ECONOMIES OF SCALE IN TURKEY HATCHERIES

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PREFACE

The U.S. Department of Agriculture began a comprehensive study of the hatchery industry in 1959, the first in over 20 years. A number of bulletins have resulted from this study. The first report, based on a nationwide survey, describes the industry and points out some of the problems confronting hatchery managers. (Cited, p.1 .) The second report, based on a survey of North Carolina broiler hatcheries, describes the economies, costs, and efficiencies of various size hatcheries. The third report, based on a study of New England broiler producing and marketing firms, describes the economies of scale in hatching and cost of distributing broiler chicks. This report, based upon a survey of turkey hatcheries in nine major turkey-producing States, describes the in-hatchery costs of a sample of turkey hatcheries in 1962 and the effects of economies of scale on the in-hatchery operation of efficient model hatcheries.

The author wishes to thank Earl H. Rinear for his assistance in getting the data and developing the initial stages of analysis. Also without the fine cooperation and contribution of information and data by the turkey hatcheries, the equipment manufacturers, and supply companies, the report could not have been written.

This study is part of a broad research program conducted by the Economic Research Service to reduce the cost of marketing poultry and eggs.

A supplement has been prepared which contains additional data on the six model turkey hatcheries described in this report, including the description of the 11 basic tasks performed in the hatcheries, floor plans for the six model hatcheries, detailed tables of supplies, equipment and operating costs, and a bibliography. The supplement is available on request from the Marketing Economics Division, Economic Research Service, U.S. Department of Agriculture.

CONTENTS

	Page
Summary	iii
Background and Objective	1
Procedure	1
Costs and Efficiency in Actual Hatcheries	2
Costs by size group	3
Costs of least-cost hatchery per group	4
Utilization of capacity	6
Utilization of labor	9
Schedule of hatchery operations	12
Maintenance	13
Economies of Scale in Model Turkey Hatcheries	17
Hatchery size and use of capacity	17
Fixed costs	18
Equipment costs	18
Building costs	21
Miscellaneous costs	23
Variable costs	23
Labor costs	23
Managerial costs	27
Cost of supplies	29
Costs of utilities	29
Summary of costs	29
Annual operation	29
34-week operation	31
Effects of pulling infertile eggs 8 to 9 days after set	33
Labor requirements	33
Schedule of hatchery operations	35
Increase in capacity	35
Changes in cost components	38

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SUMMARY

Many factors affect the cost of hatching turkey poults. The major ones are labor and managerial efficiency, utilization of capacity, size of operations, hatchability of the eggs, distribution of fixed and utility costs over other agricultural enterprises, age and condition of hatchery building and equipment, depreciation allowances, wage rates, and discounts on purchases of supplies and services.

The weighted average in-plant cost for the 15 turkey hatcheries analyzed in this study during 1962, was 7.57 cents per poult hatched, with costs ranging from 6.04 to 16.12 cents. In six model turkey hatcheries synthesized in this study, where the most efficient work methods and equipment were utilized, the cost per poult ranged from 2.39 to 9.14 cents depending on the size and capacity utilized.

Wages and salaries of all in-plant labor in the hatcheries studied represented over 40 percent of the cost of each poult hatched. In the group of smallest hatcheries, those that hatched less than 100,000 poults per season, labor represented about 80 percent of total costs and was nearly twice the labor cost per poult hatched by the group of largest hatcheries, those that hatched 1 million or more poults per season. The labor costs and total costs per poult were reduced in the more progressive hatcheries by use of egg-traying machines, tray washers, and efficient scheduling of work crews.

As the size of turkey hatcheries increased, the cost of labor per poult decreased and that of fixed overhead increased. The medium-size and large hatcheries utilized more laborsaving equipment than their smaller competitors. The larger firms were also able to obtain discounts on purchases of supplies and services when they operated the greater part of the year.

Almost 84 percent of the hatcheries surveyed operated at less than 50 percent of their potential annual capacity. The range in use of annual capacity was from 3.3 to 88.0 percent. Twenty of the 27 hatcheries surveyed operated their hatcheries less than 9 months a year. The main operating months were February, March, April, and May, with all 27 firms operating in April.

Only four hatcheries were not operated in conjunction with some other agricultural business. Owners of 10 of the 27 hatcheries, in addition to a hatchery, produced turkeys, ran a general farm, and had their own breeding flock. Other hatchery owners sold feed, farm supplies, remedies, and services, and some were vertically integrated operations.

Six model hatcheries of different sizes were synthesized. Each hatchery was analyzed when operating at 100, 80, 60, and 40 percent of capacity. All variable inputs were standardized and then compared with different units of output.

The six model hatcheries (models A - F), when operating on an annual basis at 100 percent of capacity, would set just under 1, 2, 3, 5, 10, and 20 million eggs a year and would sell poults from 56 percent of all eggs set. As the size of hatchery increases, the cost per poult hatched at 100 percent of capacity decreases from 3.88 cents in model A to 2.39 cents in model F. At 40 percent of capacity per year, the cost per poult is 6.34 cents in model A and 4.04 cents in model F.

To make the model hatcheries more realistic the output was reduced to the number of poults that could be hatched in a 34-week season. Fixed investment did not change with this reduction in operations. Therefore, the total cost per poult hatched increased.

