.0</td>
<td>2,304.0</td>
<td>3,456.0</td>
<td>5,760.0</td>
</tr>
<tr>
<td>Total whole</td>
<td>2,304.0</td>
<td>4,608.0</td>
<td>6,912.0</td>
<td>11,520.0</td>
</tr>
<tr>
<td>Fillets (ice pack)</td>
<td>345.6</td>
<td>691.2</td>
<td>1,036.8</td>
<td>1,728.0</td>
</tr>
<tr>
<td>Fillets (tray pack)</td>
<td>345.6</td>
<td>691.2</td>
<td>1,036.8</td>
<td>1,728.0</td>
</tr>
<tr>
<td>Fillets (frozen)</td>
<td>691.2</td>
<td>1,382.4</td>
<td>2,073.6</td>
<td>3,456.0</td>
</tr>
<tr>
<td>Total fillets</td>
<td>1,382.4</td>
<td>2,764.8</td>
<td>4,147.2</td>
<td>6,912.0</td>
</tr>
<tr>
<td>Steaks (ice pack)</td>
<td>52.8</td>
<td>105.6</td>
<td>158.4</td>
<td>264.0</td>
</tr>
<tr>
<td>Steaks (tray pack)</td>
<td>52.8</td>
<td>105.6</td>
<td>158.4</td>
<td>264.0</td>
</tr>
<tr>
<td>Steaks (frozen)</td>
<td>105.6</td>
<td>211.2</td>
<td>316.8</td>
<td>528.0</td>
</tr>
<tr>
<td>Total</td>
<td>3,897.6</td>
<td>7,795.2</td>
<td>11,692.8</td>
<td>19,488.0</td>
</tr>
</tbody>
</table>
acre. Land requirements and costs are presented in Table 2. Land requirements were based on requirements for buildings, receiving and holding area for live fish, parking, loading and area for the waste-water treatment facility. Additional area also was allowed for each plant around the waste-water lagoon to satisfy state law requirement of a 300 foot buffer on all sides of the waste-treatment facility.

Waste - Treatment Facility

The method of effluent disposal used by a catfish processing plant depends largely upon the facility location and the accessibility of a municipa sewage system. alternatives include (1) use of an existing system capable of handling the needs of the plant and pretreating effluent before discharge; (2) locating this facility in the country, with treatment and discharge into an existing drainageway and (3) locating the facility in the country and treating and storing the effluent for irrigation purposes. Methods (2) and (3) necessitate primary and secondary treatment of effluent before discharge or use for irrigation.

For the purposes of this study, the second method was chosen because (1) there are apparent

<table>
<thead>
<tr>
<th>Facility Area</th>
<th>Unit</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receivinga/</td>
<td>sq. ft.</td>
<td>3,680</td>
<td>4,960</td>
<td>6,240</td>
<td>8,800</td>
</tr>
<tr>
<td>Buildingb/</td>
<td>sq. ft.</td>
<td>15,004</td>
<td>22,212</td>
<td>28,850</td>
<td>42,005</td>
</tr>
<tr>
<td>Waste treatmentc/</td>
<td>sq. ft.</td>
<td>558,000</td>
<td>729,189</td>
<td>818,389</td>
<td>981,504</td>
</tr>
<tr>
<td>Parking and loadingd/</td>
<td>sq. ft.</td>
<td>20,250</td>
<td>32,940</td>
<td>45,630</td>
<td>65,070</td>
</tr>
<tr>
<td>Miscellaneouse/</td>
<td>sq. ft.</td>
<td>42,445</td>
<td>55,353</td>
<td>62,240</td>
<td>74,450</td>
</tr>
<tr>
<td>Total land</td>
<td>sq. ft.</td>
<td>639,376</td>
<td>844,654</td>
<td>961,349</td>
<td>1,171,829</td>
</tr>
<tr>
<td>Total cost</td>
<td>dollars</td>
<td>29,356</td>
<td>38,781</td>
<td>44,139</td>
<td>53,803</td>
</tr>
</tbody>
</table>

a/ Includes holding vats and live haul area.
b/ Includes eviscerating and processing rooms, refrigeration, offices, break room, and storage.
c/ Includes area for buffer zone.
d/ Based on two employees per parking space.
e/ Includes area between plant and waste treatment facility as well as an area for landscaping.
advantages to locating outside municipalities and (2) the economic feasibility of using the effluent for irrigation in the Delta has not been investigated.

The level of effluent treatment necessary to meet federal regulations is dependent upon the flow of the drainageway into which the effluent is discharged. The greater and more consistent the flow of water in the drainageway, the less stringent are the regulations regarding the levels of effluents. For this study, it was assumed that there was year-round flow and that plants would be located on drainageways where flows are adequate.

Size of waste-treatment facilities needed varies according to the daily processing capacities of the plants. Costs of the waste-treatment facilities necessary for the four model plants are presented in Appendix Tables 1-4. Costs include construction, a pump station, engineering fees and permits required for construction, but do not include cost of land.

### Building Requirements

Capital outlay necessary for modern catfish processing plants are mainly for buildings, processing equipment and trucks. Building costs are dependent upon several factors, such as the topography of the land and the type of building constructed.

For this analysis, it was assumed that the plants would be constructed on relatively level land. The general construction of the building was assumed to be of metal with masonry interior walls. Cost estimates reflect varying concrete slab depths as necessary depending upon the freezer-cooler space in a particular plant.

Building layouts, in general, were synthesized on the basis of the equipment requirements for processing the given product mix. Floor space requirements were based on the square footage needed for the specified equipment, as well as walkways and workspace requirements in each general area of the processing facility. Average construction costs of $45 per square foot were used for all the model plants. Space requirements for specific plant area and construction costs are presented in Table 3.

<table>
<thead>
<tr>
<th>Facility Area</th>
<th>Unit</th>
<th>Plant Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>OF\text{III}</td>
<td>sq. ft.</td>
<td>3,680</td>
</tr>
<tr>
<td>OF\text{IV}</td>
<td>sq. ft.</td>
<td>4,960</td>
</tr>
<tr>
<td>OF\text{V}</td>
<td>sq. ft.</td>
<td>0,240</td>
</tr>
<tr>
<td>OF\text{VI}</td>
<td>sq. ft.</td>
<td>8,800</td>
</tr>
<tr>
<td>OF\text{VII}</td>
<td>sq. ft.</td>
<td>2,025</td>
</tr>
<tr>
<td>OF\text{VIII}</td>
<td>sq. ft.</td>
<td>2,925</td>
</tr>
<tr>
<td>OF\text{IX}</td>
<td>sq. ft.</td>
<td>3,825</td>
</tr>
<tr>
<td>OF\text{X}</td>
<td>sq. ft.</td>
<td>5,700</td>
</tr>
<tr>
<td>OF\text{XI}</td>
<td>sq. ft.</td>
<td>4,050</td>
</tr>
<tr>
<td>OF\text{XII}</td>
<td>sq. ft.</td>
<td>5,850</td>
</tr>
<tr>
<td>OF\text{XIII}</td>
<td>sq. ft.</td>
<td>7,650</td>
</tr>
<tr>
<td>OF\text{XIV}</td>
<td>sq. ft.</td>
<td>11,400</td>
</tr>
<tr>
<td>OF\text{XV}</td>
<td>sq. ft.</td>
<td>5,306</td>
</tr>
<tr>
<td>OF\text{XVI}</td>
<td>sq. ft.</td>
<td>6,557</td>
</tr>
<tr>
<td>OF\text{XVII}</td>
<td>sq. ft.</td>
<td>7,330</td>
</tr>
<tr>
<td>OF\text{XVIII}</td>
<td>sq. ft.</td>
<td>8,409</td>
</tr>
<tr>
<td>OF\text{XIX}</td>
<td>sq. ft.</td>
<td>1,880</td>
</tr>
<tr>
<td>OF\text{XX}</td>
<td>sq. ft.</td>
<td>3,762</td>
</tr>
<tr>
<td>OF\text{XXI}</td>
<td>sq. ft.</td>
<td>5,642</td>
</tr>
<tr>
<td>OF\text{XXII}</td>
<td>sq. ft.</td>
<td>9,406</td>
</tr>
<tr>
<td>OF\text{XXIII}</td>
<td>sq. ft.</td>
<td>743</td>
</tr>
<tr>
<td>OF\text{XXIV}</td>
<td>sq. ft.</td>
<td>1,073</td>
</tr>
<tr>
<td>OF\text{XXV}</td>
<td>sq. ft.</td>
<td>1,403</td>
</tr>
<tr>
<td>OF\text{XXVI}</td>
<td>sq. ft.</td>
<td>2,090</td>
</tr>
<tr>
<td>OF\text{XXVII}</td>
<td>sq. ft.</td>
<td>1,000</td>
</tr>
<tr>
<td>OF\text{XXVIII}</td>
<td>sq. ft.</td>
<td>2,000</td>
</tr>
<tr>
<td>OF\text{XXIX}</td>
<td>sq. ft.</td>
<td>3,000</td>
</tr>
<tr>
<td>OF\text{XXX}</td>
<td>sq. ft.</td>
<td>5,000</td>
</tr>
<tr>
<td>Total</td>
<td>sq. ft.</td>
<td>18,684</td>
</tr>
<tr>
<td>Unit cost</td>
<td>$/sq. ft.</td>
<td>45</td>
</tr>
<tr>
<td>Total cost</td>
<td>dollars</td>
<td>840,780</td>
</tr>
</tbody>
</table>

This rate was provided by a major building-construction firm that has been involved in constructing catfish processing plants in the area.
Receiving

The receiving area is for unloading catfish from live-haul trucks to holding vats, where the fish are kept alive until processed. Holding vats were assumed to be 45 feet long by 4 feet wide, sloping from 3 feet deep at one end to 4 feet deep at the other. This allows ease of exit from the holding vat as fish are essentially water flumed into a waiting receiving basket. Each vat can hold about 4000 pounds of live catfish.

