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Framework for evaluating the economic efficiency of a cooperative sheep slaughter house at Bangalore, India

A. N. K. Murthy

To the Graduate Council:

I am submitting herewith a thesis written by A. N. K. Murthy entitled "Framework for evaluating the economic efficiency of a cooperative sheep slaughter house at Bangalore, India." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

Irving Dubov, Major Professor

We have read this thesis and recommend its acceptance:

C.F. Lard, B.D. Raskopf, J.W. Cole

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

December 7, 1963

To the Graduate Council:

I am submitting herewith a thesis written by Murthy A. N. K. entitled "Framework for Evaluating the Economic Efficiency of a Cooperative Sheep Slaughter House at Bangalore, India." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science with a major in Agricultural Economics.

Irving Dubow
Major Professor

We have read this thesis and recommend its acceptance:

B. D. Raskopf

Curtis F. Laird

J. R. Wolf

Accepted for the Council:

Clifton D. Smith
Dean of the Graduate School

FRAMEWORK FOR EVALUATING THE ECONOMIC EFFICIENCY OF A COOPERATIVE SHEEP SLAUGHTER HOUSE AT BANGALORE, INDIA

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Murthy A. N. K.

December 1963

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TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

CHAPTER I

INTRODUCTION

I. GENERAL CHARACTERISTICS OF BANGALORE

Bangalore, the capital of Mysore State in India, has grown rapidly since the turn of the century. The city's population increased 700 per cent from 1901 to 1960--from 170,000 to 1,390,000. The growth of the city has been accelerated since World War II by the establishment of such industries as Hindustan Aircraft Ltd., Indian Telephone Industries, Hindustan Machine Tools, Bharat Electronics Ltd. and the Government Electric, porcelain and soap factories. In addition, there is a large transient population continuously resident in the city because of the location of State Government offices and High Courts in Bangalore.

According to the population growth rate projection made by the Government of India, an increase of 2.14 per cent per annum during 1960-66 and 1.90 per cent per annum during 1966-71 is anticipated.[1] Hence the population of the city of Bangalore is expected to exceed 1,600,000 by 1966.

According to the All-India Survey, per capita real income per annum increased from Rs. 280 ($59.50) in 1950, to

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[1]Third Five Year Plan, A Draft Outline (New Delhi: Planning Commission, Government of India, June 1960), p. 5.

Rs. 330 ($70.06) in 1960. Allowing for expected increases in population, per capita real income should rise from Rs. 330 ($70.06) at the end of 1960 to about Rs. 385 ($81.73) in 1966, Rs. 450 ($95.50) in 1971, and Rs. 530 ($112.52) in 1976.[2] Forty-four per cent of the personnel employed in the State Government office received from Rs. 51 to Rs. 80 per month, 21 per cent received from Rs. 81 to Rs. 100 per month, and about 12 per cent received from Rs. 101 to Rs. 175 per month.[3] The pay scale of persons employed in Government of India undertakings and private businesses is higher than that of those employed in the State Government services

Ragi, which is by far the most important millet crop raised in the state, supplies the staple food, especially for diets of people in the working classes. It is regarded as a most wholesome food by the working class. Rice and wheat are consumed, along with milk, meat and eggs, by the middle and upper income groups in Mysore State. Fresh vegetables, such as beans, cauliflower, tomatoes, and cabbages, are important in the diet of the residents of Bangalore, since Bangalore and its environments are particularly suitable for the cultivation of vegetables.

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[2]Ibid., p. 28.

[3]Statistical Outline of Mysore (Government of Mysore Publication, 1960), p. 174.

Although most people are reluctant to try new foods, Indian experience indicates that changes are made, either in emergency circumstances or as a result of income improvement.

> The quantity of food eaten per person is likely to increase as India's development program provides employment for more people in urban areas, but nutritional inadequacies may still persist. The low income groups, whose incomes are likely to increase fastest with economic growth, spend more of this increase on food than do those in higher income groups. [4]

At present, the actual average daily intake of meat, fish and eggs is 0.9 ounce, as against a recommended intake of 4.0 ounces. [5] It is hoped that with an increase in per capita incomes in Bangalore, per capita consumption of meat will increase. The quantity of meat demanded is assumed to be influenced by the real retail price, by real income in the given year, and in the previous year, and by a complex of factors relating to consumer's desire and habits which may be expressed as a time trend. [6]

II. MEAT AS AN ITEM IN THE DIET

For thousands of years meat has been the mainstay in the human diet. Primitive man chose it instinctively and modern

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[4]Agricultural Production Team, Sponsored by Ford Foundation, India's Food Crisis and Steps to Meet It (New Delhi: Government of India, April 1959), p. 239.

[5]Ibid.

[6]Elmer J. Working, Demand for Meat (Chicago: Institute of Meat Packing, University of Chicago, 1954), p. 6.

man has learned from scientific investigations that meat contributes richly to the satisfaction of his body's needs, for high-quality proteins, easily digestible fats and many of the essential minerals and vitamins. Meat is a highly perishable commodity and poor handling of it can exact large costs in terms of public health and economic loss. Therefore, there can be no room for complacency over problems of meat hygiene, and the first consideration in the slaughtering of animals for human consumption is the observance of a strict sanitary code. Any economic considerations affecting the handling of meats should be applied within the general framework of good sanitation. Though seemingly simple, the economic and hygienic handling of animals from the time they enter the sheep pen until they leave the slaughter house as dressed carcasses is a skilled and complex series of operations. These considerations become still more important in a country like India, where it is essential to increase the availability of high quality meat at reasonable price.

At present, sheep and goats are slaughtered at two slaughter houses in the Bangalore city area. One is located in the city area and the other is in the old cantonment area. There is one slaughter house that kills a few hogs daily. Cattle are not slaughtered in Bangalore, but twenty-five carcasses of beef are imported daily from neighboring Madras. A study made by the Marketing Department of the Government of Mysore in 1950

estimates the annual per capita consumption of all kinds of meat in the urban areas at 34.28 pounds per person among the meat-consuming public, and 26.38 pounds per person per annum including the non-meat consuming public of the state. The study revealed that the price of meat was nearly six times that of wheat and five times that of rice. The price of meat as compared with the price of other commodities is given in Table I.

III. PRESENT STATUS OF SLAUGHTER HOUSES

The two slaughter houses mentioned above were built decades ago and do not have modern facilities and equipment. The slaughter house located in the former cantonment area is bigger, better built, and has a larger floor space than the one located in the city area. Both slaughter houses are surrounded by residential houses. The slaughter houses are controlled by the Corporation (an elected body that controls the administration of the city). The Corporation's control over the slaughter houses is concerned mainly with providing a place for slaughtering animals and collecting a nominal fee.

The entire operations of slaughtering, dressing, and sale of carcass are controlled by a few people, known as "contractors". The butchers are hired by these contractors and they receive a fixed fee for slaughtering and dressing each animal. The carcasses, after certification by the veterinary inspector (who is an employee of the Corporation), are kept

TABLE I

RATIO OF MEAT PRICES TO PRICES OF OTHER COMMODITIES ON WEIGHT[a] IN BANGALORE, INDIA, 1950

Commodity	Price ratio
Fish	0.475
Eggs	0.938
Milk	0.218
Rice	0.183
Wheat	0.174
Pulses	0.160
Meat	1.000

[a]Report on the Marketing of Meat in Mysore State (Bangalore: Marketing Department, Government of Mysore, 1950), Marketing Series No. 9, p. 14.

overnight in an aeration chamber and are sold to the retail meat shops next morning. The Corporation has no control over the price of meat. Neither the live animals nor carcasses are graded.

On an average, 800 to 1,000 sheep and goats are slaughtered each day, and the average weight of the carcass varies from 22 to 25 pounds. The number of animals slaughtered during the years 1950-55 is shown in Table II. The number of animals slaughtered generally increase during the winter months. This may be attributed to a seasonal increase in demand during the winter season.

Most of the animals brought to slaughter houses in Bangalore come from the adjoining districts of Mandya, Tumkur, and Kolar. These districts had a total sheep and goat population of 3,092,074 in 1961.[7] The animals are usually brought to the slaughter house by farmers on foot, but in some cases the contractors purchase animals in the villages and transport them to the slaughter house by truck.

To improve the present condition of the slaughter houses, the Government of Mysore established a committee in 1955 to suggest measures in this direction. After careful examination, the committee suggested the construction of a new slaughter house on the outskirts of the city of Bangalore at an estimated

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[7] Census Report (Bangalore: The Department of Animal Husbandry and Veterinary Services in Mysore, 1961), p. 1.

TABLE II

NUMBER OF SHEEP AND GOATS SLAUGHTERED IN BANGALORE DURING THE YEARS 1950-1955[a]

Year	Sheep and goats slaughtered (head)	Average per day (head)
1950-51	290,211	795
1951-52	301,394	826
1952-53	333,350	913
1953-54	339,608	930
1954-55	318,648	873

[a]Note on Combined Slaughter House (Bangalore: Unpublished Report from the Department of Animal Husbandry and Veterinary Services in Mysore, 1962), p. 4.

cost of $305,357. The project could not be undertaken for many reasons. Among them were the objections raised by the military authorities over the selected site, and opposition by the butchers in the community to shifting it to another locality.

IV. BENEFITS BY SETTING UP OF A NEW PLANT

By replacing the two existing slaughter houses with one well-equipped modern one, the cost of maintaining the two establishments could be avoided. By setting up a cooperative stockyard, better facilities would be provided for farmers bringing their animals to market in the city. At the same time, their bargaining power could be improved. A cooperative organization with good management should operate the slaughter house more efficiently than the existing system. Farmers and the general public could share the benefits derived, possibly enabling farmers to breed better quality sheep that would result in higher quality meat. Equipping the slaughter house with new machinery and introducing an on-the-rail system of operations would allow better viscera and by-products utilization, augmenting total returns from slaughtering operations and could result in lower prices of meat. The introduction of live grading and pricing on the basis of quality animals could induce farmers to bring better quality and substantially heavier animals in for slaughter. In addition to meeting the expected increased demand in high quality meat, this could also reduce per pound costs of

the slaughtering operations. If heavier animals are brought to the packing house, the number required for a specific quantity of meat could be substantially reduced. The cost of operation does not increase in direct ratio to the weight of the animal. The on-the-rail system of operations permits job specialization that increases the efficiency of plant operations and improves sanitary conditions.