In model A, at 100 percent of 34-week hatching capacity, or about 58 percent of annual capacity, the cost per poult is 5.06 cents and in model F the cost is 3.18 cents. At 40 percent of 34-week hatching capacity, or at about 23 percent of annual capacity, costs per poult are 9.14 cents and 5.89 cents, respectively.

Most of the economies gained from increasing the output of a hatchery are achieved when about 5 million eggs are set per year. This is the annual capacity of the incubating units in the model D hatchery. Labor efficiency and productivity increases from model A to model D, where its maximum is reached. In plants larger than model D there are slight decreases in utility, supply, and fixed costs per unit, but the difference is only 0.36 cent per poult between model D and F.

The scheduling of hatchery in-plant workers is an important function of each manager. Daily work flows should be relatively stable from day to day to fully utilize the labor force. The number of in-hatchery employees needed to perform the workload varied from 2 in models A and B to 12 in model F.

To further reduce costs per poult hatched, a hatchery owner may decide to pull the infertile turkey eggs 8 to 9 days after they are set in the incubator instead of on the day of transfer to the hatcher.

This study dealt only with in-plant hatching costs and cannot be used by itself to determine optimum hatchery size. Egg-assembly and poult-distribution costs can modify in-plant costs and are needed to determine optimum hatchery size.

ECONOMIES OF SCALE IN TURKEY HATCHERIES

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BACKGROUND AND OBJECTIVE

The objective of this study is to provide in-plant efficiency and cost information on turkey hatcheries useful to hatchery managers and owners. This is achieved by: (1) examining the costs of a sample of actual turkey hatcheries, and (2) synthesizing cost information for six model turkey hatcheries of different sizes.

Hatcheries can use this report to compare their in-plant costs with those in the study and with the costs projected for the model hatcheries. Three major areas for comparison are (1) utilization of capacity, (2) scheduling of work crews, and (3) use of modernized in-hatchery laborsaving and cost-reducing equipment. Hatcheries may be able to increase efficiency and lower in-plant costs if they utilize some of the methods used in the six synthesized model hatcheries.

A survey of the hatchery industry in 1959 indicated that the number of hatcheries is decreasing. Between 1937-38 and 1958-59 the number of all types of hatcheries declined from 11,638 to 5,169. 1/ Decreases also occurred in the number of turkey hatcheries, which declined from 682 to 551 between 1959 and 1963 (table 1). The major reasons for the decrease in the number of turkey hatcheries are: (1) inefficient operations, (2) inadequate utilization of incubator capacities, (3) decreases in the number of small turkey flocks, causing small hatcheries to close down, (4) shifts in production from one region to another, and (5) increased financing of turkey growing through vertical integration, which results in the consolidation of all production activities including hatcheries.

The number of turkeys produced in the United States has increased proportionately with the increase in hatchery capacity. Turkey production increased from 84.3 million birds in 1959 to 93.3 million in 1963. 2/ Gross income from the production of turkeys increased from $345 million in 1959 to $373 million in 1963.

The first section of this report deals with the cost of hatching turkeys, use of available capacity by hatcheries, utilization of labor, and efficient scheduling of operations in the actual hatcheries survey. The second section deals with economies of scale in the six model turkey hatcheries.

PROCEDURE

Turkey hatcheries were stratified into six size categories based upon rated egg capacities. 3/ A random sample was drawn from each stratum. During the last 6

1/ Rinear, Earl H. The Hatchery Industry - Structure - Economic Changes - Problems, Mktg. Res. Rpt. 483, U.S. Dept. Agr. June 1961. (p. 8.)

2/ U.S. Department of Agriculture. Farm Production Disposition and Gross Income - Turkeys, 1962-63, by States, Statis. Rptg. Serv. Pou. 3-1 (64), April 1964. (p. 3.)

3/ Capacity throughout this study refers to the total egg capacity of the incubating units owned or operated by a hatchery.

Table 1.--Number of turkey hatcheries and incabator capacities, by regions, United States, 1959 and 1963

Region	Number of hatcheries		Egg capacity 1/	
	1959	1963	1959	1963
	Number	Number	Thousands	Thousands
North Atlantic	2/ 142	2/ 94	3,167	2/ 2,828
East North Central	96	73	5,540	7,179
West North Central	2/ 149	153	11,675	15,987
South Atlantic	2/ 72	2/ 54	6,728	2/ 7,195
South Central	2/ 77	2/ 59	2/ 5,206	2/ 5,221
West	2/ 136	2/ 110	2/ 13,005	2/ 14,502
United States	682	551	45,544	54,237

1/ Egg capacity of incubators per setting.
2/ Less than 3 hatcheries in the States of R.I., N.Dak., W.Va., Tenn., Idaho, and N. Mex. in 1959 and in R.I., W.Va., Ky., and Idaho in 1963. These are not shown in regional totals but are included in United States totals.

months of 1962, data pertaining to in-plant operating costs were secured by personal interviews with hatchery owners and managers.