It was assumed that each plant has a catfish holding capacity equal to one-half of its daily processing capacity. This ensures a processing supply when delays are incurred in procuring nish. The receiving-area space requirements for each plant are presented in Table 3.

Parking and Loading

Space requirements for parking, loading-out processed fish and driveways were estimated on the basis of the number of employees and the size of the plant. Parking space was calculated on the basis of a requirement of 270 square feet per car. It was assumed that employees travel to work in groups of two, on the average. Space requirements for driveways and loading areas were based on the number of trucks at the dock, turnaround and parking requirements and the drive area. This area was about the same as employee parking in each instance. Space requirements for the parking and loading areas for each model plant are presented in Table 2.

Equipment Requirements

All equipment needed to process a given product mix adequately as considered for each model plant. The equipment needs of the respective plants were grouped into general categories, or phases, in the order that they occur in the processing cycle. These include (1) receiving, (2) heading and eviscerating, (3) skinning, (4) chilling, (5) sorting, (6) filleting, (7) ice packing, (8) tray packing, (9) steaking, (10) individual quick freezing, (11) refrigeration, (12) offal disposal and (13) welfare and offices. In many instances, alternative technology is available for individual phases of the processing cycle. A cost comparison of alternative technology as used as a basis for determining the most efficient equipment available for each phase of processing.3 The text that follows discusses alternative technologies available for use phases and the technology chosen for inclusion in the study. Equipment requirements and associated costs are presented in Appendix Tables 1-4.

Receiving

The equipment requirements for the receiving area include an overhead track system with a track scale for weighing catfish. A steel track is attached to the metal trusses of the building, and an electrical hoist and trolley maneuver baskets of fish along this track. The hoist and trolley should have a capacity of about 10,000 pounds. Receiving baskets, which usually are made of stainless steel mesh with a drop bottom, also are needed to hold the fish during movement through the receiving area.

When the receiving baskets of fish reach the entrance to the eviscerating room, a holding structure and an electrical shock system are needed. The catfish are transferred from the receiving baskets into the holding structure and are then conveyed through an electrical shock system to immobilize them.

Heading and Eviscerating

Head removal generally can be done by one of two methods—a hand-fed meat type bandsaw or an automated system. The bandsaw line, more commonly referred to as a headsaw line, is highly labor intensive, requiring more than twice the labor of an automated line. However, the capacity of the headsaw line is greater than that of the automated line.

The annual ownership and operating costs of the two systems are very close. A comparison indicated that the headsaw line is slightly more cost efficient under the production, wage and interest rates used. The eviscerating machine, which

removes the entrails, sometimes creates a bottleneck in the automated line and slows production; whereas, conventional evisceration methods have no apparent problems. If the eviscerating machine could be modified to keep up with the header of the automated system, it undoubtedly would be the more efficient of the two technologies.

Based on the cost comparisons of the two systems and the present problem with the automated eviscerating machine, the headsaw line was chosen for use in this study. The equipment requirements for this particular line include (1) a distribution conveyor, (2) two layup tables, (3) two headsaws, (4) a belly-split table, (5) a six-station vacuum eviscerating system, (6) a two-tier conveyor and (7) a stainless steel belt conveyor. A schematic of the two-headsaw line is shown in Figure 2.

**Skinning**

Skinning of whole catfish is accomplished by a mechanical skinner. The fish are passed by hand over a rotary drum and knife mechanism and the skin is pulled from the fish. Machines in use at present were developed for skinning other products and have been adapted for skinning catfish. Skinning costs used in this study were based on the predominant skinning machine used in the industry. Automated equipment is available for skinning fillets, but not whole catfish.

**Chilling**

The chilling phase of the processing cycle involves reducing the temperature of the beheaded, eviscerated and skinned fish to a temperature of 39° to 40°F. Alternatives available for chilling include ice-bath chillers and refrigerated jacketed chillers. In both instances, the fish are conveyed and dropped into the entrance end of the chiller, are moved by a network of paddles to the other end and are conveyed out of the chiller.

The ice-bath chiller is basically a large stainless steel tub that contains water and requires ice to keep the water cold. The jacketed chiller requires ice only at start-up and refrigeration cools the water for the remainder of the processing day. The trade-off between the two systems is relatively high initial
most of the jacketed system against the relatively high operating cost (ice requirements) of the ice-bath filer. Based on a total cost comparison of the two systems, the jacketed chiller was chosen for the model plants.

**Sorting**

Individual sorting allows the processor to divert fish of different size to the proper processing areas. For instance, the smaller to medium-size fish usually go to whole fish processing while the larger fish generally are processed as steaks or fillets. Further sorting usually is required after the fish reach a designated processing area. Most farm-raised catfish product forms are packaged in two-ounce increments, and it is important that these packaging increments be accurate. Thus, individual weighing of the various product forms is required.

Hand sizing and automated sizing are the two main alternatives available to the processor. A cost comparison indicated that an automatic system supplemented with hand sizing would be more cost-effective at the model plants.

**Filleting**

Filleting of catfish can be done by hand or by automated equipment. Hand filleting is highly labor intensive while automatic filleting is highly capital intensive. Factors other than the labor-capital trade-off between automated and hand filleting are involved in comparing the two approaches. First, based on limited data, it appears that the percentage yield of shank fillets differs by method. Second, a true nugget is obtained from hand filleting while the automatic equipment does not produce a nugget per se. The meat left on the frame is wasted unless it is separated from the frame and sold in minced form. Therefore, the selling prices of shank fillets, nuggets and possible minced product enter into the comparison of the two methods.

A cost and returns comparison based on the limited data available revealed that hand filleting is slightly more cost-effective than is the automatic equipment under the assumed production, wage and interest rates used in the study. However, small changes in wages, performance rates, dressing percentage of shank fillets, interest rates or any combination of the above may alter the economics of hand versus machine filleting.

**Steaking**

Catfish are cut into steaks by a bandsaw. The operator feeds the fish along a guide that is set according to desired thickness and the steaks are channeled to the proper packing area.

Automatic steaking machines are available, but the standard bandsaw was used for purposes of this study. The quantity of steaks produced with the product mix used for this study was not sufficient to justify the automatic equipment for any of the model plants.

**Ice Packing**

Ice packing of catfish is a relatively straightforward procedure. Ice is conveyed by an auger from the ice room to suspended ice drops that deposit pre-measured amounts of ice into ice-pack boxes. After fish are placed into the boxes and covered with ice, the boxes are topped, strapped and conveyed to a holding cooler.

The necessary equipment includes a screw auger, ice drops and an ice machine. The auger and drops are included in the building construction.

**Tray Packing**

Most tray packing is done by machine. A liner is placed in the bottom, and the fish are placed in the tray. It is then conveyed into a machine that wraps and seals a plastic film around the product. The tray-packed fish then can pass through a pricing machine where it is weighed and priced according to pricing information that can be preprogrammed into the machine. Comparisons of two major brands of tray-packing systems revealed little difference in costs.

**Individual Quick Freezing**

Catfish are quick frozen, as a general rule, by carbon dioxide (CO₂). The CO₂ is used to freeze the individual pieces of fish quickly to retain product quality. Other methods, such as liquid nitrogen and mechanical freezing, are available, but their costs were not determined because of limited data.

The individual pieces of catfish are placed on a conveyor that runs through a CO₂ tunnel or spiral freezer. A dwell time of about 10-20 minutes can reduce the core temperature of the fish to about -40°F. The fish are conveyed out of the tunnel or spiral into a water-glaze bath that protects and preserves the frozen fish. The frozen products are then boxed and sent to the freezer as expeditiously as is possible.

Differences in efficiencies of spiral and tunnel freezers were noted by some industry personnel. Some believed that the CO₂ cost/lb was lower for the spiral freezer than for the tunnel freezer. A cost comparison based on data obtained from manufacturers of both tunnels and spirals suggests the spiral CO₂ freezer is more efficient.

**Refrigeration**

Refrigeration systems required in
modern catfish processing plants are among the more costly equipment items. The refrigeration area is composed of a cooler, a freezer and a blast freezer. The cooler, which is maintained at 28°F, is used primarily for ice-packed and chill-packed products. The freezer, maintained at about 0°F, is for the frozen product forms. The blast freezer has special functions, such as timed use for crust freezing of chill-packed product and, in some instances, an intermediate stop for frozen products. The size of the system necessary for each model plant was based on a holding capacity of two weeks inventory.

Refrigeration alternatives considered were the conventional freon system and an ammonia-type system. The ammonia system has an initial cost about twice that of the freon system but has a longer expected life and, on large systems, operates more efficiently. Nevertheless, the freon-type system was selected here because the model plants do not require refrigeration systems sufficiently large to justify the ammonia system.

Offal

As a general rule existing processing plants do not render their offal. Offal is generally conveyed from the eviscerating and processing rooms into holding tanks and transported to an off-site rendering plant. Also, the waste water is usually put through a strainer system to recover solids from the water. This reduces costs of transportation and rendering, as well as the load placed on the lagoon. Therefore, a straining system was incorporated in the model plants of this study.

Welfare and Offices

Office equipment requirements were based on the number of office personnel and the respective need of each. The welfare area need were based on federal inspection guidelines which require facilities such as lockers and toilets. An employee break/lunch room was included for each plant. The size and components of this room, such as tables and chairs, were estimated based on the number of employees in the respective plants.

Investment Requirements and Costs

Estimated investment requirements pertain only to the given product mix used in this study. Variations in the product mix may change the equipment and/or facility make-up and in turn alter the investment requirements. Furthermore, the total investment estimates (Table 4) do not include investment in harvesting and hauling equipment for live fish and distribution equipment (trucks) for processed products.

Building costs represent a major portion of the total investment, ranging from 52 to more than 54% of the total (Table 5). Processing room equipment comprises the second major cost item, ranging from 18 to more than 20% of total investment. Investment in the remaining necessary items varied from less than 1 to slightly more than 7% of the total.