The by-products provide a base for such secondary industries as livestock feed production, tanneries, soap, and glue. The improved meat handling techniques used in American packing houses improves butchers' working conditions, reduces labor input requirements, and lowers costs of slaughtering. Improved meat handling techniques, together with efficient meat inspection, extends the keeping quality of meat and meat products. Finally, efficient operation of the plant will facilitate operation at lower costs.

> An increase in efficiency will mean an increase in the total output of goods and services from given resources, and so would permit an increase in real income. This means that it would be possible for everyone to have more of economic good (leisure included), and thus suggests that efficiency will be in the general welfare.[8]

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[8]R. G. Bressler, Jr., "Efficiency in the Production of Marketing Services," Economic Efficiency Series, Paper No. 6 (Chicago: University of Chicago, 1950), p. 3.

V. OBJECTIVES OF STUDY

Expansion and/or improvement of the two existing slaughter houses will not solve the problem of supplying high quality meat to the ever-growing population of the city of Bangalore. Consolidation of the entire operations of slaughtering, dressing, distribution, and of the ownership of the animals and products under a cooperative arrangement appears to be a better situation.

The overall objective of this study is to provide information and develop cost data pertaining to the construction and equipping of a model slaughter house for the Bangalore area that is designed like the packing houses presently existing in the United States of America. The specific and detailed objectives are these:

1. To describe in sufficient detail the physical and technical specifications of a new slaughter house adapted to the needs of the Bangalore market area.
2. To describe the methodological approach to the measurement of various costs associated with the assembling, slaughtering, and dressing operations for sheep.
3. To develop the cost functions associated with the operation of the proposed model plant at varying rates of utilization.

4. To present the appropriate theoretical framework for evaluating the economic efficiency of plant operation.
5. To indicate the steps needed to set up a cooperative stockyard in the vicinity of the slaughter house and a cooperative organization to operate the model slaughter house. It is presumed that the basic approach of the model plant and organization can then be applied to other areas, time periods, and local conditions by altering the prices of plant inputs and other factors to satisfy the conditions that are associated with the different situations.

VI. PROCEDURE OF STUDY

The approach used in this study sets up a model slaughter house designed to kill sheep and goats at a rate of 150 to 300 animals per hour. The design follows largely the general pattern of federally inspected meat packing plants in the United States. The design of buildings and equipment is based on the specifications and catalogues furnished by meat packing equipment manufacturers in the United States of America. Allowance is made in the plan for future expansion. Cost estimates for various items of equipment needed for slaughtering, dressing, storing, and distributing carcasses are based also on quotations furnished by meat packing equipment manufacturers

in the U. S. A. The costs of shipment to India and local installation charges have been added to these costs. As a forerunner to the establishment of a model slaughter house, a model cooperative stockyard is also designed to maintain the regular supply of raw materials. The facility is designed along the lines of the Union Stockyards in Omaha and Chicago. A cooperative organization would be established to operate the slaughter house, with necessary capital contributed by the sheep breeders associations in the State, the Cooperative National Development Fund, the State Bank of India, the Government of Mysore, the Corporation of the City of Bangalore, and the general public of Bangalore.

The procedure used in developing the physical relationship and costs resembles, in principle, the synthetic approach to cost measurement as presented by Bressler and applied in the measurement of marketing costs and efficiencies by French, Samett and Bressler.[9] The procedure used gives estimates of the cost of physical input requirements at the different production stages:

1. Yard operations in receiving, weighing, and ante-mortem examination.
2. Plant operations in killing and dressing.
3. Carcass cooling.

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[9]French, Samett and Bressler, Economic Efficiency in Plant Operations with Special Reference to the Marketing of California Pears (Hilgardia: Giannini Foundation, University of California, July 1956), Vol. 24.

4. Sale and distribution.

These estimates, weighted by appropriate factor prices, are then used as "building blocks" in determining cost rates in the model plant. Then the various measures needed to make the different stages of operation efficient are established. Finally, a suitable framework for evaluating the economic efficiency of the whole slaughter house is suggested.

CHAPTER II

SPECIFICATIONS OF A MODEL PLANT

I. BRIEF DESCRIPTIONS OF THE FUNCTIONS TO BE PERFORMED

The operations in the slaughter house include:

1. Yard operations--receiving, weighing, grading, and ante-mortem examination of animals.
2. Slaughter operations--killing the animals and dressing the carcasses.
3. Cooling and storing the carcasses.
4. Cleaning and maintenance in the plant.
5. Administrative operations in buying sheep and selling meat and other products.

Assembly

After purchase in the cooperative stockyards located nearby, sheep and goats are transferred to the sheep pen. They are weighed as they enter the pen and are sorted according to weights by yardmen. They are housed in separate sheds in the sheep pen. Then they are examined by the veterinary inspector, and any animal suspected of any disease is transferred to the suspect pen for further detailed examination. These animals are slaughtered separately at the end of the day and a detailed post-mortem examination is conducted. Any animal suspected

of communicable disease is destroyed. All the animals found healthy are slaughtered for human consumption.

Slaughter Operations, Killing and Dressing

The next stage of operations is killing. These operations use an "on-the-rail system," in which all operations are done while the carcass is suspended from an overhead rail. The animal never leaves the rail during the operations.[1] The system has many advantages. The movement is progressive and continuous from the time the animals enter the plant until the carcasses leave. Each stage of operation is performed by a separate group of employees. The procedure permits better sanitary control because: (1) workers can be supervised more closely, (2) sanitary inspection can be carried out at one point more effectively with a smaller staff, (3) movement of workers from dirty to clean jobs and vice-versa is avoided, (4) each worker specializes in particular tasks and thus carries them out better, faster, and at a lower cost to the plant; a larger number of animals can be handled per man hour of labor as a result of the division of labor into specialized operations.

The sheep are driven into the shackling room of the main slaughtering hall, through the entrance just in front of the sheep

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[1] S. H. Logan and G. A. King, Economies of Scale in Beef Slaughter Plants, Giannini Foundation Research Report No. 260 (Berkely: University of California, December 1962), p. 24.

pen. The operations of the killing and dressing stage can be divided into the following steps:

1. Hoisting the animals by means of a shackle.
2. Sticking.
3. Scalping.
4. Legging.
5. Raising the forequarters.
6. Breaking the joints.
7. Facing or pelting.
8. Rumping.
9. Pulling the backs.
10. Washing the outside of the carcasses.
11. Splitting the breasts.
12. Removing the pluck and visceral organs and placing them in a compartment upon a moving top table for post-mortem examination. (The speed of the chain is synchronized with that of the moving conveyor carrying the carcass so that identification of the carcass from which the viscera comes is assured.
13. Examining the viscera and carcasses. (A suspected tag is put on those found questionable as to disease or sanitation, and further detailed examination is made later.)
14. Spreading the bellies.

15. Weighing the carcasses.
16. Washing the carcasses both outside and inside with high pressure sprays, with water temperature maintained at 116° F.
17. Removal of visceral organs to viscera room.
18. Stamping the carcasses and transferring them from the rails to the racks for moving into the chilling room.

Storage

Each rack holding ten carcasses is moved into the chilling room (maintained at 36° F.). They are held for about 4 to 5 hours. Then they are moved into the carcass holding room (36° F.) for storage overnight.

Sale and Distribution

The visceral organs after separation and cleaning are kept in the viscera chamber and are disposed of to a wholesaler for sale to the general public. These organs may be sold also to the Industrial Testing Laboratory Ltd., located in the city, for use in the manufacture of such drugs as insulin and liver extracts. The hides and skins are sold to tanneries on an annual contract basis.

The carcasses are transported the morning after slaughter to the retail meat shops situated in different parts of the city. The price of the carcass is to be based on the weight and quality of meat, and farmers are to be paid by the management

at the sales office for their animals on the basis of live grades and weights.

Management

Good management is essential for efficient operation of the slaughter house. Since it is a cooperative organization in which the shares are held by such diverse groups as the different Sheep Breeders Associations, the Government of Mysore, the Corporation of the City of Bangalore, and the general public, a competent and knowledgable manager is needed. The manager should have adequate experience in the field of administration of commercial enterprises and should be empowered to make decisions on all day-to-day administrative matters.

The profits of the organization are to be distributed in the following manner: First, interest on the loan granted by the National Cooperative Development Fund would be paid. Second, a certain amount would be paid toward the principal of the loan. Part of the earnings should be earmarked toward the depreciation fund needed for replacing equipment, and a certain amount is kept as reserve in the development fund to use in later expansion and improvement of the enterprise. Next, a portion is to be kept in a contingency fund to meet emergency situations in times of loss. The remaining amount would be distributed as dividends to the shareholders.

II. MODEL PLANT TO CARRY OUT THE ABOVE FUNCTIONS

To carry out the functions described above, the model plant should be set up according to specified requirements. The site of the

slaughter house should have a plentiful supply of water and accessability to rail and highway transportation. Also, the site should cause the least amount of inconvenience to the community and vice-versa.

To satisfy these conditions, the slaughter house should be located on the outskirts of the city, completely separated from buildings used for residences or for other industrial and commercial purposes. An area of three acres of land should be acquired for the plant site.

The sheep pen should have a floor space of 4,200 square feet, just sufficient to hold the animals for one day's kill. The pen should be divided into several smaller pens to facilitate separation of sorted animals. The entrance to the main slaughter hall and the exit gate of the sheep pen should be connected by a protected corridor with a concrete floor, so that the movement of the animals is uninterrupted by external forces. The main slaughter hall should measure 100 feet in length and 40 feet in width.[2] It should be adequate for handling 1,800 sheep per day.

The carcass chilling and the carcass holding rooms should be constructed so that little labor is needed to move the carcasses from the main slaughter hall. The carcass chilling room should be designed to hold 600 carcasses, and the carcass holding room should hold 1,200

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[2]Designed by Allbright-Nell Company, Manufacturers of Meat Packing Equipment, Chicago, Illinois. Plan No. LC-19734, June, 1963.

carcasses. Additional space is provided on the other side for additional buildings if needed in the future.