During 1962, personnel of 47 turkey hatcheries were interviewed. These hatcheries, varying in capacity from less than 121,000 eggs to more than 15 million a year, were located in California, Minnesota, Iowa, Missouri, Ohio, Utah, Arkansas, Kansas, and New York. Data obtained from 27 of these hatcheries included some information on plant layouts, types and cost of equipment, crew organization, operating practices, volume of eggs set, and poults hatched. Fifteen of these 27 hatcheries furnished specific in-plant operating costs for the most recent accounting year, providing the basis for analyzing the various in-hatchery short-run costs of current turkey hatcheries in the first part of this report.

The synthetic method of determining economies of scale was used for the second section of this study. The physical input-output relationships were determined for each segment of the poult-hatching process. These input-output relationships then provided the foundation upon which model plants were developed. By applying given prices to the input factors, the optimum combination of equipment and methods for the least-cost operation of each plant was determined.

The model hatcheries represent the optimum combinations of resources possible from the information available. These six model hatcheries were the basic framework upon which short-run cost curves were developed. An economies-of-scale curve (also called the long-run average cost curve and the long-run planning curve) was derived by drawing an envelope curve tangent to the short-run cost curves of each model hatchery. This long-run cost curve shows the level of costs that may be expected from turkey hatchery operations of various size when the hatcheries are operated as efficiently as possible within the limits of present knowledge. This is the curve which members of the hatchery industry can use in long-range planning and decision-making.

COSTS AND EFFICIENCY IN ACTUAL HATCHERIES

Recordkeeping systems used by turkey hatcheries vary widely. Many of these systems do not provide management with all the timely and detailed information needed to make intelligent decisions. The different methods used by the individual

hatcheries to classify and enter individual cost items make it difficult to compare the records of various hatcheries.

Moreover, hatching was often only one of several enterprises of the firm. Four of the 27 turkey hatcheries operated a hatchery only. The remaining 23 hatcheries had a number of other agricultural activities in addition to a hatchery. Even the larger hatcheries operated other enterprises along with their hatchery. The most typical combination of activities was hatchery operation, a general farm enterprise including the production of turkeys, and a turkey-breeding operation (table 2). Such a combination of enterprises allows management to spread supervisory, office, utility, and fixed costs over the entire operation. But with the bookkeeping system used by many of the firms, it is difficult for the owner to detect which enterprise is the most profitable.

Table 2.--Type of business operations performed by 27 turkey hatcheries, by size of hatchery, 1962

Type of operation	Size of hatchery in actual eggs set per year					Total
	Less than 100,000	100,000 to 500,000	500,001 to 1,000,000	1,000,001 to 2,000,000	Over 2,000,000	
	Hatcheries					
Hatchery only	---	1	---	2	1	4
Raising turkeys, general farm, and own breeding stock	2	2	2	2	2	10
General farm	3	1	---	---	1	5
Vertically integrated operation	---	1	1	2	---	4
Sell supplies, feed, remedies, and services	---	1	2	---	1	4
Total	5	6	5	6	5	27

Turkey hatcheries generally operate seasonally, since most turkeys are grown for the Thanksgiving and Christmas holiday periods. Seasonal operation does not allow maximum efficiency of labor and utilization of equipment and buildings. For this reason, most turkey hatcheries operate other types of businesses which supplement income and provide for better utilization of resources.

Costs by Size Group

In-plant costs varied widely among plants in each size group (table 3). The actual cost per egg set ranged from 3.37 to 8.41 cents. The actual cost for each poult hatched ranged from 6.04 to 16.12 cents.

Many factors in addition to hatchery size affect costs. Among these are: Distribution of fixed and utility costs over other income-producing activities such as sales of supplies, feed, and equipment; age and condition of the hatchery building and equipment; utilization of capacity; depreciation allowances; hatchability of the eggs; labor and managerial efficiency; wage rates; and prices of other items and services.

Table 3.--In-plant costs per turkey egg set and poult hatched by size group of hatcheries, 15 firms, 1962

Turkey hatching eggs		Poults hatched	
Quantity set per year	Cost per egg	Quantity hatched per year	Cost per poult
	Cents		Cents
Less than 160,001...	4.33 to 8.12	Less than 100,001	7.21 to 15.04
160,001 to 1,800,000	3.86 to 8.41	100,001 to 1,000,000	7.11 to 16.12
Over 1,800,000.....	3.37 to 6.26	Over 1,000,000	6.04 to 9.63

Variations in types of expenses by size groups of hatcheries are shown in table 4. For all hatcheries, wages and salaries of all in-plant labor, including office and management, but not sales, represented over 40 percent of the cost of each poult hatched. In the group of smallest hatcheries labor represented about 80 percent of all operating costs, and was nearly double the labor cost per poult hatched by the group of largest hatcheries. This wide variation in labor costs can be attributed to two main sources: (1) greater general efficiency in utilization of labor by the largest firms and (2) greater use of modernized time-saving equipment such as egg-traying machines and tray washers by the largest hatcheries. The group of smallest hatcheries had low miscellaneous costs, because management did not charge for travel and generally did not allocate funds for advertising. Many hatcheries in this group also were operating old equipment including incubators and hatchers that were completely depreciated in value. Such equipment and old buildings reduced the firms' expenditures for depreciation, interest, taxes, and insurance, making fixed overhead cost the lowest of the three groups. The medium-sized hatcheries had the highest fixed overhead costs per poult hatched of all three groups, because these firms were carrying large interest and insurance payments.