<table>
<thead>
<tr>
<th>Item</th>
<th>Plant Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model I</td>
</tr>
<tr>
<td>Land</td>
<td>29,356</td>
</tr>
<tr>
<td>Waste treatment facility</td>
<td>80,000</td>
</tr>
<tr>
<td>Buildings</td>
<td>840,780</td>
</tr>
<tr>
<td>Receiving equipment</td>
<td>16,780</td>
</tr>
<tr>
<td>Eviscerating room</td>
<td>89,308</td>
</tr>
<tr>
<td>Processing room</td>
<td>323,101</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>61,032</td>
</tr>
<tr>
<td>Material handling</td>
<td>21,605</td>
</tr>
<tr>
<td>Cleanup</td>
<td>11,935</td>
</tr>
<tr>
<td>Furniture</td>
<td>25,350</td>
</tr>
<tr>
<td>Miscellaneous equipment</td>
<td>67,851</td>
</tr>
<tr>
<td>Waste handling</td>
<td>31,625</td>
</tr>
<tr>
<td>Total</td>
<td>1,598,723</td>
</tr>
</tbody>
</table>

Table 4. Estimated investment requirements for four model catfish processing plants, Delta area of Mississippi, 1983
Table 5. Estimated investment requirements expressed as a percentage of total investment for four model catfish processing plants, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Item</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>1.84</td>
<td>1.71</td>
<td>1.52</td>
<td>1.25</td>
</tr>
<tr>
<td>Waste treatment facility</td>
<td>5.00</td>
<td>4.85</td>
<td>5.50</td>
<td>4.66</td>
</tr>
<tr>
<td>Buildings</td>
<td>52.59</td>
<td>53.92</td>
<td>54.24</td>
<td>53.26</td>
</tr>
<tr>
<td>Receiving equipment</td>
<td>1.05</td>
<td>.87</td>
<td>.78</td>
<td>.83</td>
</tr>
<tr>
<td>Eviscerating room</td>
<td>5.59</td>
<td>6.13</td>
<td>6.45</td>
<td>7.05</td>
</tr>
<tr>
<td>Processing room</td>
<td>20.21</td>
<td>19.76</td>
<td>18.48</td>
<td>19.91</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>3.82</td>
<td>4.24</td>
<td>4.14</td>
<td>4.18</td>
</tr>
<tr>
<td>Material handling</td>
<td>1.35</td>
<td>.97</td>
<td>1.37</td>
<td>1.43</td>
</tr>
<tr>
<td>Cleanup</td>
<td>.75</td>
<td>.61</td>
<td>.54</td>
<td>.65</td>
</tr>
<tr>
<td>Furniture</td>
<td>1.59</td>
<td>1.61</td>
<td>1.55</td>
<td>1.24</td>
</tr>
<tr>
<td>Miscellaneous equipment</td>
<td>4.24</td>
<td>3.90</td>
<td>3.81</td>
<td>4.10</td>
</tr>
<tr>
<td>Waste handling</td>
<td>1.98</td>
<td>1.42</td>
<td>1.62</td>
<td>1.45</td>
</tr>
<tr>
<td>Totals¹</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

¹/May not add due to rounding.

Ownership Costs

Ownership costs (fixed costs) of durable assets occur even if the assets are not used. These costs include depreciation, interest, taxes and insurance. Procedures employed in calculating the annual ownership cost estimates (Table 6) for the four model plants are as follows:

Depreciation was calculated by the straight-line method based on estimated useful life of each piece of equipment (Appendix Tables 1-4). A zero salvage value was assumed for all buildings, facilities and equipment because little is known about salvage values of much of the equipment used in catfish processing.

Interest at a rate of 12% was charged on one half of the original investment in depreciable items such as buildings and equipment. Non-depreciable items, such as land and lagoons, were charged at an interest rate of 11.5% on the full inventory value.
Table 6. Estimated annual costs for four model catfish processing plants, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Item</th>
<th>Model I</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Ownership Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation</td>
<td>99,523</td>
<td>140,705</td>
<td>182,298</td>
<td>280,315</td>
</tr>
<tr>
<td>Insurance</td>
<td>28,000</td>
<td>44,289</td>
<td>61,992</td>
<td>108,247</td>
</tr>
<tr>
<td>Interest</td>
<td>101,940</td>
<td>143,654</td>
<td>185,902</td>
<td>271,186</td>
</tr>
<tr>
<td>Taxes</td>
<td>10,761</td>
<td>15,265</td>
<td>19,595</td>
<td>28,895</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>240,224</td>
<td>343,913</td>
<td>449,787</td>
<td>688,643</td>
</tr>
<tr>
<td>Annual Operating Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages</td>
<td>604,043</td>
<td>967,325</td>
<td>1,429,260</td>
<td>2,152,977</td>
</tr>
<tr>
<td>Salaries</td>
<td>467,112</td>
<td>779,052</td>
<td>990,570</td>
<td>1,255,360</td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td>35,050</td>
<td>54,224</td>
<td>66,679</td>
<td>107,145</td>
</tr>
<tr>
<td>Water</td>
<td>3,756</td>
<td>9,132</td>
<td>14,508</td>
<td>25,260</td>
</tr>
<tr>
<td>Telephone</td>
<td>41,143</td>
<td>54,857</td>
<td>62,286</td>
<td>96,000</td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>41,680</td>
<td>59,004</td>
<td>74,457</td>
<td>118,199</td>
</tr>
<tr>
<td>Supplies and Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td>35,050</td>
<td>54,224</td>
<td>66,679</td>
<td>107,145</td>
</tr>
<tr>
<td>Water</td>
<td>3,756</td>
<td>9,132</td>
<td>14,508</td>
<td>25,260</td>
</tr>
<tr>
<td>Telephone</td>
<td>41,143</td>
<td>54,857</td>
<td>62,286</td>
<td>96,000</td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>41,680</td>
<td>59,004</td>
<td>74,457</td>
<td>118,199</td>
</tr>
<tr>
<td>Supplies and Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO</td>
<td>77,986</td>
<td>155,971</td>
<td>233,957</td>
<td>389,928</td>
</tr>
<tr>
<td>Packaging</td>
<td>202,560</td>
<td>405,120</td>
<td>607,680</td>
<td>1,012,800</td>
</tr>
<tr>
<td>Misc. Supplies &amp; Services</td>
<td>21,060</td>
<td>36,120</td>
<td>51,182</td>
<td>81,302</td>
</tr>
<tr>
<td>General Office Overhead</td>
<td>28,696</td>
<td>47,120</td>
<td>64,607</td>
<td>93,226</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>1,520,868</td>
<td>2,567,925</td>
<td>3,615,386</td>
<td>5,332,197</td>
</tr>
<tr>
<td>Interest on Operating Capital</td>
<td>65,151</td>
<td>125,519</td>
<td>185,914</td>
<td>302,922</td>
</tr>
<tr>
<td>Total Annual Operating Costs</td>
<td>1,588,237</td>
<td>2,693,444</td>
<td>3,801,300</td>
<td>5,635,119</td>
</tr>
<tr>
<td>Total Costs</td>
<td>$1,828,461</td>
<td>$3,037,357</td>
<td>$4,251,087</td>
<td>$6,323,762</td>
</tr>
<tr>
<td>Cost per Pound</td>
<td>.4691</td>
<td>.3896</td>
<td>.3636</td>
<td>.3245</td>
</tr>
</tbody>
</table>

a/ Includes private laboratory fees, chemicals, fillet knives, uniforms, assorted tools and supplies for maintenance, and bathroom supplies.

b/ Based on pounds processed annually (dressed weight) from Table 1.

**Insurance**

Insurance coverage for each of the model plants includes fire, vandalism and malicious mischief and extended coverage. Extended coverage includes hail, windstorm, smoke, riot or civil commotion and explosion. A base rate of $1.60 per $100 of buildings and equipment was used for a plant of 7500 square feet. An excess area charge amounting to 2 1/2 cents per 1000 square feet was used to calculate the additional rate per $100 of buildings and equipment for the four model plants.
Taxes

Property taxes are considered a part of annual ownership costs, and an average rate applicable to the Delta area of Mississippi was used. The standard assessment is based on the appraised value of land, buildings, equipment and the average inventory on January 1 of each year. The appraised value was assumed to be original cost, and the average inventory was assumed to be two weeks production at capacity. The value of the inventory was estimated as 15% of the appraised value of land, buildings and equipment. The average tax rate used to determine annual taxes incurred by the model plants was 58.53 mills.

Operating Costs

Operating costs (variable costs) include labor, utilities, repairs and maintenance and necessary supplies such as CO₂ gas, boxes, bags, film, general office overhead and interest on operating capital (Table 6).

Personnel

Labor requirements for the four model plants were estimated on the basis of each plant's level of output, manufacturers' specifications, engineering studies, personal interviews with plant personnel and, in some cases, time-motion studies of particular phases of processing. The hourly employee requirements for each model plant are presented by phase of operation in Appendix Table 5.

The average wage rate used for processing labor was $3.71 per hour. Wages rates for maintenance and security personnel were set at $5.00 per hour. These rates are representative of wages paid in 1983 in Mississippi catfish processing plants. Wage rates were increased by 15% to cover fringe benefits for the hourly employees.

Numbers of salaried personnel and salary levels were estimated using data obtained from personal interviews with managers of existing processing plants. Salaried personnel requirements for each model plant are presented in Appendix Table 6. A rate of 20% was used for fringe benefits for salaried personnel. Appendix Table 7 shows salary costs by position.

Utilities

Electricity Requirements and Costs—Electricity is used in catfish processing primarily for lighting and for operating electric motors. Survey of existing processors revealed that the refrigeration equipment consumed about one-fourth of the total electricity required. Once the electrical consumption for refrigeration equipment was determined, the consumption was quadrupled to reflect the needs of the entire plant.

Electricity requirements for refrigeration in the model plants were calculated on the basis of the horsepower necessary to run the equipment. Efficiency of motors of different sizes used was obtained from engineering studies. The cost of electricity was estimated for the respective model plants by applying the November 1983 Mississippi Power and Light Company rates for the Delta area of Mississippi to the estimates of consumption.