Definite consideration must be given in the design to sanitation. All floors should be constructed of durable concrete, with at least one floor drain for each 200 square feet area. The floor should be graded one-fourth inch per foot toward the nearest drainage to facilitate easy flow of water. The walls and ceilings of all rooms in which meat is handled should have lightly colored, washable, and smooth surfaces that are impervious to moisture. All doors must be self-closing and fly-proof. Toilet rooms for the employees and inspectors should be conveniently located and should not open on to the main slaughtering hall. To prevent contamination of equipment by possible back flow of sewage in case of drain stoppage, drainage from all equipment into which meat or utensils may be placed should be discharged through an air gap into an open sink or drain that is properly tapped or connected to a sewer. Since the handling and disposal of waste is the most important problem involved in plant sanitation, toilet sewer lines are kept separate from the plant drainage lines to a point outside the building.

The design for the proposed building is shown in Figures 1 and 2.

Equipment

The selection of each piece of equipment to be used in the proposed plant is based on specifications supplied by Allbright-Nell

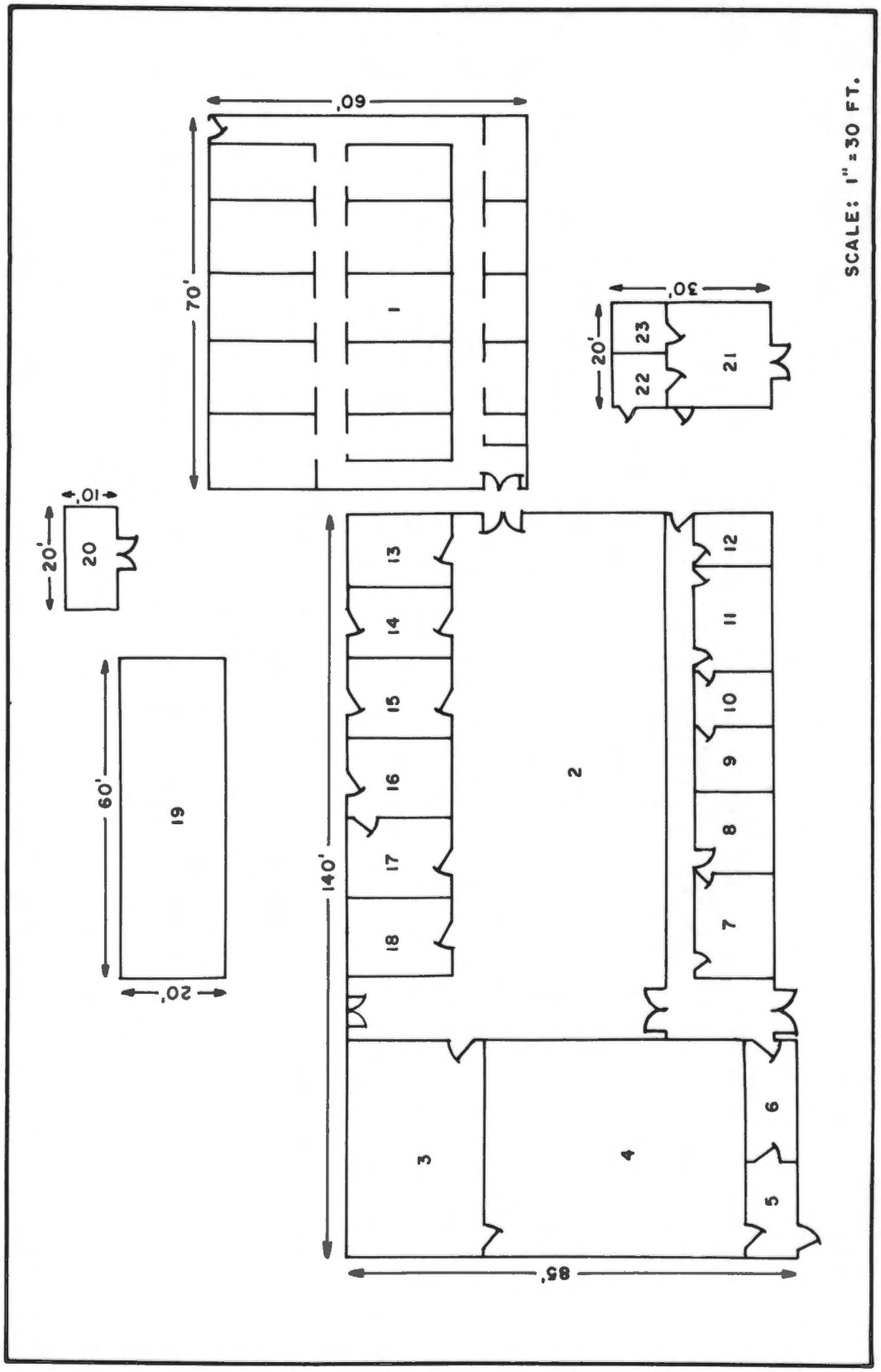

Figure 1. Floor plan of the model sheep slaughter house. (See Table XVII for legend.)

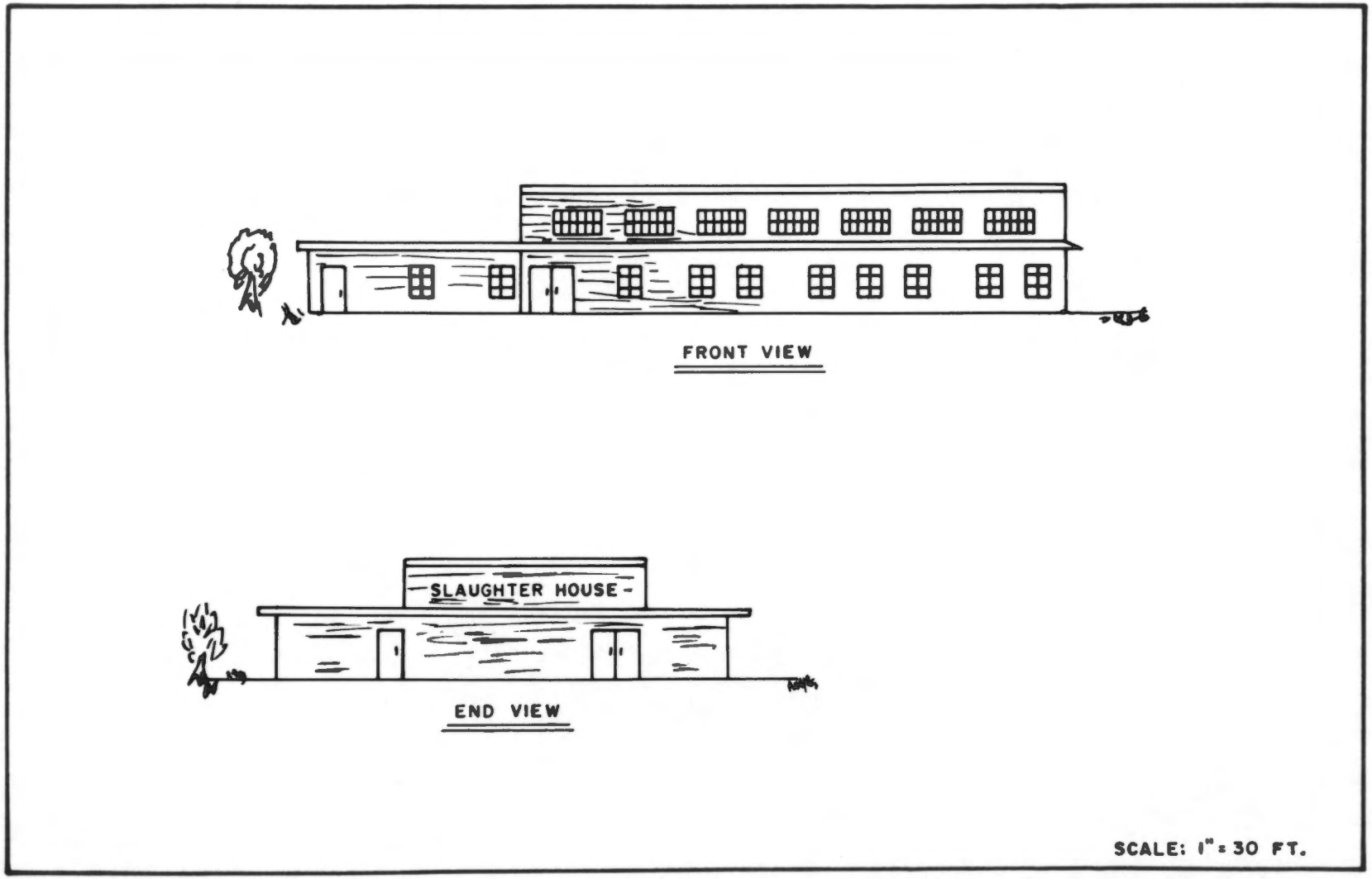

Figure 2. Front and end view of the model sheep slaughter house.

Company of Chicago, and Cincinnati Butcher's Supply Company and Schmidt Company of Cincinnati, Ohio. Emphasis was placed on having equipment large enough to allow for smooth and continuous movement of the carcasses through the plant. The main slaughtering equipment suggested allows a kill rate of 150 to 300 sheep per hour. Layout of equipment is shown in Figure 3. Refrigeration units required for the chilling room, carcass holding room, and viscera chamber, were designed on the basis of specifications furnished by Brink's Incorporated of Knoxville, Tennessee. Since the pluck and visceral organs are disposed of to a wholesaler at the slaughter house premises, no equipment would be necessary for their utilization. To supply steam under pressure for washing the carcasses, a 30 horsepower boiler (fueled with diesel oil) and 1.5 horsepower pump should be installed. [3]

To distribute the carcasses to the two large markets in the city--the Russel Market and Sri Krishna Rajendra Market--and to numerous retail meat shops located in various parts of the city, four small delivery trucks would be required. Each truck would carry 100 carcasses when fully loaded.

A borewell, together with a 20,000 gallons overhead tank, should be constructed. Costs of equipment F. O. B. India and installation charges are listed in Appendix Table XVI.

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[3] Recommended by Superior Combustion Industries, Inc., New York, New York.