Costs of Least-Cost Hatchery Per Group

The minimum cost per unit of in-plant hatchery operations by different-size hatcheries is shown in tables 5 and 6. These tables contain data for the individual turkey hatchery with the lowest cost per egg set and poult hatched in each of five size groups. The total cost per egg set indicates that there are greater economies in larger plants than in smaller plants.

The smallest minimum-cost hatchery set less than 200,000 eggs in 1962. This hatchery had the highest labor cost of all five hatcheries. It was operating with completely depreciated equipment; therefore, its fixed costs were very low. However, it was operated at only 20.8 percent of its annual capacity, the lowest of the five firms. On the other hand, it had the highest hatchability (60 percent) of any of the hatcheries listed in table 6, which was great enough to make its cost per poult hatched lower than one of the larger firms.

The second smallest hatchery was located in a production area with relatively cold weather during the hatching period. Therefore, its utility cost per egg set was higher than the other hatcheries. It also had more floor space in proportion to its incubator capacity than the other four hatcheries, which resulted in large heating expenses. This hatchery was operated efficiently even in an old building and with much of its equipment outdated.

Table 4.--Average cost per poult for different size groups of turkey hatcheries, 15 firms, 1962

Item	Number of poults hatched per hatchery			All hatcheries
	Less than 100,001	100,001 to 1,000,000	Over 1,000,001	
	Cents			
Wages and salaries 1/	6.8058	4.9887	3.4437	3.7284
Packaging, supplies, and miscellaneous 2/	.7139	1.3892	1.0811	1.1316
Utilities	1.5422	1.2249	.6064	.7179
Fixed overhead 3/	.6060	2.6647	1.8656	1.9947
Total cost	9.6679	10.2675	6.9968	7.5726

1/ Includes hatchery labor for receiving eggs, candling, traying, setting, assembling poult boxes, pulling infertiles, transferring eggs from incubator to hatcher, taking off hatch, grading, counting and boxing poults; loading out poults, cleanup, maintenance, supervisory, office, and managerial personnel; plus fringe benefits.

2/ Includes all hatchery and office supplies, management travel, dues, contributions, and advertising.

3/ Includes repairs and maintenance, rent, depreciation, interest, taxes, and insurance.

Table 5.--Costs per egg set, minimum-cost turkey hatchery in each of 5 size groups, 1962

Item	Size group (thousands of eggs set per year)				
	Less than 300	300 to 920	920 to 1,440	1,440 to 2,400	Over 2,400
	Cents				
Wages and salaries 1/	3.1842	2.5423	2.1643	2.2831	1.8604
Packaging, supplies, and miscellaneous 2/	.4330	.4077	.6726	.3987	.5462
Utilities	.3480	.5199	.3764	.2308	.2839
Fixed overhead 3/	.3600	.3908	.7056	1.1569	.6814
Total	4.3252	3.8607	3.9189	4.0695	3.3719

1/ Includes hatchery labor for receiving eggs, candling, traying, setting, pulling infertiles, assembling poult boxes, transferring eggs from incubator to hatcher, taking off hatch, grading, counting, and boxing poults; loading out poults, cleanup, maintenance, supervisory, office, and managerial personnel; plus fringe benefits.

2/ Includes all hatchery and office supplies, management travel, dues, contributions, and advertising.

3/ Includes repairs and maintenance, rent, depreciation, interest, taxes and insurance.

Table 6.--Costs per poult, minimum-cost turkey hatchery in each of 5 size groups, 1962

Item	Size group (thousands of eggs set per year)				
	Less than 300	300 to 920	920 to 1,440	1,440 to 2,400	Over 2,400
	Cents				
Wages and salaries 1/	5.3071	4.5133	3.9244	4.1807	3.330
Packaging, supplies, and miscellaneous 2/	.7216	.7237	1.2196	.7302	.9777
Utilities	.5800	.9230	.6824	.4226	.5082
Fixed overhead 3/	.6000	.6939	1.2793	2.1185	1.2196
Total	7.2087	6.8539	7.1057	7.4520	6.0355

1/ Includes hatchery labor for receiving eggs, candling, traying, setting, pulling infertiles, assembling poult boxes, transferring eggs from incubator to hatcher, taking off hatch, grading, counting, and boxing poults; loading out poults, cleanup, maintenance, supervisory, office, and managerial personnel; plus fringe benefits.

2/ Includes all hatchery and office supplies, management travel, dues, contributions, and advertising.

3/ Includes repairs and maintenance, rent, depreciation, interest, taxes, and insurance.

The next-to-the-largest hatchery had the highest fixed overhead cost of the five hatcheries. It has increased its capacity recently with new incubators and hatchers. To protect its investment and the value of eggs which it was custom hatching, it carried more insurance than any of the other four hatcheries. Also, this hatchery utilized only 47.1 percent of its annual capacity and had the lowest hatchability record of the five hatcheries, 54.7 percent of the eggs set.

The largest hatchery utilized 88 percent of its annual capacity by hatching a large number of Beltsville Whites and operating on a 12-month basis. This greater utilization of facilities allowed the various costs of hatching to be spread out over a larger number of eggs set, thereby lowering the total cost per egg set and poult hatched.