Water Requirements and Costs—Large amounts of water are needed by catfish processing plants. Water is needed for holding vats, processing equipment, clean-up, ice making and for use by plant personnel. Consumption requirements for the model plants were based on actual use by existing plants. Water consumption by the industry averages 2 gallons of water per live-weight pound of fish.

The cost of water consumed by each of the model plants was determined by applying the 1983 average water rates existing in the study area to the estimates of consumption. Rates used were $215 for the first one million gallons plus $.35 per 1,000 gallons in excess of one million gallons.

Telephone Service and Costs—Monthly service and equipment charges for each of the model plants were estimated according to the number of salaried personnel and the number of lines, intercoms and related equipment for each model plant. Long distance billing was based on the industry average prevailing at the time of the study.

Repairs and Maintenance

Annual repairs and maintenance for the four model plants were computed from estimates of average repairs over the life of the component as a percentage of the estimated purchase price. Estimated life and repair and maintenance costs were obtained from manufacturers' specifications, dealer estimates and estimates from processing plant personnel.

Supplies and Services

The total cost of CO₂ used to quick-freeze individual pieces of catfish in each plant was based on a cost of 3.85 cents per pound of frozen fish. Packaging supplies for processed catfish vary according to product forms. The major items include boxes for ice-packed, individually quick-frozen and chilled-packed products and trays, pads, film, stickers and tape. Costs of packaging supplies were estimated to be 5 cents per pound of processed fish (average of all product forms). Office supplies and general overhead were estimated as slightly less than 2% of annual operating cost.

The major items in miscellaneous supplies and services are chemicals for the tri-phosphate injector, clean-
ing systems and chlorination of water. Also included in the estimate is a charge for private laboratory services. The amount and cost of injection solutions were obtained from dealers. Fees for private laboratory work were obtained from processing plant personnel.

Interest on Operating Capital
Interest on operating capital was based on an annual rate of 12%. It was assumed that the operating capital necessary for the plant was one-twelfth of total annual operating cost plus the cost of live catfish F.O.B. processing plant for one month. A price of 65 cents per pound live-weight was assumed as the purchase price.

Total Costs
Ownership costs ranged from 10.58% of total cost in Model III to 13.14% of total cost in Model I (Table 7). Depreciation and interest were the major ownership cost items and ranged from almost 9 to slightly more than 11% of total annual cost.

Annual operating cost was about 88% of total cost. Personnel costs ranged from slightly more than 53% to slightly more than 58% of total cost. No other operating cost accounted for more than 16.02% of total cost, and most other items accounted for less than 5% of total cost.

<table>
<thead>
<tr>
<th>Item</th>
<th>Plant Size</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model I</td>
<td>Model II</td>
<td>Model III</td>
<td>Model IV</td>
</tr>
<tr>
<td>Annual Ownership Costs</td>
<td></td>
<td>------------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Depreciation</td>
<td>5.44</td>
<td>4.63</td>
<td>4.29</td>
<td>4.43</td>
</tr>
<tr>
<td>Insurance</td>
<td>1.53</td>
<td>1.46</td>
<td>1.46</td>
<td>1.71</td>
</tr>
<tr>
<td>Interest</td>
<td>5.58</td>
<td>4.73</td>
<td>4.37</td>
<td>4.29</td>
</tr>
<tr>
<td>Taxes</td>
<td>.59</td>
<td>.50</td>
<td>.46</td>
<td>.46</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>13.14</td>
<td>11.32</td>
<td>10.58</td>
<td>10.89</td>
</tr>
<tr>
<td>Annual Operating Costs</td>
<td></td>
<td>------------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Personnel</td>
<td></td>
<td>------------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Wages</td>
<td>33.04</td>
<td>31.85</td>
<td>33.62</td>
<td>34.05</td>
</tr>
<tr>
<td>Salaried</td>
<td>25.55</td>
<td>25.65</td>
<td>23.30</td>
<td>19.85</td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td>------------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Electricity</td>
<td>1.92</td>
<td>1.79</td>
<td>1.57</td>
<td>1.69</td>
</tr>
<tr>
<td>Water</td>
<td>.21</td>
<td>.30</td>
<td>.34</td>
<td>.40</td>
</tr>
<tr>
<td>Telephone</td>
<td>2.25</td>
<td>1.81</td>
<td>1.94</td>
<td>1.52</td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
<td>2.28</td>
<td>1.94</td>
<td>1.75</td>
<td>1.87</td>
</tr>
<tr>
<td>Supplies and Services</td>
<td></td>
<td>------------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>CO₂</td>
<td>4.27</td>
<td>5.14</td>
<td>5.50</td>
<td>6.17</td>
</tr>
<tr>
<td>Packaging</td>
<td>11.08</td>
<td>13.34</td>
<td>14.29</td>
<td>16.02</td>
</tr>
<tr>
<td>Miscellaneous Supplies</td>
<td>1.15</td>
<td>1.19</td>
<td>1.20</td>
<td>1.29</td>
</tr>
<tr>
<td>General Office Overhead</td>
<td>1.57</td>
<td>1.55</td>
<td>1.52</td>
<td>1.47</td>
</tr>
<tr>
<td>Interest on Operating Capital</td>
<td>3.56</td>
<td>4.13</td>
<td>4.37</td>
<td>4.79</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>86.86</td>
<td>88.68</td>
<td>89.42</td>
<td>89.11</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

1/ May not add due to rounding.
Annual total costs were $1,828,461, $3,037,357, $4,251,087 and $6,323,762 for Models I, II, III, and IV, respectively (Table 6). Cost per pound of processing catfish were $4691, $3896, $3636 and $3245 for the respective models, evincing substantial decreases in per-unit costs as plant size increased.

More than one half of the operating cost for each model plant was for wages and salaries. Labor and salary costs per pound decreased as plant size increased. Wages and salaries totaled more than 27 cents per pound in Model I and decreased to 22.4, 20.7 and 17.5 cents per pound in successive models (Table 8). Much of this decrease is explained by the fact that numbers of management and supervisory personnel do not increase in proportion to increases in size of plant.

The estimated total, ownership and operating costs per pound reveal substantial economies of size in processing farm-raised catfish (Figure 3).

**Effects of Varying Wage Rates**

To determine the effects of higher wages on total annual costs of processing for each of the model plants, the effective hourly wage rate was increased from $3.71 to $4.96 in increments of 25 cents. Fringe benefits for each of the wage rates were

<table>
<thead>
<tr>
<th>Table 8. Estimated annual cost components expressed in cents per pound for four model catfish processing plants, Delta area of Mississippi, 1983</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td><strong>Annual Ownership Costs</strong></td>
</tr>
<tr>
<td>Depreciation</td>
</tr>
<tr>
<td>Insurance</td>
</tr>
<tr>
<td>Interest</td>
</tr>
<tr>
<td>Taxes</td>
</tr>
<tr>
<td>Sub-total</td>
</tr>
<tr>
<td><strong>Annual Operating Costs</strong></td>
</tr>
<tr>
<td>Personnel</td>
</tr>
<tr>
<td>Wages</td>
</tr>
<tr>
<td>Utilities</td>
</tr>
<tr>
<td>Electricity</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>Telephone</td>
</tr>
<tr>
<td>Repairs and Maintenance</td>
</tr>
<tr>
<td>Supplies and Services</td>
</tr>
<tr>
<td>CO₂</td>
</tr>
<tr>
<td>Packaging</td>
</tr>
<tr>
<td>Miscellaneous Supplies</td>
</tr>
<tr>
<td>General Office Overhead</td>
</tr>
<tr>
<td>Interest on Operating Capital</td>
</tr>
<tr>
<td>Sub-Total</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

¹/ May not add due to rounding.
FIGURE 3. TOTAL, OPERATING AND OWNERSHIP COSTS PER POUND OF PROCESSING CATFISH, BY SIZE OF PLANT.
assumed to be 15%. Generally, with each 25 cent increase in the wage rate, the increased total cost from .74 to 4 cents per pound, depending on plant size (Table 9). This may not appear dramatic in this context, but, when viewed from the total annual cost basis, the effects are more readily observable. For instance, a 1 cent cost increase per pound results in increases in total cost, ranging from $38,976 for Model I to $194,880 for Model IV. Thus, a small variation in the wage rate has a significant impact on total cost of processing.

<table>
<thead>
<tr>
<th>Wage Rate</th>
<th>Plant Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model I</td>
</tr>
<tr>
<td>$3.71</td>
<td>.4691</td>
</tr>
<tr>
<td>$3.96</td>
<td>.4795</td>
</tr>
<tr>
<td>4.21</td>
<td>.4899</td>
</tr>
<tr>
<td>4.46</td>
<td>.5003</td>
</tr>
<tr>
<td>4.71</td>
<td>.5107</td>
</tr>
<tr>
<td>$4.96</td>
<td>.5211</td>
</tr>
</tbody>
</table>

**Table 9. Estimated total cost per pound of processing catfish at selected wage rates, four model catfish processing plants, Delta area of Mississippi, 1983**

**Summary, Conclusions and Limitations**

An economic-engineering approach was used to estimate investment requirements and costs of processing catfish in the Delta of Mississippi. Performance rates of the most efficient technologies available for heading and eviscerating operations were used to synthesize plants with daily processing capacities of 32,000, 64,000, 96,000 and 60,000 pounds of catfish (live weight). For the analysis, the plants were designated Models I-IV. The product mix, derived from industry averages adjusted for expected near-future change, was 60% hole fish, 35% fillets and 5% steaks. One half of each product volume was to be processed as fresh fish, the remainder as frozen. The fresh fish were divided equally between ice-packed and chill-packed (tray-packed). Data for selecting the most efficient method and equipment for each processing operation were obtained from processors’ records, manufacturers’ specifications, dealer estimates and in some instances, time and motion studies. Estimated investment requirements at 1983 prices ranged from $1.6 million for the least of the four plants to about $4.3 million for the largest. In each instance, building cost amounted to slightly more than one half of the total investment requirement, and equipping the eviscerating and processing room amounted to another one fourth.