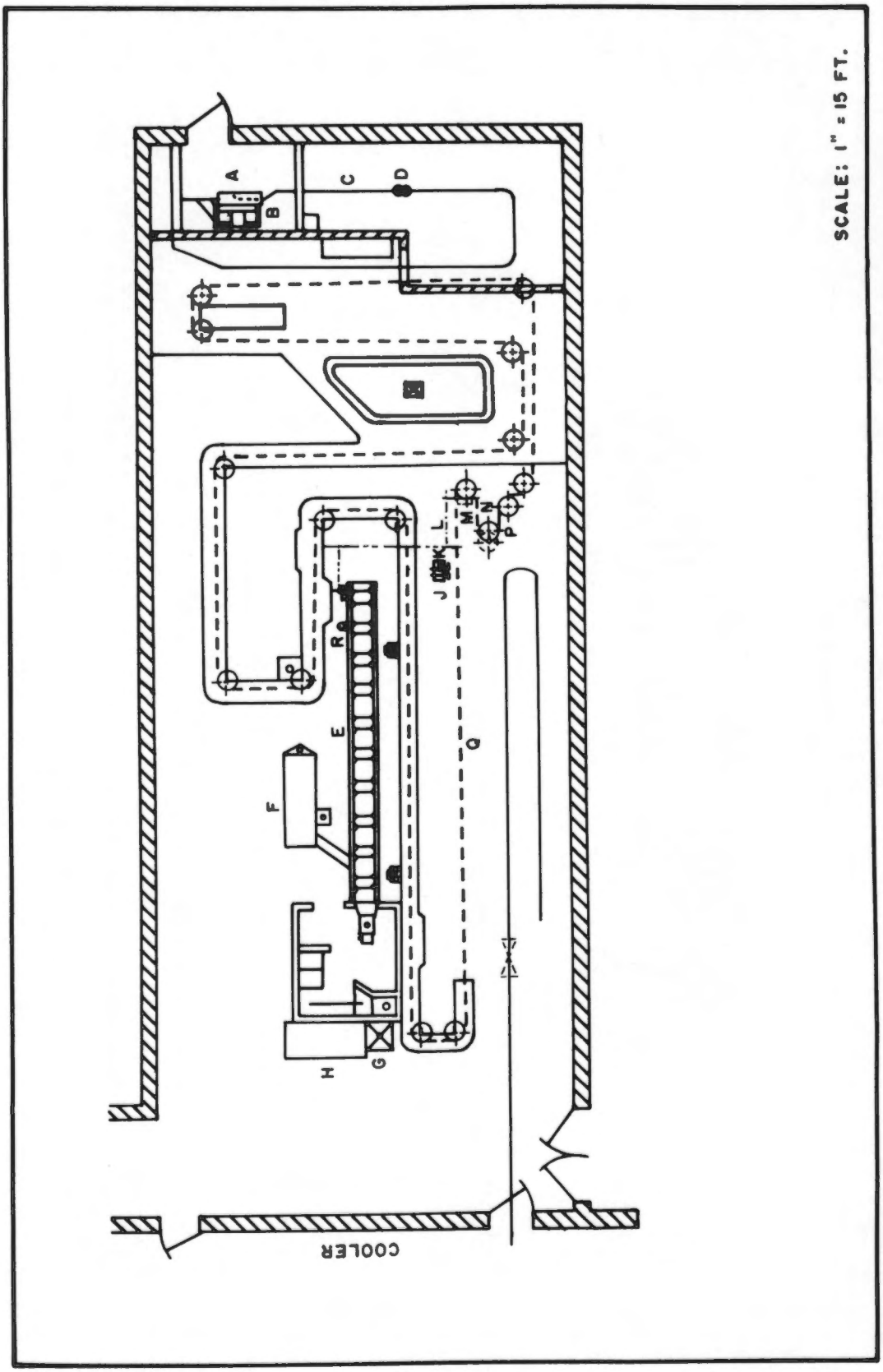

Figure 3. Layout of sheep slaughtering and dressing. (See Table XVIII for legend.)

CHAPTER III

FRAMEWORK FOR EVALUATION OF COST VARIATION

I. REVIEW OF LITERATURE

Marshall

Alfred Marshall, who represented the English school of thought, was interested in expounding the results of scientific inquiry in easily understandable terms. His formulation of the theories of value and distribution involved a technique based on the use of a time element which is derived from three connected aims: comprehensiveness, realism, and significance of economic policy. He illustrated for the first time that the forces of both demand and supply determine the price. He developed the idea of price-elasticity of demand to provide a method for comparing the responsiveness of a buyer to changes in the prices of the different commodities. He introduced the idea of consumer's surplus doctrine and defined it as "the difference between the amount a consumer actually paid for a given commodity and the amount he was willing to pay for it."[1]

Marshall's contribution to the problems of value and price determination rests in his analysis of equilibrium between supply and demand. He defined equilibrium as "a condition under which the total utility is maximized, as the one under which the consumer will so

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[1]Alfred Marshall, Principles of Economics (London and New York: The Macmillan Company, 1920), p. 10.

distribute his income or purchasing power that it will have the same marginal utility."[2]

Marshall considered the equilibrium conditions of a perfectly competetitive economy to represent conditions of relative economic efficiency on the assumption that the income must be above the subsistence level. The whole field of welfare economics, of which Professor Pigou is the author, is based on Marshall's consumer's surplus doctrine. Marshall said:

> In the long run there would be a tendency for the earnings of factors to equal their marginal real cost, interest would tend to be identical with the marginal sacrifice involved in saving, wages with the marginal disutility effort.[3]

Viner

Jacob Viner[4] developed a graphical exposition of the manner in which the suuply curves are dependent upon the possible types of technological and pecuniary cost situations under the usual assumptions of pure or perfect competitions. He indicated some of the defects of Marshall in labelling of cost curves and supply curves. He defined short-run as a period long enough to permit any desired change of output technologically possible without altering the scale of plant, but

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[2]Ibid., p. 11.

[3]Eric Roll, History of Economic Thought, Third Edition, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1953), p. 601.

[4]Jacob Viner, "Cost Curves and Supply Curves," A. E. A. Readings in Price Theory, Vol. vi. by George Stigler and Kenneth E. Boulding (Chicago: Richard D. Irwin, Inc., 1952), p. 198.

not long enough to permit any adjustment of the scale of plant. He stated that for short-run equilibrium the marginal cost curve must intercept the average cost curve at its minimum point, whereas in the case of long-run equilibrium, not only must marginal cost curve of output from existing plant equal the price for each individual firm, but it also must equal average cost. He graphically illustrated the behavior of cost curves for a firm and industry, due to the net internal and external economies of large-scale production. Finally, he illustrated graphically the familiar proposition that net internal economies of large-scale production and long-run stable equilibrium are inconsistent under competitive conditions.

Bressler

Bressler developed a budgeting or synthetic approach to the determination of plant costs under efficient operating conditions. In various publications, he showed empirically how the average cost decreases with increases in scale of operations under the most efficient conditions.[5] An appropriate theory was developed for providing workable research tools for measurement of efficiency in performing marketing services. His pioneering work in the synthetic method of measurement costs and efficiencies in the operation of milk plants is the basis of later research work on costs in other agricultural

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[5]R. G. Bressler, Jr., Economies of Scale in the Operation of Country Milk Plants with Special Reference to New England (Boston, 1962); R. G. Bressler, Jr., Efficiency in Fruit Marketing, Giannini Foundation of Agricultural Economics, Report No. 128 (Berkely: California Agricultural Experiment Station, June 1952).

processing plants.

Dean

Joel Dean outlined how economic analysis can produce from orthodox accounting records cost estimates that are relevant for managerial decisions. He discussed in detail the problems of empirical analysis for the major cost problems; cost-output relation, cost-size relation, and product costs in multiple product operations.[6]

He indicated how cost behavior can be analyzed in terms of a number of cost functions and how this partial analysis is a practical approach in empirical studies of cost measurement. He stated that such factors as rate of output, size of plant, prices of input factors, technology, and efficiency determine the behavior of costs. He showed the usefulness of statistical analysis in the estimation of cost functions. This approach uses multiple regression analysis to find a functional relation between changes in costs and such important cost determinants as output rate, lot size, and output fluctuations.[7]

The problem of measuring costs in the operations of any plant may be approached in a number of ways, depending upon the objectives of the study and the amount of data available. In the statistical approach, the input-output data for a particular plant are taken and subjected to a multiple regression analysis to determine the net effects

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[6]Joel Dean, Managerial Economics (New York: Prentice-Hall, Inc., 1951).

[7]Ibid.

of several input elements on output.[8]

In the synthetic approach, the total operations are divided into their elements, and are analyzed in simple terms. These relationships are then combined into a total complex function.

French, Sammet and Bressler made a comprehensive study of pear packing operations in California.[9] Their objective was to develop an appropriate theoretical framework for studies of plant cost and efficiency, using the synthetic approach.

They developed a long-run cost function from elemental input-output data. This function represented a least-cost organization of production with efficient management and labor performance. The study then applied these methods to an analysis of the major functions or stages of operation in pear packing houses, and finally, these stage relationships were synthesized into descriptions of short-run and long-run cost functions under efficient operating conditions.[10]

On the general lines outlined by Bressler and Viner, Logan and King made a detailed study to provide quantitative estimates of short-run and long-run average cost functions for beef slaughter plants in California.[11] They also indicated what type of technology will provide

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[8]R. G. Bressler, Jr., "Efficiency in the Production of Marketing Services," Economic Efficiency Series, Paper No. 6 (Chicago: University of Chicago, 1950), p. 69.

[9]French, Samett, and Bressler, loc. cit.

[10]Ibid.

[11]S. H. Logan and G. A. King, op. cit., p. 113.

a least-cost of operations for a certain level of output and how the level of costs vary with the size of the plant.

II. EMPIRICAL FRAMEWORK USED IN THE STUDY

In the operations of a slaughter house, the input-output ratios are a means of measuring efficiency of organization. Generally speaking, an efficient organization is one that can produce a greater output from any given combination of inputs, or, after appropriate price weights are introduced, uses a minimum cost combination of inputs.[12]

The slaughtering plant consists of a given set of buildings, equipment and layout, and the processes within this plant are composed of a number of stages in which the live animal is transformed into a more hygienic form of meat for human consumption. The process begins in the sheep slaughtering plant with the assembling of sheep in the sheep pen, and after several stages of operations, the live animal is transformed into a carcass, which is chilled and kept in the carcass cooler before sale to the retail meat shops.