Utilization of Capacity

Turkey hatcheries generally are not operated 12 months a year. Production of turkeys has been and continues to be predominately a seasonal operation. Eggs are normally set only when the hatchery has sufficient orders to cover a specific hatch. The number of eggs set for a given hatch depends on the type of eggs set, because hatchability varies considerably. Hatchability of all turkey eggs by the hatcheries ranged from 42 to 65 percent. Average hatchability of Beltsville Whites was 60 percent, Broad Breasted Whites 54 percent, and Broad Breasted Bronze 57 percent (table 7).

A great many things affect hatchability of turkey eggs: Fertility, breeding-flock management, length of egg-laying season, egg-handling methods and timeliness, and control of incubator and hatcher operations. Producers and hatcherymen are continually

Table 7.--Turkey egg hatchability, percentage range by types of turkeys for specific months, 27 hatcheries, 1962

Kind	Month												Range in yearly hatch	Simple average
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.		
	Percent													
Beltsville	42-63	52-72	40-60	60-76	52-66	51-53	45-49	1/	1/	1/	1/	1/	42-65	60
Broad Breasted White	44-68	40-62	44-62	36-64	49-64	51-64	31-61	60-63	60-69	59-60	57-60	30-52	42-65	54
Broad Breasted Bronze	54-65	56-67	49-66	46-62	39-59	34-52	1/	--	--	--	1/	54-55	51-61	57

1/ Less than 3 turkey hatcheries were represented.

working to improve hatchability of turkey eggs. A 1-percent increase in hatchability in a hatchery setting 1 million eggs a year will yield 10,000 more salable poults. Such an increase in hatchability could mean the difference between profit and loss in many hatcheries.

In 1959, only 5 percent of the turkey hatcheries were operated 12 months of the year; none of the hatcheries had more than five incubator-capacity turnovers per year and 75 percent of them had less than two turnovers. 4/ In the 1962 study, 5 of the 27 hatcheries were operated 12 months a year. In only one of these five hatcheries were broiler chicks hatched as well as turkey poults.

In recent years the hatching season has been lengthened by the growing of more than one batch of heavy young turkeys on some farms and continuous placements of Beltsville poults (small young turkeys) on many farms. This allows hatcheries to make fuller use of capacity than formerly and to retain a regular and efficient labor force.

Excess capacity exists in turkey hatcheries. Almost 55 percent of the hatcheries studied operated at less than 30 percent of potential annual capacity and almost 84 percent at less than 50 percent of potential annual capacity (table 8).

Table 8.--Percentage of annual capacity utilized by 27 turkey hatcheries, 1962 1/

Percent of annual capacity utilized	Percent of firms
Less than 10.0	15
10 - 19.9	12
20 - 29.9	27
30 - 39.9	15
40 - 49.9	15
50 - 59.9	4
60 - 69.9	--
70 - 79.9	8
Over 79.9	4
Total	100

1/ Annual capacity equals the total egg capacity of the incubating units set 12 times in a 12-month period.

Costs per poult can be reduced if more efficient use can be made of the potential annual hatchery capacity. Reductions can specifically be made in fixed overhead costs such as depreciation, rent, interest, taxes, and insurance.

The larger of these 27 hatcheries operated more months of the year than the smaller ones. The average annual capacity of the five hatcheries operating 12 months a year was 5.24 million eggs, whereas the six hatcheries operating 5 months a year had an average annual capacity of only 2.06 million eggs (table 9). The number of months a hatchery operated was correlated with the use of available capacity. The hatcheries that operated 11 and 12 months a year utilized their annual capacity to a greater extent than the others. The extent of use of available capacity is a good indicator of efficiency and corresponds closely to the cost of hatching poults. The hatchery that

4/ Rinear, Mktg. Res. Rpt. 483, p. 24.

Table 9.--Months of operation and use of available annual capacity, 27 turkey hatcheries, 1962

Months of operation	Hatcheries	Range in use of available capacity	Average annual capacity of hatcheries
	Number	Percent	Million eggs
12	5	34.6 to 88.0	5.24
11	2	43.9 to 52.0	3.70
10	--	---	---
9	--	---	---
8	3	28.5 to 47.1	4.93
7	2	27.3 to 45.3	3.15
6	2	19.5 to 32.7	3.35
5	6	9.8 to 34.3	2.06
4	5	3.3 to 21.0	.95
3	2	4.0 to 10.0	.45
All hatcheries	27	3.3 to 88.0	2.98

utilized only 3.3 percent of its capacity was old with no costs allocated to fixed overhead, but still its cost per egg set was over 6 cents. The other extreme was a modern hatchery with 88 percent utilization of its capacity at a cost of 3.37 cents per egg set, the lowest cost per unit of all hatcheries.

More turkey hatcheries operate their incubators and hatchers during February through May than in any other time. At least 24 of the 27 hatcheries hatched eggs during these 4 spring months (table 10). Seasonal production of turkeys continues to dominate this industry, with most turkeys going to market during the Thanksgiving and Christmas holidays. Over half of the turkeys produced are consumed during November and December. Most Broad Breasted White and Bronze turkeys are ready for market when they are 5 to 6 months old. This makes April the most likely month for the hatcheries to be operating and all 27 firms reported doing so. One hatchery set over 51 percent of its annual setting of eggs during April.