Estimates of total annual costs in the four synthesized establishments ranged from $1.8 million to $6.3 million. Estimates of ownership costs (depreciation, interest on investment, taxes and insurance) ranged from $240,224 to $688,643. Annual operating cost estimates ranged from about $1.6 million to $5.6 million and accounted, on average, for about 88% of total annual costs.

At these costs and processing volumes, processing costs per pound (unit costs) were $4.91c in Model I
ammonia refrigeration systems, were not included in the model plants because of insufficient volume to justify these technologies. Also, it is likely that per-unit cost reductions associated with marketing and distribution of product from larger plants will more than offset additional per-unit procurement costs as plant size increases.

Costs of livehauling fish to the plant and distribution costs of the processed product were not included in the study. Also, some marketing costs, such as advertising and brokerage, were not included. More research is needed to determine cost-size relationships associated with procurement and marketing and distribution of farm-raised catfish.

The lack of data relating to some alternative equipment items caused the omission of these items from cost comparisons with their counterparts. Alternative technology exists for a particular phase of processing in some instances, but adequate data could not be obtained. Therefore, change to a more efficient piece of equipment for a given phase could slightly alter the cost of processing figures derived in this study.

Additionally, when comparing alternative technologies for a given phase, dressing percentages and product prices in some instances played a major role in the determination of the most efficient technology. Slight changes in dressing percentage, relative product price, interest rate and wage rate could modify the equipment make-up formulated for the plants in the study. In turn, the cost of processing coefficients would be altered, as the cost-size relationships discussed in this study possibly may be affected.

The model catfish processing plants are highly labor intensive; wage rates should increase relative to interest rates, more automation would be included in the processing plants, and in turn, the cost of processing estimates would be altered. It is likely that the economies outlined in this study could be affected by this relative change.

Cost estimates derived in the study are consistent with the underlying assumptions made and may not reflect actual cost of any one plant existing in the study area. For example, at the time of the study, some plants were not operating at one-shift capacity and may have costs higher than those reported here.
Appendix Tables
Table 1. Estimated land, building and equipment requirements, initial investment, expected life and associated annual costs, Model Plant 1, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Estimated New Cost ($)</th>
<th>Expected Life</th>
<th>Annual Repairs ($)</th>
<th>Annual Interest ($)</th>
<th>Annual Depreciation ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>Lot</td>
<td>29,356</td>
<td>--</td>
<td>--</td>
<td>3,376</td>
<td>--</td>
</tr>
<tr>
<td>Waste treatment facility</td>
<td>Lot</td>
<td>80,000</td>
<td>--</td>
<td>--</td>
<td>9,200</td>
<td>--</td>
</tr>
<tr>
<td>Buildings</td>
<td>Lot</td>
<td>840,780</td>
<td>25</td>
<td>8,408</td>
<td>50,447</td>
<td>33,631</td>
</tr>
<tr>
<td>Receiving area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock system</td>
<td>1</td>
<td>4,000</td>
<td>5</td>
<td>200</td>
<td>240</td>
<td>800</td>
</tr>
<tr>
<td>Basket holding structure</td>
<td>1</td>
<td>4,000</td>
<td>20</td>
<td>--</td>
<td>240</td>
<td>200</td>
</tr>
<tr>
<td>Haul baskets</td>
<td>2</td>
<td>6,000</td>
<td>20</td>
<td>--</td>
<td>360</td>
<td>300</td>
</tr>
<tr>
<td>Overhead track scales</td>
<td>1</td>
<td>2,780</td>
<td>5</td>
<td>139</td>
<td>167</td>
<td>556</td>
</tr>
<tr>
<td>Eviscerating room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layup tables</td>
<td>2</td>
<td>1,200</td>
<td>15</td>
<td>--</td>
<td>72</td>
<td>80</td>
</tr>
<tr>
<td>Belly split tables</td>
<td>1</td>
<td>600</td>
<td>15</td>
<td>--</td>
<td>36</td>
<td>40</td>
</tr>
<tr>
<td>Headsaw</td>
<td>3</td>
<td>6,912</td>
<td>6</td>
<td>1,152</td>
<td>414</td>
<td>1,152</td>
</tr>
<tr>
<td>Vacuum eviscerator</td>
<td>1</td>
<td>9,000</td>
<td>6</td>
<td>675</td>
<td>540</td>
<td>1,500</td>
</tr>
<tr>
<td>Freon chiller</td>
<td>1</td>
<td>33,200</td>
<td>10</td>
<td>1,328</td>
<td>1,992</td>
<td>3,320</td>
</tr>
<tr>
<td>Automatic skinner</td>
<td>4</td>
<td>29,000</td>
<td>5</td>
<td>4,352</td>
<td>1,740</td>
<td>5,800</td>
</tr>
<tr>
<td>Two tier conveyor</td>
<td>1</td>
<td>4,116</td>
<td>5</td>
<td>412</td>
<td>247</td>
<td>823</td>
</tr>
<tr>
<td>Transfer conveyor</td>
<td>1</td>
<td>2,000</td>
<td>15</td>
<td>200</td>
<td>120</td>
<td>667</td>
</tr>
<tr>
<td>Elevating conveyor</td>
<td>1</td>
<td>5,280</td>
<td>5</td>
<td>230</td>
<td>197</td>
<td>656</td>
</tr>
<tr>
<td>Processing room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic sorter</td>
<td>1</td>
<td>62,555</td>
<td>10</td>
<td>1,251</td>
<td>3,753</td>
<td>6,256</td>
</tr>
<tr>
<td>Roller conveyor</td>
<td>1</td>
<td>1,260</td>
<td>15</td>
<td>--</td>
<td>76</td>
<td>84</td>
</tr>
<tr>
<td>Sort/pack tables</td>
<td>1</td>
<td>4,000</td>
<td>15</td>
<td>--</td>
<td>240</td>
<td>268</td>
</tr>
<tr>
<td>Electronic scales</td>
<td>1</td>
<td>4,005</td>
<td>5</td>
<td>504</td>
<td>604</td>
<td>2,012</td>
</tr>
<tr>
<td>Fillet table</td>
<td>1</td>
<td>17,000</td>
<td>8</td>
<td>850</td>
<td>1,020</td>
<td>2,125</td>
</tr>
<tr>
<td>Tray pack system</td>
<td>1</td>
<td>29,480</td>
<td>5</td>
<td>2,948</td>
<td>1,769</td>
<td>5,896</td>
</tr>
<tr>
<td>CO₂ freezer</td>
<td>1</td>
<td>108,350</td>
<td>15</td>
<td>4,334</td>
<td>6,501</td>
<td>7,223</td>
</tr>
<tr>
<td>CO₂ tank</td>
<td>1</td>
<td>30,000</td>
<td>15</td>
<td>--</td>
<td>1,800</td>
<td>2,000</td>
</tr>
<tr>
<td>Tri-phosphate injector</td>
<td>1</td>
<td>42,500</td>
<td>15</td>
<td>5,950</td>
<td>2,550</td>
<td>2,833</td>
</tr>
<tr>
<td>Box taping system</td>
<td>1</td>
<td>4,400</td>
<td>10</td>
<td>110</td>
<td>264</td>
<td>440</td>
</tr>
<tr>
<td>Ice machine</td>
<td>1</td>
<td>13,500</td>
<td>10</td>
<td>675</td>
<td>810</td>
<td>1,350</td>
</tr>
<tr>
<td>Material handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fork truck</td>
<td>1</td>
<td>17,275</td>
<td>15</td>
<td>864</td>
<td>1,037</td>
<td>1,152</td>
</tr>
<tr>
<td>Walkie</td>
<td>1</td>
<td>3,850</td>
<td>15</td>
<td>385</td>
<td>231</td>
<td>257</td>
</tr>
<tr>
<td>Floor pallet mover</td>
<td>1</td>
<td>480</td>
<td>15</td>
<td>48</td>
<td>48</td>
<td>32</td>
</tr>
<tr>
<td>Clean-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam cleaning system</td>
<td>1</td>
<td>1,935</td>
<td>10</td>
<td>48</td>
<td>116</td>
<td>194</td>
</tr>
<tr>
<td>High pressure washdown</td>
<td>1</td>
<td>10,000</td>
<td>10</td>
<td>500</td>
<td>600</td>
<td>1,000</td>
</tr>
<tr>
<td>Office furniture &amp; equip.</td>
<td>Lot</td>
<td>25,350</td>
<td>1/</td>
<td>--</td>
<td>1,521</td>
<td>2,768</td>
</tr>
<tr>
<td>Waste handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offal tank</td>
<td>1</td>
<td>13,750</td>
<td>20</td>
<td>--</td>
<td>825</td>
<td>688</td>
</tr>
<tr>
<td>Offal strainer</td>
<td>1</td>
<td>7,875</td>
<td>10</td>
<td>788</td>
<td>473</td>
<td>788</td>
</tr>
<tr>
<td>Offal lift conveyor</td>
<td>1</td>
<td>10,000</td>
<td>15</td>
<td>500</td>
<td>600</td>
<td>667</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>Lot</td>
<td>61,032</td>
<td>10</td>
<td>3,052</td>
<td>3,662</td>
<td>6,103</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Lot</td>
<td>67,851</td>
<td>2/</td>
<td>1,777</td>
<td>4,071</td>
<td>5,708</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>1,598,723</td>
<td>--</td>
<td>41,680</td>
<td>101,940</td>
<td>99,523</td>
</tr>
</tbody>
</table>

1/ Office chairs have an expected life of 5 years. All other office furniture and equipment was assumed to have a 15 year life.