The total costs of operating the sheep slaughter house during a given time period may be expressed either in terms of dollars per unit of carcasses during the period or the units of carcass sold during

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[12]Bressler, op. cit., p. 2.

the period. Stated algebraically:[13]

C a bx, where

C total cost,

a constant fixed cost,

x net sale of carcass (processed),

bx total variable cost or b unit variable costs.

By total costs, the economist means a money figure composed of the costs of all the inputs or services of the factors of production which are necessary to produce a given output.[14]

For the sheep slaughtering plant, the cost elements involved in daily operations may be grouped into two general categories: (1) those that are fixed regardless of the number of animals handled, (2) those that vary with changes in the number of animals handled.

Changes in the number of animals handled has considerable influence on variable and total cost functions and is important in determining optimum size of plant. As the present study involves one plant of given size, the only possible way of increasing the number of animals slaughtered per day is by altering the rate of kill per hour and/or the number of hours of operation. That is to say, the change in intensity is achieved either by utilizing nearer to the plant capacity per

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[13]Walter Rautenstrauch, Design of Manufacturing Enterprise; A Study in Applied Industrial Economics (New York and Chicago: Pitman Publishing Corporation, 1961), p. 10.

[14]H. H. Liebhafskey, The Nature of Price Theory (Chicago: The Dorsey Press Inc., 1963), p. 153.

per unit of time or by extending the operating time each day. The plant capacity may be considered either technically or economically.

> Technical capacity in this case refers to the maximum rate of output possible for the plant regardless of costs, and is bounded by the technical nature of the plant and equipment. The economic capacity indicates the least average cost point of operation.[15]

In the synthetic approach to estimating plant operating costs, the actual quantities of variable services used are computed and then multiplied by their per unit respective prices. While the synthetic approach to cost estimation is theoretically conceivable, the indivisible nature of some productive services renders such estimates for the short-run (as in the case of labor) too rigid for changing the number of animals handled. In addition, there is always a danger that in our synthesis we have used an incorrect framework as a basis for combining several elements or failed to include some costs. But the synthetic approach is the only possible one in many marketing problems. A strong advantage of the synthetic approach is that it can be applied in an industry where data are not adequate for statistical analysis or where it is not possible to find a sample of plants operating under comparable conditions at a given time.

In this study, the various costs associated in the operation of the slaughter house are broken up into several components, each corresponding to a stage of operations. When the calculation of these

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[15]Joel Dean, The Long Run Behavior of Costs in a Chain of Shoe Stores, A Statistical Analysis (Chicago: University of Chicago Press, 1942), p. 6.

costs associated with different stages of operations are completed, they provide a set of "building blocks" for estimating the cost function as a whole. The building blocks are the costs of the various operations performed on sheep in converting them into meat for human consumption. From analysis of these separate operations, an analysis of the complete process of production can be assembled. Then the problem of determining the short-run cost function for the model plant becomes one of finding the optimum combination of variable factors to be used to produce various levels of output.

In describing the most efficient organization, the first step is to determine the most efficient combination of inputs at each stage of operations. This is achieved when the marginal increments of product per dollar of factor expenditure are equal for all factors involved, or when the ratios of marginal productivities are equated to the ratio of prices.[16] One practical aspect that must be noted is that it may not be possible to equate the ratios of marginal productivities and factor prices at each stage of operation because of limits imposed by limited possibilities of input substitution. So, we have to define the most efficient rate of output as that where the average variable costs are a minimum. Then the constant fixed costs at each stage of operation are introduced into the function, and the total costs for a given period of time is calculated. Next, these different stages of operations, which are organized efficiently, are combined in such way that the entire

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[16] Bressler, op. cit., p. 28.

organization becomes most efficient. For a plant with given equipment and buildings, therefore, we can determine the hourly rate of output at which costs are lowest. This enables the management to determine the rate the animals should be killed to make the plant operate at maximum efficiency. In the present study, the output rate must depend on the demand rate for meat at Bangalore, but the possibility of supplying meat to the neighboring towns must also be considered if such possibilities exist.

CHAPTER IV

COST BUDGET FOR OVERHEAD ITEMS

I. INTRODUCTION

To set up the slaughtering plant, capital investments are required for land, buildings and equipment.

Land

Three acres of land would be needed at an estimated cost of $6,302.52 (Rs. 30,000).

Buildings

Investment outlays would be required for constructing the following buildings:

1. Sheep pen and sheep suspect pen for assembly of animals.
2. Main plant for slaughtering operations, storage, and offices.
3. Garages for motor trucks.
4. Cafeteria for employees and farmers bringing animals to market.
5. Miscellaneous items, such as borewell with overhead tank, drainage, and electrical fittings for all buildings.

It was not possible to estimate separate cost rates for each type of building needed for the different operations. Instead a uniform

construction cost rate (currently existing at Bangalore) was assumed for all buildings and was used to estimate the costs shown in Table III.

Equipment

The costs of the various items of equipment that would be required to perform the operations in the plant are shown in Table IV. Total equipment costs amount to $85,323.62, and include manufacturer's price, F. O. B. port of embarkation, shipping costs to Bombay, India, and the costs of installing the equipment at Bangalore. The total investment needed for the sheep slaughter house would amount to $163,579.92 (Rs. 778,640.43). The details of these data are shown in Table V.

II. ALLOCATION OF OVERHEAD COSTS

Four major cost categories are associated directly or indirectly with overhead expenses:

1. Depreciation on buildings and equipment.
2. Insurance on buildings and equipment.
3. Maintenance and repairs of both buildings and equipment.
4. Interest to be paid on the loan granted by the National Cooperative Development Fund and State Bank of India.

Once the plant is established, these costs are fixed for given accounting periods, and do not vary with output. In addition, the total wage bill for permanent staff of the slaughter house is fixed during a given accounting period, and can be varied only by adding or dropping personnel.

TABLE III

TOTAL COST OF BUILDINGS[a] OF SHEEP SLAUGHTER HOUSE AT BANGALORE, INDIA

Item	Cost in dollars	Cost in rupees[b]
Sheep pen and suspect pen	9,243.69	44,000.00
Main building	26,659.66	126,900.00
Garage	3,025.21	14,400.00
Cafeteria	1,512.60	7,200.00
Sewage drains	5,252.10	25,000.00
Miscellaneous, like plumbing and electrical connections	10,504.20	50,000.00
Borewell with overhead tank	15,756.30	75,000.00
Total	71,953.08	342,500.00

[a]Calculated on existing rates at Mysore State.

[b]$1.00 4.76 Rupees.

TABLE IV

TOTAL COST OF EQUIPMENT[a] FOR SHEEP SLAUGHTER HOUSE, BANGALORE, INDIA

Item	Cost in dollars	Cost in rupees
Equipment for assembling operation	221.57	1,054.67
Equipment for slaughtering operations	44,572.41	212,164.67
Equipment for storage	27,696.89	131,827.68
Trucks for distribution	11,885.70	56,579.93
Office supplies[b]	949.05	4,517.48
Total	85,323.62	406,140.43

[a]Includes initial cost of equipment, shipping charges of $10,693.50 and installation charges of $4,042.69 (Bangalore labor rates).

[b]To be purchased locally.

TABLE V

TOTAL INVESTMENT COSTS OF THE SHEEP SLAUGHTER HOUSE, BANGALORE, INDIA

Item	Cost in dollars	Cost in rupees
Land	6,302.52	30,000.00
Buildings	71,953.78	342,500.00
Equipment and office supplies	85,323.62	406,140.43
Total	163,579.92	778,640.43

Depreciation

In the course of time, renewable and tangible assets such as machinery and buildings undergo a loss in value attributable to three factors: obsolescence, deterioration as a function of time, and the wear and tear on the machinery as a function of use. To cover this loss in value from all three causes, an allowance for depreciation cost should be established. The rate selected is determined by the estimated life of the building or individual item of equipment. For buildings, an annual rate of 3 per cent of the original value is used to cover the depreciation, since the life of the building is estimated at 33 1/3 years.[1] The depreciation rate for individual equipment items varies according to estimated useful life. It is assumed that the machinery has no scrap value.

Fire Insurance

Property is always subject to damage or destruction by vagaries of nature that are beyond human control. The risk of loss from such causes should be shifted to insurance companies by paying an annual premium. The cost rates calculated here are based on local Knoxville insurance company rates (comparable data for the Bangalore area were not available in time for inclusion in this study). The annual rates used are $.20 per $100 value on

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[1] T. R. Owens and D. A. Clarke, Jr., Class III Milk in the New York Milk Shed, Part III, Costs of Manufacturing Dairy Products, (Washington: United States Department of Agriculture, May 1960), Marketing Research Report No. 400, p. 19.

buildings, and $.35 per $100 value in equipment.[2]

Maintenance and Repairs

Maintenance and repair costs for buildings and equipment depend on the type of operation performed, the intensity with which the equipment is used, and the quality of construction of buildings and equipment. Maintenance and repair costs are, therefore, composed of both fixed and variable components. Since a certain minimum amount of maintenance cost is incurred in keeping the machinery in good condition, this minimum would comprise the fixed component. As the slaughter house operates at varying rates during the year, it is difficult to estimate how much of the total expense results from deterioration over time and how much results from wear or use. Based on experience of American packing plant managers who were interviewed, an arbitrary annual cost allowance of 1 per cent on buildings and 5 per cent on equipment is used.

Interest

Since the model slaughter house is to be operated by a co-operative organization, any profit over and above the costs of operation would be shared by the members. Hence, no interest as such on the total investment made by the membership is calculated. However, interest must be paid on the amount loaned by the

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[2]Roy Burgess, "Cost Analysis of Whole-Hog Sausage Processing Plants" (Unpublished Master's Thesis, University of Tennessee, Knoxville, Tennessee, 1962), p. 23.

Cooperative National Development Fund and the State Bank of India to help in financing construction of buildings and equipment. An interest rate of 4 per cent per annum on this amount is included in the total overhead costs.

The various cost allowances for depreciation, maintenance and repairs, and insurance on buildings and equipment have been estimated separately for each stage of operation and are shown in Table VI. Annual overhead costs, excluding the interest on borrowed capital and the pay of permanent staff, would amount to $11,975.00 The annual total wages of permanent staff is estimated to be $13,462.20. This could be either increased or decreased only by the addition or reduction of the labor force or by changes in salary rates.

The equipment selected is such that the output per day can be changed by hiring more butchers or by operating for more hours during the day or by both.