During 6 months of the year, February, March, April, May, June, and December, some hatcheries utilized more than their rated capacity. These hatcheries candled out the infertile turkey eggs after they had been in the incubator 7 to 10 days, then shuffled the fertile eggs into full trays and set new eggs in the empty trays. Infertiles often run between 20 and 30 percent of the eggs set. Generally, the infertiles were not pulled until the 24th day after setting, when the eggs were transferred to the hatchers. By pulling the infertiles early the hatcheries added almost 31 percent to their normal capacity (table 10).

Utilization of Labor

Labor is the largest single cost item in a turkey hatchery. As previously stated the cost of labor represented just under 50 percent of all in-plant costs.

One method of measuring labor efficiency is to compare the numbers of poults hatched per man-hour of in-plant labor. The smaller hatcheries--those hatching less than 20,000 poults a week--had the lowest weighted average number of poults hatched per man-hour. These smaller hatcheries also had a wider range in poults

Table 10.--Month of operation and use of available monthly capacity, 27 turkey hatcheries, 1962

Month of operation	Hatcheries	Range in use of available monthly capacity	Range that actual monthly set is of annual number of eggs set
	Number	Percent	Percent
January	21	16.3 to 89.0	5.0 to 24.0
February	24	6.2 to 101.8	7.0 to 25.0
March	25	16.1 to 130.7	8.4 to 40.0
April	27	13.6 to 126.6	6.8 to 51.6
May	24	4.3 to 130.3	8.4 to 38.2
June	18	11.7 to 103.4	5.0 to 33.6
July	13	12.3 to 83.2	3.8 to 9.3
August	8	1.1 to 77.4	.2 to 12.1
September	6	4.3 to 77.4	.7 to 8.3
October	7	5.0 to 84.9	.9 to 11.0
November	7	6.5 to 88.5	1.0 to 8.4
December	8	4.4 to 117.4	1.1 to 11.1

hatched per man-hour, from 38 to 208 poults (table 11). Such extremes were generally due to the use of antiquated hand methods and obsolete equipment versus the use of some modern equipment, better work flow or location of equipment, carts and dollies to move cases, boxes, and trays, and better scheduling of hatchery activities. The most efficient small hatcheries did not keep workers idle, but assigned them to other duties in addition to the hatching operation. In the least efficient small hatcheries, employees were idle part of the time and this idle time was charged to the hatchery operation.

Table 11.--Output per man-hour in 20 turkey hatcheries by number of poults hatched per week, 1962 1/

Poults hatched per week	Poults per man-hour	
	Weighted average	Range
Less than 5,001	98.9	38 - 181
5,001 to 20,000	106.5	62 - 208
20,001 to 30,000	124.7	80 - 180
30,000 to 60,000	118.3	103 - 126
Over 60,000	132.8	119 - 157
Average	125.2	--

1/ Generally includes supervised hatchery operations, but not sales, delivery, or overhead management activities.

The weighted average number of poults hatched per man-hour increased to 132.8 as the number of poults hatched per week increased from less than 20,000 to over 60,000. The range in poults hatched per man-hour between the least efficient hatchery and most efficient hatchery per size group became narrower as the size of hatcheries

increased. This trend was largely the result of utilizing a full-time labor force in the hatchery and using more modern laborsaving equipment.

Wages paid to in-plant employees varied between $1 and $2.50 per hour. The smaller hatcheries generally paid lower wages to their employees, with the average wage per hour increasing as the size of operation increased (table 12). The $1 to $1.15 wage per hour was primarily paid to part-time women employees who graded and trayed the eggs, washed the hatch trays by hand, and pulled the infertile eggs when the fertile eggs were transferred from incubator to hatchers. A number of hatchery managers said that women performed the job of hand-grading and traying eggs faster and with greater efficiency than men. However, the hatcheries that used vacuum egg-traying equipment had men as operators and, if they hired women, they were used for pulling infertile eggs.

Table 12.--Wages per hour paid employees of 15 turkey hatcheries by size group of hatcheries, 1962

Size group of hatcheries in incubator capacity (thousands of eggs)	Range	Average
	Dollars	Dollars
Less than 25	1.00 -- 1.50	1.21
25 - 59	1.00 -- 2.50	1.65
60 - 99	1.40 -- 2.40	1.81
100 - 199	1.15 -- 1.75	1.36
Over 199	1.15 -- 2.25	1.72

The average wage rates for all hatcheries were between $1.21 and $1.81 per hour, including Social Security and other basic fringe benefits. In some hatcheries, during peak operating months some employees worked longer than the regular 40-hour week and were paid time-and-a-half for such labor. Occasionally the supervisors in the larger hatcheries would work a few extra hours a week without extra compensation.

In most instances managerial and supervisory employees were paid a weekly salary. Most managers were also owners or part owners of the hatcheries and their salaries included a portion of expected profits for that year. The return to the manager in salary and profits varied from $42 a week for the smallest hatchery to $360 a week for a large, efficient hatchery. By size groups of hatcheries average weekly salary for managers ranged from $69 to $241 as the average size of hatchery increased (table 13). Hence, as the responsibility of operating more incubators and hatchers and supervising in-plant employees increased, the compensation to the manager also increased. In some hatcheries, the manager was the chief salesman of the poults, as well as the office manager and the plant manager. He received a combined weekly paycheck for these services. In other cases, these functions were itemized in the bookkeeping system and the manager's weekly salary was allocated to each function. Table 13, therefore, does not reflect the actual returns for the duties of a plant manager only.