2/ Depending on function, expected life of miscellaneous equipment ranges from 10 to 15 years.
Table 2. Estimated land, building and equipment requirements, initial investment, expected life and associated annual costs, Model Plant II, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Estimated New Cost</th>
<th>Expected Life</th>
<th>Annual Repairs</th>
<th>Annual Interest</th>
<th>Annual Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land</strong></td>
<td>Lot</td>
<td>38,781</td>
<td>--</td>
<td>--</td>
<td>4,460</td>
<td>--</td>
</tr>
<tr>
<td><strong>Waste treatment facility</strong></td>
<td>Lot</td>
<td>110,000</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>12,650</td>
</tr>
<tr>
<td><strong>Buildings</strong></td>
<td>Lot</td>
<td>1,222,740</td>
<td>25</td>
<td>12,227</td>
<td>73,364</td>
<td>48,910</td>
</tr>
<tr>
<td><strong>Receiving area</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock system</td>
<td>1</td>
<td>4,000</td>
<td>5</td>
<td>200</td>
<td>240</td>
<td>800</td>
</tr>
<tr>
<td>Basket holding structure</td>
<td>1</td>
<td>4,000</td>
<td>20</td>
<td>--</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Haul baskets</td>
<td>3</td>
<td>9,000</td>
<td>20</td>
<td>--</td>
<td>540</td>
<td>450</td>
</tr>
<tr>
<td>Overhead track scales</td>
<td>1</td>
<td>2,780</td>
<td>5</td>
<td>139</td>
<td>167</td>
<td>556</td>
</tr>
<tr>
<td><strong>Eviscerating room</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution conveyor</td>
<td>1</td>
<td>2,000</td>
<td>3</td>
<td>200</td>
<td>120</td>
<td>667</td>
</tr>
<tr>
<td>Layup tables</td>
<td>4</td>
<td>2,400</td>
<td>15</td>
<td>--</td>
<td>144</td>
<td>160</td>
</tr>
<tr>
<td>Belly split tables</td>
<td>2</td>
<td>1,200</td>
<td>15</td>
<td>--</td>
<td>72</td>
<td>80</td>
</tr>
<tr>
<td>Headsaw</td>
<td>6</td>
<td>13,824</td>
<td>6</td>
<td>2,304</td>
<td>828</td>
<td>2,304</td>
</tr>
<tr>
<td>Vacuum eviscerator</td>
<td>2</td>
<td>18,000</td>
<td>6</td>
<td>1,350</td>
<td>1,080</td>
<td>3,000</td>
</tr>
<tr>
<td>Freon chiller</td>
<td>1</td>
<td>33,200</td>
<td>10</td>
<td>1,328</td>
<td>1,992</td>
<td>3,320</td>
</tr>
<tr>
<td>Automatic skinner</td>
<td>8</td>
<td>58,000</td>
<td>5</td>
<td>8,704</td>
<td>3,480</td>
<td>11,600</td>
</tr>
<tr>
<td>Two-tier conveyor</td>
<td>1</td>
<td>4,116</td>
<td>5</td>
<td>412</td>
<td>247</td>
<td>823</td>
</tr>
<tr>
<td>Transfer conveyor</td>
<td>1</td>
<td>3,000</td>
<td>5</td>
<td>300</td>
<td>180</td>
<td>600</td>
</tr>
<tr>
<td>Elevating conveyor</td>
<td>1</td>
<td>3,280</td>
<td>5</td>
<td>230</td>
<td>197</td>
<td>656</td>
</tr>
<tr>
<td><strong>Processing room</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic sorter</td>
<td>1</td>
<td>62,555</td>
<td>10</td>
<td>1,251</td>
<td>3,753</td>
<td>6,256</td>
</tr>
<tr>
<td>Roller conveyor</td>
<td>1</td>
<td>2,520</td>
<td>15</td>
<td>--</td>
<td>152</td>
<td>168</td>
</tr>
<tr>
<td>Sort/pack tables</td>
<td>6</td>
<td>6,000</td>
<td>15</td>
<td>--</td>
<td>360</td>
<td>402</td>
</tr>
<tr>
<td>Electronic scales</td>
<td>6</td>
<td>15,084</td>
<td>5</td>
<td>756</td>
<td>906</td>
<td>3,018</td>
</tr>
<tr>
<td>Fillet table</td>
<td>1</td>
<td>49,000</td>
<td>8</td>
<td>1,730</td>
<td>2,340</td>
<td>4,875</td>
</tr>
<tr>
<td>Tray pack system</td>
<td>1</td>
<td>29,480</td>
<td>5</td>
<td>2,948</td>
<td>1,769</td>
<td>5,896</td>
</tr>
<tr>
<td>CO₂ freezer</td>
<td>1</td>
<td>189,200</td>
<td>15</td>
<td>7,568</td>
<td>11,352</td>
<td>12,613</td>
</tr>
<tr>
<td>CO₂ tank</td>
<td>1</td>
<td>30,000</td>
<td>15</td>
<td>--</td>
<td>1,800</td>
<td>2,000</td>
</tr>
<tr>
<td>Box taping system</td>
<td>1</td>
<td>4,400</td>
<td>10</td>
<td>110</td>
<td>264</td>
<td>440</td>
</tr>
<tr>
<td>Tri-phosphate injector</td>
<td>1</td>
<td>42,500</td>
<td>15</td>
<td>5,950</td>
<td>2,550</td>
<td>2,833</td>
</tr>
<tr>
<td>Ice machine</td>
<td>1</td>
<td>17,500</td>
<td>10</td>
<td>875</td>
<td>1,050</td>
<td>1,750</td>
</tr>
<tr>
<td><strong>Material handling</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fork truck</td>
<td>1</td>
<td>17,275</td>
<td>15</td>
<td>864</td>
<td>1,037</td>
<td>1,152</td>
</tr>
<tr>
<td>Walkie</td>
<td>1</td>
<td>3,850</td>
<td>15</td>
<td>385</td>
<td>231</td>
<td>257</td>
</tr>
<tr>
<td>Floor pallet mover</td>
<td>2</td>
<td>960</td>
<td>15</td>
<td>96</td>
<td>58</td>
<td>64</td>
</tr>
<tr>
<td><strong>Clean-up</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam cleaning system</td>
<td>2</td>
<td>3,870</td>
<td>10</td>
<td>96</td>
<td>232</td>
<td>388</td>
</tr>
<tr>
<td>High pressure washdown</td>
<td>1</td>
<td>10,000</td>
<td>10</td>
<td>500</td>
<td>600</td>
<td>1,000</td>
</tr>
<tr>
<td><strong>Waste handling</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offal strainer</td>
<td>1</td>
<td>8,550</td>
<td>10</td>
<td>855</td>
<td>513</td>
<td>855</td>
</tr>
<tr>
<td>Offal tank</td>
<td>1</td>
<td>13,750</td>
<td>20</td>
<td>--</td>
<td>825</td>
<td>688</td>
</tr>
<tr>
<td>Offal lift conveyor</td>
<td>1</td>
<td>10,000</td>
<td>15</td>
<td>500</td>
<td>600</td>
<td>667</td>
</tr>
<tr>
<td><strong>Office furniture &amp; equip.</strong></td>
<td>Lot</td>
<td>36,421</td>
<td>1/</td>
<td>--</td>
<td>2,185</td>
<td>3,977</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>Lot</td>
<td>96,172</td>
<td>10</td>
<td>4,809</td>
<td>5,770</td>
<td>9,617</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Lot</td>
<td>88,460</td>
<td>2/</td>
<td>2,317</td>
<td>5,307</td>
<td>7,442</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td>2,267,868</td>
<td>--</td>
<td>59,004</td>
<td>143,654</td>
<td>140,705</td>
</tr>
</tbody>
</table>

1/ Office chairs have an expected life of 5 years. All other office furniture and equipment was assumed to have a 15 year life.