The variation in overhead costs when the slaughter house is operated at different levels of output has been estimated. The levels of output calculated are for rates of:

1. 900 animals per day, 26 days in a month and 600 animals on four Sundays in a month (because of dietary customs little meat is purchased on Mondays), totalling 309,600 animals per annum (Note: This is a total of only 360 days operation per year, since animals are not slaughtered on five holy days during the year
2. 1,200 animals per day 26 days in a month and 900 animals

TABLE VI

OVERHEAD COSTS OF BUILDINGS AND EQUIPMENT

Item	Depreciation cost[a] in dollars	Maintenance and repair cost[b] in dollars	Cost of fire insurance[c] in dollars	Total cost in dollars
Buildings	2,031.46	1,016.03	143.90	3,191.39
Equipment				
Assembly	39.41	5.30	0.87	45.58
Slaughter operations	2,559.44	1,155.16	155.75	3,910.35
Storage	1,388.73	1,220.80	96.75	2,706.28
Distribution	1,485.70	520.00	41.65	2,047 35
Office supplies	63.30	7.50	3.25	74.05
Total cost in dollars	7,608.04	3,924.79	442.17	11,975.00

[a]Depreciation by straight line method at 3 per cent on buildings per annum and on the number of useful years of life of equipment.

[b]Maintenance and repair cost at 1 per cent per annum on buildings and 5 per cent per annum on the initial cost on equipment.

[c]Fire insurance at $0.20 per $100 value on building and $0.35 per $100 value on equipment.

per day on four Sundays in a month, totalling 417,600 animals per annum.

3. 1,500 animals per day 26 days in a month and 1,200 animals per day on four Sundays in a month, totalling 525,600 animals per annum. The overhead cost per carcass when the plant operates at different rates as outlined above are estimated and listed in Table VII.

The overhead costs associated with each stage of operations, such as assembly, slaughtering operation, storage, and distribution, shown in Table VIII, in combination with the various variable costs associated with each stage of operations, provide the basis for determining the most efficient rates of operations at each stage.

TABLE VII

VARIATION IN OVERHEAD COSTS AT VARIOUS LEVELS OF OUTPUT

Item	Total cost in dollars	Cost per carcass		
		At 900 animals per day[a] in dollars	At 1,200 animals per day[b] in dollars	At 1,500 animals per day[c] in dollars
Depreciation on buildings and equipment	7,608.04	0.024573	0.018218	0.014475
Maintenance and repairs on buildings and equipment	3,924.79	0.012677	0.009398	0.007467
Insurance on buildings and equipment	442.17	0.001428	0.001058	0.000841
Salaries of permanent staff	13,462.20	0.043482	0.032237	0.025613
Interest on loan granted by lending agencies	4,136.28	0.013360	0.0099	0.00787
Total in dollars	29,573.48	0.095520	0.07081	0.05626
Total in rupees	140,769.76	0.45467	0.3371	0.2678

[a] 309,600 animals per annum.

[b] 417,600 animals per annum.

[c] 525,600 animals per annum.

TABLE VIII

FIXED COSTS ASSOCIATED WITH THE DIFFERENT STAGES OF OPERATION

Item	Fixed cost in dollars	Fixed cost in rupees
Buildings	3,191.39	15,191.02
Office supplies	74.35	353.91
Interest on loan	4,136.28	19,688.69
Salaries of permanent staff	13,462.20	64,080.06
Fixed cost common to all stages of operation	20,864.22	99,313.68
Equipment		
Assembly	45.58	216.96
Killing and dressing	3,910.35	18,613.27
Storage	2,706.28	12,881.19
Distribution	2,047.35	9,745.39
TOTAL FIXED COST	29,573.78	140,770.49

CHAPTER V

COST VARIATIONS IN THE MODEL PLANT

I. VARIABLE COSTS

Some operating costs vary with numbers of animals handled. These include such items as wages of butchers, unskilled laborers, cost of electricity, deisel oil, and gasoline.

Labor

Wages paid to butchers are a major variable component of variable costs of slaughtering. No specific standards for labor inputs required for killing and dressing sheep have been used in this study. Instead, estimates made by the packing plant managers operating in various parts of the U. S. A. have been used. These estimates range from one-sixth to one-fifth man hour per animal slaughtered, depending on the amount of experience and specialization. The second figure (equivalent to five animals slaughtered per hour) is, however, more realistic for purposes of this study. Each laborer will work approximately seven hours per day after time for lunch and personal needs is subtracted. Also, one hour of the seven hours must be spent in cleaning floors and equipment and other items. Therefore, each butcher slaughters thirty sheep per day, and this is the labor input standard that is used in this study. And so, for an output of 900 carcasses per day, 30 butchers are needed; 40 butchers for 1,200 carcasses per day; and 50 for 1,500 carcasses per day.

Further, it is assumed that one additional laborer is needed to move carcasses on the overhead rails from the kill floor to the chill room, and that the same laborer moves these chilled carcasses from the chill room to the holding cooler.[1] The wage rates assumed for butchers and for common labor are $1.05 (Rs. 5) and $0.53 (Rs. 2.50) per day, respectively.

Electricity

Electricity is needed in the proposed packing house for power to drive the conveyor and to move viscera inspection tables, for refrigeration equipment, and for lighting the kill floor and the storage rooms. The costs of electricity are treated as variable because there will be a zero cost for electricity when the plant is not operating, and meat is not stored overnight.

Two motors of 3 horsepower each and one motor of 1.5 horsepower would be installed in the proposed model plant. They would consume 5.625 kilowatts per hour at peak operation. The 76.5 horsepower refrigeration unit would consume 57.4 kilowatts per hour at peak capacity.

The main killing floor should be lit with an intensity of 20 operating foot candles per square foot for general illumination, and

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[1]Donald R. Hammons and Jarvis E. Miller, Improving Methods and Facilities for Cattle Slaughtering Plants in the Southwest, (Washington, D. C.: U. S. Department of Agriculture in cooperation with Texas Agricultural Experiment Station, Marketing Research Report No. 436, Agricultural Marketing Service, 1961), p. 29.

have at least 50 operating foot candles per square foot at places where meat inspection is conducted.[2] For this purpose 44 lamps of 300 watts each should be installed in the main kill floor and 30 lamps of 300 watts each in the three storage rooms. Generally, no artificial illumination is required during daylight hours in other rooms since they are well supplied with natural light.

Total electricity consumed for lighting would be 22.2 kilowatts per hour at peak operation. In the absence of local rates for Bangalore, electricity costs are calculated on the basis of rates charged by the Knoxville Utilities Board whose rates are close to those prevailing in Bangalore. Rates charged to customers who demand at least 50 kilowatts are as follows:

Demand charge: $1.00 per month per kilowatt for peak consumption.

Energy charge: 0.8¢ per kilowatt hour for the first 15,000 kilowatt hours per month, and 0.6¢ for the next 25,000 kilowatt hours.

The estimated demand charge per month is $91.04, and the electricity charges for different stages of operation at different rates of kill per month are shown in Table IX.

Water

Water is required to clean equipment and floors and by personnel to wash up. Water heated to 116° F. is required for washing the carcasses and also for use of personnel. Twelve gallons of hot water are

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[2] U. S. Inspected Meat Packing Plants, op. cit., p. 6.

TABLE IX

VARIABLE COSTS PER MONTH AT DIFFERENT LEVELS OF OUTPUT

Stage of operation	Cost per month in dollars		
	900 animals (weekdays) 600 animals (Sundays)	1,200 animals (weekdays) 900 animals (Sundays)	1,500 animals (weekdays) 1,200 animals (Sundays)
Assembly			
Labor	31.50	31.50	47.25
Additional veterinary inspector	--	--	63.02
Subtotal	31.50	31.50	110.27
Killing and dressing			
Labor	903.36	1,218.48	1,596.61
Diesel oil	740.78	984.37	1,344.53
Electricity	58.00	58.00	58.00
Subtotal	1,702.14	2,260.85	2,999.14
Storage			
Labor	15.75	15.75	15.75
Electricity	256.82	277.48	320.47
Subtotal	272.57	293.23	336.22
Distribution			
Labor	31.50	31.50	47.25
Gasoline	323.53	355.88	451.41
Subtotal	355.03	387.38	451.66
Total variable cost in dollars	2,361.24	2,972.96	3,897.29
Total variable cost in rupees	11,239.50	14,151.29	18,551.10

needed to wash each carcass, and each butcher and veterinary inspector requires 5 gallons daily for washing.[3] When the plant is operated at 900 carcasses per day on week days and 600 carcasses on Sundays, the hot water requirements would be 316,050 gallons per month.

Diesel Oil

Hot water in the proposed plant is to be supplied by a 30 horse-power boiler fueled by diesel oil. The boiler equipment company estimates that approximately 9 gallons of diesel oil are needed to heat 2,400 gallons of water to the required temperature. Diesel oil costs $0.673 (Rs. 3.20) at Bangalore. Total cost for diesel oil per month, when the plant operates at 900 animals per day on week days and 600 per day on Sundays, would be $740.78 (Rs. 3526.08).

Gasoline

Four small gasoline powered trucks would distribute the chilled carcasses to the two large markets and 52 retail meat shops located in different parts of the city. The estimated total distance travelled daily by each of the four trucks are approximately 200, 225, and 250 miles at the three rates of week day output--900, 1,200, and 1,500 per day, respectively. Gasoline costs per month would be $323.53, $355.88 and $404.41 at the three rates of output, respectively.

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[3]Estimated based on S. H. Logan and G. A. King, op. cit., p. 69.

II. VARIABLE COSTS AT EACH STAGE OF OPERATION

Assembly

The only variable cost item in this stage of operations is the wages of unskilled laborers to assist the veterinary inspectors and the yard men. Two unskilled laborers would be needed when the plant operated at 900 and 1,200 animals per weekday. Three unskilled laborers and one additional veterinary inspector would be needed for this stage alone when the plant operated at 1,500 animals per weekday.

Slaughtering operations

The variable costs incurred at this stage of operation are for wages of butchers, electric power for motors and lighting, and diesel oil to heat water. One additional veterinary inspector would be needed for this stage also when the plant operated at 1,500 animals per day, bringing the total number of veterinary inspectors to three.

Storage

Variable costs at this stage of operation would be incurred for electricity to operate the refrigeration equipment and lighting, and the wages of one unskilled laborer.