As the capacity of a turkey hatchery approached 100,000 eggs, some plant managers hired plant supervisors or foremen. Most of the plants with capacities of 800,000 eggs had full-time plant supervisors who were paid from $95 to $105 a week. The supervisors were not required to work a specific number of hours a week but most worked a minimum of 40 hours. When a hatchery had a plant supervisor, the manager was able to spend more time with recordkeeping, sales promotion, and public relations work.

Table 13.--Weekly salaries paid to managers and supervisors of 15 turkey hatcheries, by size group of hatcheries, 1962

Size group of hatcheries in incubator capacity (thousands of eggs)	Managers		Supervisors (average)
	Range	Average	
	Dollars	Dollars	Dollars
Less than 25	42 -- 116	69	---
25 - 59	93.50 -- 110	102	---
69 - 99	151 -- 233	192	95
100 - 199	145 -- 360	227	105
Over 199	175 -- 314	241	100

Schedule of Hatchery Operations

The labor requirements in a turkey hatchery vary from day to day, depending on what operations are performed. Most hatcheries try to maintain a smooth flow of labor inputs per week. However, in the smaller hatcheries the work flow is erratic at times because of the jobs that must be performed on certain days, when less than three hatches are pulled a week. This can readily be seen when a weekly work schedule is analyzed. Using data from the hatcheries surveyed, a fairly typical work schedule for an efficient one-hatch-a-week turkey hatchery was put together (table 14).

Table 14.--Typical work schedule for a turkey hatchery producing one hatch a week

Day	Work performed
Sunday	Check machines
Monday	Receive and store eggs
	Grade and tray eggs
	Make poult boxes
Tuesday	Set eggs
	Pull hatch, grade, count, and box poults
	Wash hatch trays
	Make poult boxes
Wednesday	Load out poults
	Clean hatcher
	Clean hatchery
Thursday	Check machines
Friday	Transfer and pull infertiles
Saturday	Clean and vacuum incubator
	Check machines

The schedule shown in table 14 indicates that the hatching of eggs is a cyclic process. Each cycle begins when the eggs are set in the incubator and ends when the poults are loaded on the truck for delivery. The work inputs during the cycle are quite variable. For example, following the schedule in table 14, 1 man-hour would be required on Thursday for the manager to check the incubators and hatchers for

malfunctions. On Friday, he must transfer the eggs from the incubator to the hatcher and remove the infertile eggs to provide more space for the poults to hatch. This operation required at least 14.6 man-hours. In many of the less efficient hatcheries, these variations in manpower were greater, especially in the hatcheries that had less than one hatch a week. These small hatcheries are rapidly going out of the hatchery business except those which hatch poults for their own grow-out program. Such hatcheries can be operated at relatively low costs in the short run, if the hatchery is free of debt and the required labor can be temporarily shifted from some other farm enterprise.

The larger turkey hatcheries increase their operation to more than one hatch a week and the utilization of labor becomes more uniform. Tables 15, 16, and 17 show typical work schedules for two, three, and five hatches per week. The four work schedules (tables 14 to 17) show one method of dividing the hatchery jobs among the weekly labor force, but other methods can be used. A number of the jobs can be completed on one day as well as the next.

Poult boxes can be assembled any time before the poults are removed from the hatchers. In table 14, a number of the boxes were made on Monday afternoon before the poults were pulled on Tuesday morning. Some boxes were made on Tuesday afternoon for the next week's hatch. In the largest hatcheries, the poult boxes were not assembled until 1 or 2 days before the poults were pulled from the hatchers, because these hatcheries did not have the extra storage area required for a large supply of assembled boxes.

A number of other hatchery functions could be shifted from the days shown in the schedules. The function of receiving and storing eggs can be altered 1 to 3 days from the time they are needed for grading and traying. Most hatchery managers indicated that turkey eggs can be held up to 1 week in the cooler without any significant loss of hatchability. Therefore, the grading and traying function can also be altered to some extent, since the trayed eggs can be placed back into the cooler for later setting.

Another function which can be completed on different days than those designated in tables 14 through 17 is the cleaning of hatcheries, hatchers, and hatch trays. The hatchers and trays must be cleaned and ready for the fertile eggs when they are transferred from the incubators to the hatchers on the 24th day of the hatching cycle. There is some leeway on when the hatchers and their trays can be cleaned. However, the trays are easier to clean before the contents of the broken eggs have dried.

Maintenance

Some hatcheries have a night crew which does the cleaning jobs and, when necessary, the maintenance functions. The night crew is also responsible for reporting or correcting any malfunctions of the full machines. The hatcheries that do not have a night crew use an alarm system which is hooked up to two or three different employees' homes. By prior arrangement at least one of the employees of the hatchery will be within hearing distance of the alarm at all times and, if trouble develops, can be down at the hatchery within minutes after the trouble begins. An alarm system can save the hatchery owner the expense of having one or more persons at the hatchery all night.