2/ Depending on function, expected life of miscellaneous equipment ranges from 10 to 15 years.
Table 3. Estimated land, building and equipment requirements, initial investment, expected life and associated annual costs, Model Plant III, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Estimated New Cost</th>
<th>Expected Life</th>
<th>Annual Repairs</th>
<th>Annual Interest</th>
<th>Annual Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>Lot</td>
<td>$44,139</td>
<td>--</td>
<td>--</td>
<td>$5,076</td>
<td>--</td>
</tr>
<tr>
<td>Waste treatment facility</td>
<td>Lot</td>
<td>$160,000</td>
<td>--</td>
<td>--</td>
<td>$18,400</td>
<td>--</td>
</tr>
<tr>
<td>Buildings</td>
<td>Lot</td>
<td>$1,579,050</td>
<td>25</td>
<td>$15,791</td>
<td>$94,743</td>
<td>$63,162</td>
</tr>
<tr>
<td>Receiving area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock system</td>
<td>1</td>
<td>$4,000</td>
<td>5</td>
<td>$200</td>
<td>$240</td>
<td>$800</td>
</tr>
<tr>
<td>Basket holding structure</td>
<td>1</td>
<td>$4,000</td>
<td>20</td>
<td>--</td>
<td>$240</td>
<td>$200</td>
</tr>
<tr>
<td>Haul baskets</td>
<td>4</td>
<td>$12,000</td>
<td>20</td>
<td>--</td>
<td>$720</td>
<td>$600</td>
</tr>
<tr>
<td>Overhead track scales</td>
<td>1</td>
<td>$2,780</td>
<td>5</td>
<td>$139</td>
<td>$167</td>
<td>$556</td>
</tr>
<tr>
<td>Eviscerating room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution conveyor</td>
<td>1</td>
<td>$3,000</td>
<td>3</td>
<td>$300</td>
<td>$180</td>
<td>$1,000</td>
</tr>
<tr>
<td>Layup tables</td>
<td>6</td>
<td>$3,600</td>
<td>15</td>
<td>--</td>
<td>$216</td>
<td>$240</td>
</tr>
<tr>
<td>Belly split tables</td>
<td>3</td>
<td>$1,800</td>
<td>15</td>
<td>--</td>
<td>$108</td>
<td>$120</td>
</tr>
<tr>
<td>Head saw</td>
<td>9</td>
<td>$20,736</td>
<td>6</td>
<td>$3,456</td>
<td>$1,242</td>
<td>$3,456</td>
</tr>
<tr>
<td>Vacuum eviscerator</td>
<td>3</td>
<td>$27,000</td>
<td>6</td>
<td>$2,025</td>
<td>$1,520</td>
<td>$4,500</td>
</tr>
<tr>
<td>Freon chiller</td>
<td>1</td>
<td>$33,200</td>
<td>10</td>
<td>$1,328</td>
<td>$1,992</td>
<td>$3,320</td>
</tr>
<tr>
<td>Automatic skinner</td>
<td>12</td>
<td>$87,000</td>
<td>5</td>
<td>$13,056</td>
<td>$5,220</td>
<td>$17,400</td>
</tr>
<tr>
<td>Two-tier conveyor</td>
<td>1</td>
<td>$4,116</td>
<td>5</td>
<td>$412</td>
<td>$247</td>
<td>$823</td>
</tr>
<tr>
<td>Transfer conveyor</td>
<td>1</td>
<td>$4,000</td>
<td>5</td>
<td>$400</td>
<td>$240</td>
<td>$800</td>
</tr>
<tr>
<td>Elevating conveyor</td>
<td>1</td>
<td>$3,280</td>
<td>5</td>
<td>$230</td>
<td>$197</td>
<td>$656</td>
</tr>
<tr>
<td>Processing room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic sorter</td>
<td>2</td>
<td>$125,110</td>
<td>10</td>
<td>$2,502</td>
<td>$7,506</td>
<td>$12,512</td>
</tr>
<tr>
<td>Roller conveyor</td>
<td>1</td>
<td>$3,780</td>
<td>15</td>
<td>--</td>
<td>$228</td>
<td>$252</td>
</tr>
<tr>
<td>Sort/pack tables</td>
<td>8</td>
<td>$6,000</td>
<td>15</td>
<td>--</td>
<td>$480</td>
<td>$536</td>
</tr>
<tr>
<td>Electronic scales</td>
<td>8</td>
<td>$20,112</td>
<td>5</td>
<td>$1,008</td>
<td>$1,208</td>
<td>$4,040</td>
</tr>
<tr>
<td>Fillet table</td>
<td>2</td>
<td>$44,000</td>
<td>8</td>
<td>$1,760</td>
<td>$2,640</td>
<td>$5,586</td>
</tr>
<tr>
<td>Tray pack system</td>
<td>1</td>
<td>$29,480</td>
<td>5</td>
<td>$2,948</td>
<td>$1,769</td>
<td>$5,896</td>
</tr>
<tr>
<td>CO₂ tank</td>
<td>1</td>
<td>$189,200</td>
<td>15</td>
<td>$7,568</td>
<td>$11,352</td>
<td>$12,613</td>
</tr>
<tr>
<td>CO₂ tank</td>
<td>1</td>
<td>$30,000</td>
<td>15</td>
<td>--</td>
<td>$1,800</td>
<td>$2,000</td>
</tr>
<tr>
<td>Tri-phosphate injector</td>
<td>1</td>
<td>$42,500</td>
<td>15</td>
<td>$5,950</td>
<td>$2,550</td>
<td>$2,833</td>
</tr>
<tr>
<td>Ice machine</td>
<td>1</td>
<td>$37,000</td>
<td>10</td>
<td>$1,850</td>
<td>$2,220</td>
<td>$3,700</td>
</tr>
<tr>
<td>Box taping system</td>
<td>2</td>
<td>$8,800</td>
<td>10</td>
<td>$220</td>
<td>$528</td>
<td>$880</td>
</tr>
<tr>
<td>Material handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fork truck</td>
<td>2</td>
<td>$34,550</td>
<td>15</td>
<td>$1,728</td>
<td>$2,074</td>
<td>$2,304</td>
</tr>
<tr>
<td>Walkie</td>
<td>1</td>
<td>$3,850</td>
<td>15</td>
<td>$385</td>
<td>$231</td>
<td>$257</td>
</tr>
<tr>
<td>Pallet mover</td>
<td>3</td>
<td>$1,440</td>
<td>15</td>
<td>$144</td>
<td>$87</td>
<td>$96</td>
</tr>
<tr>
<td>Clean-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam cleaning system</td>
<td>3</td>
<td>$5,805</td>
<td>10</td>
<td>$144</td>
<td>$348</td>
<td>$582</td>
</tr>
<tr>
<td>High pressure washdown</td>
<td>1</td>
<td>$10,000</td>
<td>10</td>
<td>$500</td>
<td>$600</td>
<td>$1,000</td>
</tr>
<tr>
<td>Waste handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offal strainer</td>
<td>1</td>
<td>$9,800</td>
<td>10</td>
<td>$980</td>
<td>$588</td>
<td>$980</td>
</tr>
<tr>
<td>Offal holding tank</td>
<td>2</td>
<td>$27,500</td>
<td>20</td>
<td>--</td>
<td>$1,650</td>
<td>$1,376</td>
</tr>
<tr>
<td>Offal lift conveyor</td>
<td>1</td>
<td>$10,000</td>
<td>15</td>
<td>$500</td>
<td>$600</td>
<td>$667</td>
</tr>
<tr>
<td>Office furniture &amp; equip.</td>
<td>Lot</td>
<td>$45,120</td>
<td>1/</td>
<td>--</td>
<td>$2,707</td>
<td>$5,271</td>
</tr>
<tr>
<td>Refrigeration</td>
<td></td>
<td>$120,578</td>
<td>10</td>
<td>$6,029</td>
<td>$7,235</td>
<td>$12,058</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Lot</td>
<td>$110,876</td>
<td>2/</td>
<td>$2,904</td>
<td>$6,653</td>
<td>$9,328</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>$2,911,202</td>
<td>--</td>
<td>$74,457</td>
<td>$185,902</td>
<td>$182,298</td>
</tr>
</tbody>
</table>

1/Office chairs have an expected life of 5 years. All other office furniture and equipment was assumed to have a 15 year life.