Distribution

Variable costs at this stage of operation would be for gasoline to run the trucks, and the wages of two unskilled laborers needed to load the carcasses on to the trucks daily.

III. COST FUNCTIONS FOR VARIABLE ITEMS AS AFFECTED BY VARIATIONS IN OUTPUT RATE

The monthly variable costs flows associated with each stage of operations at different rates of daily output are shown in Table IX. The variable costs per carcass at three corresponding rates of output--900, 1,200, and 1,500 carcasses per weekday are given in Table X.

IV. TOTAL COST FUNCTIONS

Total costs of operating the proposed slaughter house at varying rates of output can be determined by combining the variable costs incurred at each stage of operation with cost allowances for associated fixed inputs (Table VIII) at the same stage of operation, and the fixed cost considered common to all the stages of operation. The common fixed cost allowances per carcass, when the plant operates at 900 animals, 1,200 animals, and 1,500 animals per day are \$0.06739 (Rs. 0.32077), \$0.04996 (Rs. 0.23782), and \$0.039695 (Rs. 0.188949), respectively, and are shown in Table XI.

Total costs are analyzed according to the following formula:

$Y \quad a \quad (a_1 b_1 x) \quad (a_2 b_2 x) \quad (a_3 b_3 x) \quad (a_4 b_4 x)$

Y cost per carcass

a common fixed cost per carcass

a_1, a_2, a_3, and a_4 the fixed cost per carcass at each of the four stages of operations.

b_1, b_2, b_3, and b_4 the variable costs per carcass at each of the four stages of operations.

TABLE X

VARIABLE COST PER CARCASS AT DIFFERENT LEVELS OF OUTPUT

Stage of operation	Cost per unit carcass in dollars		
	900 animals (weekdays) 600 animals (Sundays)	1,200 animals (weekdays) 900 animals (Sundays)	1,500 animals (weekdays) 1,200 animals (Sundays)
Assembly	.001216	.000905	.002518
Killing and dressing	.065974	.064967	.068474
Storage	.010564	.008426	.007676
Distribution	.013761	.011132	.010312
Cost per unit carcass in dollars	.091515	.085430	.088980
Cost per unit carcass in rupees	.435611	.406646	.423545

TABLE XI

THE COMMON FIXED COST PER UNIT CARCASS AT DIFFERENT LEVELS OF OUTPUT

Item	Common fixed cost in		Cost per carcass in dollars		
	Dollars	Rupees	900 animals per day	1,200 animals per day	1,500 animals per day
Building	3,191.39	15,191.02	0.010308	0.007642	0.006072
Office supplies	74.35	353.91	0.000240	0.000178	0.000141
Interest on loan	4,136.28	19,688.69	0.013360	0.009905	0.007869
Salaries of permanent staff	13,462.20	64,080.72	0.043482	0.032237	0.025613
Total common fixed cost in dollars	20,864.22	--	0.067390	0.049962	0.039695
Total common fixed cost in rupees	--	99,313.68	0.320776	0.237819	0.188948

x number of carcasses handled per time period.

The total annual costs of operation of the slaughter house at three specified rates--309,600 animals, 417,600 animals, and 525,600 animals--are detailed in Tables XII, XIII, and XIV. The corresponding total costs per carcass--when the slaughter house operates at 900 animals per day (weekdays) and 600 animals on Sundays, 1,200 animals per day (weekdays) and 900 animals on Sundays, and 1,500 animals per day (weekdays) and 1,200 animals on Sundays--are given in Table XV. The total cost per carcass would be $0.187 (Rs. 0.89), $0.156 (Rs. 0.7437) and $0.116 (Rs. 0.535) if the slaughter house were operated at the above three rates of 309,600, 417,600, and 525,600 animals per annum, respectively. There is some slight increase in the unit variable costs if the slaughter house were operated at a rate of 1,500 animals killed per day. This is because two additional veterinary inspectors would be needed for the slaughter house when more than 200 sheep are killed per hour, that is, one additional veterinary inspector at the assembly stage and one additional veterinary inspector at the killing and dressing stage of operations. This indicates that the costs could be reduced further if the plant is operated at a kill rate of 300 sheep per hour, which is its designed peak capacity. The labor costs per carcass is low because of the relatively lower wages of laborers in Bangalore, compared to the relatively higher wages in the United States of America.

TABLE XII

TOTAL COSTS OF OPERATION PER ANNUM AND COST PER CARCASS AT 900 ANIMALS (WEEKDAYS) AND 600 ANIMALS (SUNDAYS)

Item	Total cost per annum		Cost per carcass	
	In dollars	In rupees	In dollars	In rupees
Common fixed cost	20,864.22	99,313.68	.067390	.320776
Assembly				
Fixed cost	45.58	216.96	.000147	.000699
Variable cost	378.00	1,799.28	.001216	.005788
Killing & Dressing				
Fixed cost	3,910.35	18,613.27	.012650	.060119
Variable cost	20,425.68	97,226.24	.065974	.314036
Storage				
Fixed cost	2,706.28	12,881.19	.008741	.041607
Variable cost	3,270.84	15,569.20	.010564	.050286
Distribution				
Fixed cost	2,047.35	9,745.39	.006613	.031477
Variable cost	4,260.36	20,279.31	.013761	.065502
Total cost	57,908.66	275,645.22	.187056	.89029

TABLE XIII

TOTAL COSTS OF OPERATION PER ANNUM AND COST PER CARCASS AT 1,200 ANIMALS PER DAY (WEEKDAYS) AND 900 ANIMALS (SUNDAYS)

Item	Total cost per annum		Cost per carcass	
	In dollars	In rupees	In dollars	In rupees
Common fixed cost	20,864.22	99,313.68	.049962	.237819
Assembly				
Fixed cost	45.58	216.96	.000109	.000519
Variable cost	378.00	1,799.28	.000905	.004308
Killing & Dressing				
Fixed cost	3,910.35	18,613.27	.009364	.044573
Variable cost	27,130.20	129,139.75	.064967	.309243
Storage				
Fixed cost	2,706.28	12,881.19	.006480	.030845
Variable cost	3,518.76	16,749.30	.008426	.040108
Distribution				
Fixed cost	2,047.35	9,745.39	.004903	.023338
Variable cost	4,648.56	22,127.14	.011132	.052988
Total cost	65,249.30	310,585.96	.156248	.743741

TABLE XIV

TOTAL COSTS OF OPERATION PER ANNUM AND COST PER CARCASS AT 1,500 ANIMALS PER DAY (WEEKDAYS) AND 1,200 ANIMALS (SUNDAYS)

Item	Total cost per annum		Cost per carcass	
	In dollars	In rupees	In dollars	In rupees
Common fixed cost	20,864.22	99,313.68	.006072	.028902
Assembly				
Fixed cost	45.58	216.96	.000087	.0006137
Variable cost	1,323.24	6,298.62	.002518	.011986
Killing & Dressing				
Fixed cost	3,910.35	18,613.27	.007439	.035409
Variable cost	35,989.68	171,310.87	.068474	.325936
Storage				
Fixed cost	2,706.28	12,881.19	.005149	.024509
Variable cost	4,034.64	19,204.89	.007676	.036538
Distribution				
Fixed cost	2,047.35	9,745.39	.003895	.018540
Variable cost	5,419.92	25,798.82	.010312	.049085
Total cost	76,341.26	363,384.39	.111622	.535032

TABLE XV

TOTAL COST PER CARCASS

Number of animals	Cost per carcass	
	Dollars	Rupees
900 animals per day (weekday) 600 animals per day (Sunday)	0.187056	0.89029
1,200 animals per day (weekday) 900 animals per day (Sunday)	0.156428	0.743741
1,500 animals per day (weekday) 1,200 animals per day (Sunday)	0.111622	0.535022

V. METHODS OF VARYING RATE OF OUTPUT

To alter the rate of plant output, it is necessary to (a) alter the number of butchers working a seven-hour shift and/or (b) increase the number of hours that one or more butchers work beyond the normal seven-hour shift. It is not possible, under existing local conditions, to hire any laborer on hourly basis. Hence, a full day's wages must be paid to any worker, working seven hours or any part thereof. But when the same laborers who are employed on daily basis perform overtime work, they are paid one and one-half times the usual wage rate. If the plant were operated so that 150 sheep would be killed per hour, 30 butchers would be needed, and the estimated number of animals slaughtered per weekday would be 900 animals. In order to increase output to 1,200 animals per weekday, the 30 butchers would have to work two additional hours per day. The daily cost of the overtime labor from the 30 butchers for the additional two hours would be $11.80 (Rs. 56.17). However, if the increase in output is accomplished by employing 40 butchers who can slaughter 200 sheep per hour, the additional labor cost would be only $10.50 (Rs. 50.00) per operating day. In addition, the efficiency of the overtime labor may be lower than that of workers who are on a normal seven-hour shift.

The added cost of electricity for operating the motors for two additional hours a day would be 8.1 cents. According to the Knoxville Utilities Board, the additional amount of current required for operation of motors at higher speeds to accommodate higher

rates of kill is negligible. Since this model plant is designed to operate most efficiently at a kill rate of 300 sheep per hour, this is the rate at which the plant should be operated if there is sufficient demand for meat in Bangalore.

CHAPTER VI

ESTABLISHING AND OPERATING THE COOPERATIVE SLAUGHTER HOUSE

I. INSTITUTIONAL SETTING

In many situations, cooperative economic organization has been selected as the best means to improve the living standards of the teeming millions of India. Cooperative ownership and operation have been given an important role in the "Five Year Plans" of the nation, and encouragement of these activities has become an objective of national policy.

At present, livestock marketing functions such as assembly of animals, processing, storage, transportation, and merchandising are performed by large numbers of individual middlemen, who take relatively large margins for their services. If these marketing activities were to be carried out more efficiently by cooperative marketing associations, the price spread between the primary producer and the consumer might be reduced. This could facilitate better returns to the livestock producer and lower prices for the consumer, depending on the division of the gains from any increases in efficiency.

The operation of processing and marketing cooperatives indicates to the farmer those practices which can increase the economic value of their products.

> No influence is so important in the economic education of the farmers as their own efforts in cooperative marketing. The very attempt on the part of the farmers to solve their problems teaches basic economic truth.[1]

In order to encourage the establishment of processing cooperatives which may require heavy capital investments for buildings and equipment, the National Cooperative Development Fund was established in 1956, on the recommendations of the Reserve Bank of India. The object of the fund is to provide assistance to state governments in financing the establishment of processing cooperatives. In addition, the State Bank of India was reorganized to provide finances for cooperative marketing and processing societies. Also, the Central Cooperative Sheep Breeder's Association of Bangalore is eligible for loans from the Industrial Finance Corporation.

The two slaughter houses now located in the midst of residential and business locality could be dismantled easily and the area sold by auction for residential site. This would bring in a fairly large amount of capital, which the City Corporation could turn over to the proposed cooperative slaughter house for use in purchasing land.

II. RAISING THE CAPITAL

According to the provisional estimate given above, the total capital investment required for buildings and equipment would be $163,579.92 (Rs. 778,640.43), and with an operating expense per

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[1]S. S. Puri, Cooperative Marketing, Kuyukshetra (New Delhi: Ministry of Community Development and Cooperation, Government of India, 1961), p. 303.

month of $2,828.05 (Rs. 13,461.52), the total amount required to establish the cooperative sheep slaughter house and get it in operation the first month amounts to nearly $166.407.97 (Rs. 792,101.94). It is assumed that at least 5,000 sheep breeders who are now members of the various sheep breeders' associations functioning in Mysore State would become members by purchasing one share at $2.10 (Rs. 10.00), thus contributing $10,500.00 (Rs. 50,000.00) to the fund needed for capital investment. The consuming public of the City of Bangalore would be expected to contribute another $10,500.00 (Rs. 50,000.00). The State Government and the Corporation of the City of Bangalore would each be expected to purchase 10,000 shares, thus contributing $42,000.00 (Rs. 200,000.00). The remaining amount of $103,407.94 (Rs. 492,221.94) would be borrowed from the National Cooperative Development Fund, and the State Bank of India at an annual interest of 4 per cent, repayable in 20 years.

III. MAINTAINING REGULAR SUPPLY OF ANIMALS

To assure regular supply of animals to the slaughter house, a cooperative stockyard should be set up in the immediate vicinity of the slaughter house. The livestock market would be operated as a terminal market--as a "livestock hotel" owned by the State Cooperative Sheep Breeders' Association. The organization would own all buildings and land on which the market is to be located. In this terminal market the organization would provide the facilities

for yarding, feeding, watering, and weighing the sheep and goats that come in and go out of the market daily. The cooperative market would make a nominal charge to owners of animals for the use of these facilities. The farmers could sell their sheep and goats personally if they desired, or they could employ professional commission agents for that purpose.

IV. DISTRIBUTION OF NET SAVINGS

The net returns derived from the operations of the slaughter house would be distributed among the shareholders, after making payments to cover the following:

1. Interest due on the loans received from the National Cooperative Development Fund, the State Bank of India, and other lending institutions.
2. Retirement of regular portions of the principal of the loans.
3. Depreciation fund needed for replacing equipment.
4. Development fund to use for future expansion and improvement of the enterprise.
5. Contingency fund to meet emergency situations in times of loss.

V. MANAGEMENT AND CONTROL

If a cooperative that is organized to perform economic functions as a business organization is to make any significant

contributions toward increasing profitability, it must be built and operate upon sound business principles. No matter how good the market prospects, how good the financial structure and how outstanding the engineering setup, every organization will fail or succeed on the strength of management. The ability to obtain good management to operate the cooperative sheep slaughter house is the most important factor in the success of a venture. In the beginning it would be advisable to appoint a senior official of the cooperative department, who had experience in organizing some small-scale industries in the state, as the general manager. The state government which would be financing the organization through the funds of the National Cooperative Development Fund should nominate to the board of directors persons who have real interest in cooperatives and who are familiar with the problems of farmers. The board of directors must establish the general policies and objectives of the organization. The manager must be given the full authority to run the plant, in line with the broad policies laid down by the board.

CHAPTER VII

SUMMARY

This study was concerned with estimating the cost of establishing a model cooperative sheep slaughter house at Bangalore, on the general lines of existing packing houses in the United States and specifically analyzing the various costs associated with the several stages of operations in killing and dressing of sheep. The procedure used to estimate these cost functions was one of synthesis; that is, estimating the physical input requirements and the costs of the inputs involved in killing and dressing operations, and then combining them as "building blocks" in estimating costs for the model plant.

Under the present conditions, livestock marketing functions such as assembly of animals, killing and dressing, sale and distribution are conducted by a large number of individuals who take relatively large margins. It is hoped that the establishment of a cooperative sheep breeders' association which would carry out all the above functions would benefit farmers by giving them higher prices for their animals, and the consumers by making better meat available at reasonable prices. The various measures outlined for raising the capital for the cooperative sheep slaughter house are assumed to be feasible in view of the policy of the government towards financing of processing cooperatives.

Buildings and equipment layouts for the model plant have

been designed to meet the requirements for federally inspected plants in the United States. Equipment suggested in the model plant has been designed to accommodate maximum kill rate of 300 sheep per hour. This anticipates an increase in the area demand for meat, since current projections indicates a gradual increase in the population of the city of Bangalore, as well as an increase in per capita income, which would result in an increase in the effective demand for meat in years to come.

To maintain a regular supply of sheep and goats to the slaughter house, which is essential if the slaughter house is to operate efficiently, the establishment of a cooperative stockyard in the vicinity of the slaughter house has been recommended.

The study indicates that the cost per carcass would be reduced as the output is increased from 900 animals per day to 1,500 animals per day. There is a slight increase in the unit variable cost when the plant operated at 1,500 animals per day as compared with 1,200 animals per day, because two additional veterinary inspectors would be required. This shows that if the plant is operated at 1,800 animals per day, the cost per carcass could be further reduced, which could allow a reduction in the retail price of meat.

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APPENDIX

APPENDIX

TABLE XVI

EQUIPMENT, ANNUAL DEPRECIATION ON EQUIPMENT FOR THE MODEL PLANT

Equipment	No.	Total cost in dollars	Expected life in years	Depreciation in dollars
Assembly:				
Platform scale	1	121.57	20	6.08
Water troughs	20	100.00	3	33.33
Killing & Dressing				
Sheep hoist including 3 h.p., 1,200 r.p.m. motor wired for 220/440 volt, 3 phase, 60 cycle current	1	3,117.70	25	124.71
Sticking rail attachment	1	132.49	25	5.30
Bleeding rail and hangers	1	129.70	25	5.19
Blood and water drain	1	83.84	25	3.35
Sheep dressing conveyor	1	12,727.80	25	509.11
Viscera inspection table	1	9,792.53	25	391.70
Variable speed conveyor to drive sheep dressing conveyor and viscera inspection table	1	2,474.45	20	123.72
Stationary viscera separating table	1	1,101.85	20	55.09

TABLE XVI (continued)

Equipment	No.	Total cost in dollars	Expected life in years	Depreciation in dollars
Sheep head work up table	1	614.68	20	30.73
Sheep head flushing cabinet	1	317.69	20	15.88
Platforms	2	786.40	20	39.32
Lot of railing and hangers	1	45.58	20	2.28
Stainless steel sterilizing lavatories	5	1,125.74	25	45.03
Tracking and hangers for conveying sheep from dressing floor to cooler	1 Lot	91.96	20	4.59
Overhead track scale	1	499.73	20	24.99
Sheep shackles with roller bearings	100	1,837.99	20	91.90
Sheep spreaders with trolleys	16	162.24	20	8.11
Offal trucks	2	257.64	12	21.50
Waterproof aprons	40	148.20	1	148.20
Knee-length rubber boots	40	167.16	2	83.50
Safety helmets	40	225.72	5	45.15
Skinning knives	40	84.36	1	84.36
Boning knives	40	109.72	1	109.72
Knife steel	40	91.20	1	91.20
Water hose (180 feet)	1	133.36	1	133.36

TABLE XVI (continued)

Equipment	No.	Total cost in dollars	Expected life in years	Depreciation in dollars
Water hose nozzle	2	6.84	20	0.34
Boiler, 30 h.p. tank with 1.5 h.p., 220 volts, 1,750 r.p.m. pump	1	7,220.26	25	288.81
Lockers	33	997.34	15	66.49
Sanitary cans	4	46.28	12	3.86
Floor brushes	24	41.95	1	41.95
Storage:				
Vilter VMC ammonia compressor with accessory equipment, 76.5 h.p. capacity	1	20,864.31	20	1,043.21
Offal pan trucks and rack	1	119.58	12	9.97
Sheep logs	160	6,711.00	20	335.55
Distribution:				
Trucks	4	11,885.70	7	1,485.70
Miscellaneous:				
Office supplies	-	949.05	15	63.30
Total cost in dollars		85,323.62		5,576.58
Total cost in rupees		406,140.43		26,544.52

TABLE XVII

LEGEND FOR FIGURE 1

Ref. No.	Particulars	Size
1.	Main plant	100' x 40'
2.	Carcass chilling room	40' x 25'
3.	Carcass holding chamber	40' x 50'
4.	Sales office	17'6" x 10'
5.	Office	22'6" x 10'
6.	Employees' dressing room	20' x 15'
7.	Employees' toilet	15' x 15'
8.	Inspector's locker	12' x 15'
9.	Toilet room	10' x 15'
10.	Inspector's office	20' x 15'
11.	Laboratory	10' x 15'
12.	Store	14' x 20'
13.	Hides store	13' x 20'
14.	Condemned organs	15' x 20'
15.	Viscera cooling chambers	15' x 20'
16.	Viscera cleaning room	15' x 20'
17.	Machinery and boiler room	15' x 20'
18.	Garages	60' x 20'
19.	Suspect animal pen	20' x 10'
20.	Sheep pen	70' x 60'
21.	Cafeteria	20' x 20'
22.	Kitchen	10' x 10'
23.	Wash room	10' x 10'

TABLE XVIII

LEGEND FOR FIGURE 3

Ref. No.	Particulars
A	Vertical sheep hoist
B	Sticking rail attachment
C	Sheep bleeding rail
D	Blood and water floor drain
E	Sheep viscera inspection table
F	Viscera separating table
G	Head flushing cabinet
H	Sheep head work table
J	Conveyor drive
K	Roller chain
L	Countershaft
M	Drive
N	Take-up
P	Idler
Q	Sheep dressing conveyor
R	Overhead viscera inspection table drive