2/Depending on function, expected life of miscellaneous equipment ranges from 10 to 15 years.
Table 4. Estimated land, building and equipment requirements, initial investment, expected life and associated annual costs, Model Plant IV, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Estimated New Cost</th>
<th>Expected Life</th>
<th>Annual Repairs</th>
<th>Annual Interest</th>
<th>Annual Depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land</td>
<td>Lot</td>
<td>53,803</td>
<td>--</td>
<td>--</td>
<td>6,187</td>
<td>--</td>
</tr>
<tr>
<td>Waste treatment facility</td>
<td>Lot</td>
<td>200,000</td>
<td>--</td>
<td>--</td>
<td>23,000</td>
<td>--</td>
</tr>
<tr>
<td>Buildings</td>
<td>Lot</td>
<td>2,286,225</td>
<td>25</td>
<td>22,862</td>
<td>137,174</td>
<td>91,449</td>
</tr>
<tr>
<td>Receiving area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock system</td>
<td>2</td>
<td>8,000</td>
<td>5</td>
<td>400</td>
<td>480</td>
<td>1,600</td>
</tr>
<tr>
<td>Basket holding structure</td>
<td>1</td>
<td>4,000</td>
<td>20</td>
<td>--</td>
<td>240</td>
<td>200</td>
</tr>
<tr>
<td>Haul baskets</td>
<td>6</td>
<td>18,000</td>
<td>20</td>
<td>--</td>
<td>1,080</td>
<td>900</td>
</tr>
<tr>
<td>Overhead track scales</td>
<td>2</td>
<td>5,560</td>
<td>5</td>
<td>278</td>
<td>334</td>
<td>1,112</td>
</tr>
<tr>
<td>Eviscerating room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution conveyor</td>
<td>1</td>
<td>4,000</td>
<td>3</td>
<td>400</td>
<td>240</td>
<td>1,333</td>
</tr>
<tr>
<td>Layup tables</td>
<td>10</td>
<td>6,000</td>
<td>15</td>
<td>--</td>
<td>360</td>
<td>400</td>
</tr>
<tr>
<td>Belly split tables</td>
<td>5</td>
<td>3,000</td>
<td>15</td>
<td>--</td>
<td>180</td>
<td>200</td>
</tr>
<tr>
<td>Headsaws</td>
<td>15</td>
<td>34,560</td>
<td>6</td>
<td>5,760</td>
<td>2,074</td>
<td>5,760</td>
</tr>
<tr>
<td>Vacuum eviscerator</td>
<td>5</td>
<td>45,000</td>
<td>6</td>
<td>3,375</td>
<td>2,700</td>
<td>7,500</td>
</tr>
<tr>
<td>Two-tier conveyor</td>
<td>1</td>
<td>4,116</td>
<td>5</td>
<td>412</td>
<td>247</td>
<td>823</td>
</tr>
<tr>
<td>Freon jacketed chiller</td>
<td>1</td>
<td>52,500</td>
<td>10</td>
<td>2,100</td>
<td>3,150</td>
<td>5,250</td>
</tr>
<tr>
<td>Automatic skimmers</td>
<td>20</td>
<td>145,000</td>
<td>5</td>
<td>21,760</td>
<td>8,700</td>
<td>29,000</td>
</tr>
<tr>
<td>Transfer conveyor</td>
<td>1</td>
<td>5,320</td>
<td>5</td>
<td>532</td>
<td>319</td>
<td>1,064</td>
</tr>
<tr>
<td>Elevating conveyor</td>
<td>1</td>
<td>3,280</td>
<td>5</td>
<td>230</td>
<td>197</td>
<td>656</td>
</tr>
<tr>
<td>Processing room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automatic sorter</td>
<td>4</td>
<td>250,220</td>
<td>10</td>
<td>5,004</td>
<td>15,013</td>
<td>25,022</td>
</tr>
<tr>
<td>Roller conveyor</td>
<td>1</td>
<td>5,670</td>
<td>15</td>
<td>--</td>
<td>340</td>
<td>378</td>
</tr>
<tr>
<td>Sort/pack tables</td>
<td>11</td>
<td>11,000</td>
<td>15</td>
<td>--</td>
<td>660</td>
<td>733</td>
</tr>
<tr>
<td>Electronic scales</td>
<td>11</td>
<td>27,654</td>
<td>5</td>
<td>1,386</td>
<td>1,659</td>
<td>5,531</td>
</tr>
<tr>
<td>Fillet table</td>
<td>3</td>
<td>83,000</td>
<td>8</td>
<td>3,490</td>
<td>4,980</td>
<td>10,375</td>
</tr>
<tr>
<td>Tray pack system</td>
<td>2</td>
<td>58,960</td>
<td>5</td>
<td>5,896</td>
<td>3,538</td>
<td>11,792</td>
</tr>
<tr>
<td>CO₂ freezer</td>
<td>1</td>
<td>235,400</td>
<td>15</td>
<td>9,416</td>
<td>14,124</td>
<td>15,693</td>
</tr>
<tr>
<td>CO₂ tank</td>
<td>1</td>
<td>30,000</td>
<td>15</td>
<td>--</td>
<td>1,800</td>
<td>2,000</td>
</tr>
<tr>
<td>Box taping system</td>
<td>3</td>
<td>13,200</td>
<td>10</td>
<td>330</td>
<td>792</td>
<td>1,320</td>
</tr>
<tr>
<td>Ice machine (20 ton)</td>
<td>1</td>
<td>37,000</td>
<td>10</td>
<td>1,850</td>
<td>2,220</td>
<td>3,700</td>
</tr>
<tr>
<td>Ice machine (10 ton)</td>
<td>1</td>
<td>17,500</td>
<td>10</td>
<td>875</td>
<td>1,050</td>
<td>1,750</td>
</tr>
<tr>
<td>Tri-phosphate injector</td>
<td>2</td>
<td>85,000</td>
<td>15</td>
<td>11,900</td>
<td>5,100</td>
<td>5,666</td>
</tr>
<tr>
<td>Material handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fork truck</td>
<td>3</td>
<td>51,825</td>
<td>15</td>
<td>2,592</td>
<td>3,111</td>
<td>3,456</td>
</tr>
<tr>
<td>Walkie</td>
<td>2</td>
<td>7,700</td>
<td>15</td>
<td>770</td>
<td>462</td>
<td>515</td>
</tr>
<tr>
<td>Floor pallet mover</td>
<td>5</td>
<td>2,400</td>
<td>15</td>
<td>240</td>
<td>144</td>
<td>160</td>
</tr>
<tr>
<td>Clean-up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foam cleaning system</td>
<td>4</td>
<td>7,740</td>
<td>10</td>
<td>192</td>
<td>116</td>
<td>128</td>
</tr>
<tr>
<td>High pressure washdown</td>
<td>2</td>
<td>20,000</td>
<td>10</td>
<td>1,000</td>
<td>1,200</td>
<td>2,000</td>
</tr>
<tr>
<td>Waste handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offal strainer</td>
<td>1</td>
<td>10,800</td>
<td>10</td>
<td>1,080</td>
<td>648</td>
<td>1,080</td>
</tr>
<tr>
<td>Offal holding tank</td>
<td>3</td>
<td>41,250</td>
<td>20</td>
<td>--</td>
<td>2,475</td>
<td>2,064</td>
</tr>
<tr>
<td>Offal lift conveyor</td>
<td>1</td>
<td>10,000</td>
<td>15</td>
<td>500</td>
<td>600</td>
<td>667</td>
</tr>
<tr>
<td>Office furniture &amp; equip.</td>
<td>Lot</td>
<td>53,064</td>
<td>1/</td>
<td>--</td>
<td>3,184</td>
<td>6,317</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>Lot</td>
<td>179,236</td>
<td>10</td>
<td>8,962</td>
<td>10,754</td>
<td>17,924</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Lot</td>
<td>175,896</td>
<td>2/</td>
<td>4,607</td>
<td>10,554</td>
<td>14,798</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>4,292,879</td>
<td>--</td>
<td>118,199</td>
<td>271,186</td>
<td>280,315</td>
</tr>
</tbody>
</table>

1/Office chairs have an expected life of 5 years. All other office furniture and equipment was assumed to have a 15 year life.

2/Depending on function, expected life of miscellaneous equipment ranges from 10 to 15 years.
Table 5. Hourly labor requirements by phase of operation for four model processing plants, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Plant Size</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model I</td>
<td>Model II</td>
<td>Model III</td>
<td>Model IV</td>
<td></td>
</tr>
<tr>
<td>Receiving</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Eviscerating room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Headers</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Layup</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Belly split</td>
<td>3</td>
<td>6</td>
<td>9</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Conveyor operator</td>
<td>--</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Eviscerators</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Skinners</td>
<td>6</td>
<td>12</td>
<td>18</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Inspect/wash</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>21</strong></td>
<td><strong>41</strong></td>
<td><strong>61</strong></td>
<td><strong>88</strong></td>
<td></td>
</tr>
<tr>
<td>Processing room</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Icore loaders</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Hand sort</td>
<td>--</td>
<td>1</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Icore pan handlers</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Filleters</td>
<td>13</td>
<td>26</td>
<td>39</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Fillet pan handlers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Icers</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Ice packers/boxers</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Box strapper</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Fillet sorters</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Steakers</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Pan handler</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tray packers/boxers</td>
<td>4</td>
<td>6</td>
<td>8</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>32</strong></td>
<td><strong>51</strong></td>
<td><strong>76</strong></td>
<td><strong>125</strong></td>
<td></td>
</tr>
<tr>
<td>IQF belt loaders</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Sorters</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Boxers</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Strappers</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Cooler/freezer</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Pallet handler</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>10</strong></td>
<td><strong>13</strong></td>
<td><strong>18</strong></td>
<td><strong>28</strong></td>
<td></td>
</tr>
<tr>
<td>Clean-up</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Security guards</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>9</strong></td>
<td><strong>11</strong></td>
<td><strong>16</strong></td>
<td><strong>18</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total hourly labor</strong></td>
<td><strong>72</strong></td>
<td><strong>116</strong></td>
<td><strong>171</strong></td>
<td><strong>259</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Table 6. Estimated salaried personnel requirements for four model plants, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Model Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model I a/</td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td>Quantity</td>
</tr>
<tr>
<td>President</td>
<td>--</td>
</tr>
<tr>
<td>Marketing director</td>
<td>1</td>
</tr>
<tr>
<td>Comptroller</td>
<td>--</td>
</tr>
<tr>
<td>Distribution manager</td>
<td>1</td>
</tr>
<tr>
<td>Plant manager</td>
<td>1</td>
</tr>
<tr>
<td>Production superintendent</td>
<td>4</td>
</tr>
<tr>
<td>Bookkeeper</td>
<td>1</td>
</tr>
<tr>
<td>Secretary</td>
<td>3</td>
</tr>
<tr>
<td>Personnel manager</td>
<td>--</td>
</tr>
<tr>
<td>Quality control</td>
<td>1</td>
</tr>
<tr>
<td>Salesman</td>
<td>2</td>
</tr>
<tr>
<td>Customer service</td>
<td>1</td>
</tr>
<tr>
<td>Federal inspector b/</td>
<td>1</td>
</tr>
<tr>
<td>Total salaried personnel</td>
<td>15</td>
</tr>
<tr>
<td>requirements</td>
<td></td>
</tr>
</tbody>
</table>

a/ In Model Plant I, the duties of more than one position may be assigned to an employee. For example, an employee may serve as president and marketing director of the model plant.

b/ The federal inspector is paid on a half-time basis. This position is not included in the calculation of total salaried personnel requirements.

### Table 7. Estimated salary costs by position for four model processing plants, Delta area of Mississippi, 1983

<table>
<thead>
<tr>
<th>Position</th>
<th>Model I a/</th>
<th>Model II</th>
<th>Model III</th>
<th>Model IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dollars</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>------------</td>
<td>----------</td>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>President</td>
<td>61,200</td>
<td>67,320</td>
<td>74,052</td>
<td>81,457</td>
</tr>
<tr>
<td>Marketing director</td>
<td>61,200</td>
<td>67,320</td>
<td>74,052</td>
<td>81,457</td>
</tr>
<tr>
<td>Comptroller</td>
<td>46,200</td>
<td>50,820</td>
<td>55,902</td>
<td>61,492</td>
</tr>
<tr>
<td>Distribution manager</td>
<td>46,200</td>
<td>50,820</td>
<td>55,902</td>
<td>61,492</td>
</tr>
<tr>
<td>Plant manager</td>
<td>39,600</td>
<td>43,560</td>
<td>47,916</td>
<td>52,708</td>
</tr>
<tr>
<td>Production supervisor</td>
<td>28,400</td>
<td>29,040</td>
<td>31,944</td>
<td>35,138</td>
</tr>
<tr>
<td>Bookkeeper</td>
<td>19,800</td>
<td>19,800</td>
<td>19,800</td>
<td>19,800</td>
</tr>
<tr>
<td>Secretary</td>
<td>12,000</td>
<td>12,000</td>
<td>12,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Personnel manager</td>
<td>33,000</td>
<td>36,300</td>
<td>39,930</td>
<td>43,923</td>
</tr>
<tr>
<td>Quality control</td>
<td>39,600</td>
<td>43,560</td>
<td>47,916</td>
<td>52,708</td>
</tr>
<tr>
<td>Salesman</td>
<td>33,000</td>
<td>36,300</td>
<td>39,930</td>
<td>43,923</td>
</tr>
<tr>
<td>Customer service b/</td>
<td>33,000</td>
<td>36,300</td>
<td>39,930</td>
<td>43,923</td>
</tr>
<tr>
<td>Federal inspector b/</td>
<td>20,112</td>
<td>20,112</td>
<td>20,112</td>
<td>20,112</td>
</tr>
</tbody>
</table>

a/ Includes fringe benefits.

b/ Half-time.
References