Most of the turkey hatcheries contacted did not operate more than 9 months of the year. During the 3 inactive months, a skeleton crew was retained. These employees serviced, repaired, and painted the equipment and building. If new equipment was

Table 15.--Typical work schedule for a turkey hatchery producing two hatches a week

Day	Work performed
Sunday	Check machines
Monday	Transfer and pull infertiles
	Receive and store eggs
Tuesday	Clean and vacuum incubator
	Grade and tray eggs
	Set eggs
	Pull hatch, grade, count, and box poults
Wednesday	Load out poults
	Clean hatch trays
	Clean hatcher
	Clean hatchery
	Make boxes
Thursday	Receive and store eggs
	Grade and tray eggs
Friday	Transfer and pull infertiles
	Clean and vacuum incubator
	Set eggs
	Pull hatch, grade, count, and box poults
Saturday	Same as Wednesday

Table 16.--Typical work schedule for a turkey hatchery producing three hatches a week

Day	Work performed
Sunday	Check machines
Monday	Pull hatch, grade, count, and box poults
	Clean and vacuum incubator
	Set eggs
	Transfer and pull infertiles
Tuesday	Receive and store eggs
	Load out poults
	Grade and tray eggs
	Clean hatch trays, hatcher, and hatchery
Wednesday	Pull hatch, grade, count, and box poults
	Clean and vacuum incubator
	Set eggs
	Make poult boxes
	Clean hatcher trays and hatcher
Thursday	Receive and store eggs
	Transfer and pull infertiles
	Grade and tray eggs
	Load out poults
Friday	Clean and vacuum incubator
	Set eggs
	Pull hatch, grade, count, and box poults
	Clean hatch trays, hatcher, and hatchery
	Make boxes
Saturday	Receive and store eggs
	Transfer and pull infertiles
	Load out poults
	Grade and tray eggs

Table 17.--Typical work schedule for a turkey hatchery producing five hatches a week

Day	Work performed
Sunday	Transfer and pull infertiles
Monday	Clean and vacuum incubator
	Set eggs
	Pull hatch, count, grade, and box poults
	Clean hatch trays and hatcher
	Transfer and pull infertiles
	Receive and store eggs
	Grade and tray eggs
	Make poult boxes
Tuesday	Same as Monday except no transfer and pull infertiles
	Also clean hatchery
	Also load out poults
Wednesday	Same as Tuesday
Thursday	Same as Monday
	Also load out poults
Friday	Same as Thursday except no traying of eggs
Saturday	Transfer and pull infertiles
	Receive and store eggs
	Grade and tray eggs
	Load out poults

to be installed, it was done during the slack season. If more poult-box carts were needed, they were build during this 3-month period.

ECONOMIES OF SCALE IN MODEL TURKEY HATCHERIES

Six model hatcheries of different sizes were synthesized, each utilizing the most efficient system of in-plant functions used by the hatcheries studied. While none of the individual hatcheries surveyed had all the pieces of equipment used in these models, a number had several of them. 5/

Hatchery Size and Use of Capacity

The physical size of each model hatchery depends on the number of eggs which are set annually. The six model hatcheries, A to F, have annual capacities of just under 1, 2, 3, 5, 10, and 20 million eggs.

Six different floor plans were developed for the areas and major equipment needed for performing the various operations. Each work-flow system was designed so that operating cost and man-hour usage could be minimized. The egg cooler was located close to the egg-traying area to facilitate the traying of eggs in advance of the day when the eggs were set. The hatchers were close to the poult room, which was near the tray-washing area to allow a circular flow of continuous operations and to minimize labor.

Work schedules were based on one setting of eggs a week in model A, two sets a week in model B, three sets a week in model C, and five sets a week in models D, E, and F. To achieve standardized costs in these six model hatcheries the following assumptions were made:

1. All six model hatcheries used the same type of incubators and hatchers. All model hatcheries used modern laborsaving equipment.
2. Quantity discounts on the purchase of supplies and utilities were obtained as the hatcheries increased in size.
3. The cost per poult hatched was based on 60 percent hatchability of all eggs set.
4. The eggs were in the incubator 24 days and were transferred to the hatchers for the 4 final days. Eggs were set on the same days each week.
5. The wage rate for employees was $1.75 an hour with a 40-hour week and time and a half for overtime. This hourly wage included Social Security and the normal fringe benefits.
6. The managerial and supervisory salaries were increased as responsibility increased with larger hatcheries.
7. All model hatcheries were equipped with electronic alarm systems, which largely eliminated the need for a surveillance night crew and weekend watchmen.
8. The model hatcheries contained cooler facilities to hold a week's supply of eggs when the hatchery was operating at 100 percent of capacity.
9. Storage areas were standardized to hold sufficient supplies for 4 weeks of operation at 100 percent of capacity and a 2-day supply of assembled poult boxes.

As the size of hatchery increased the average total cost per poult hatched at 100 percent of capacity decreased from 3.88 cents in model A to 2.39 cents in model F.

5/ Readers who desire more detailed information than that presented here may request the supplement described in the Preface to this report.

At 40 percent of capacity the average total cost per poult is 6.34 cents in model A and 4.04 cents in model F. Thus, there are economies of scale in turkey hatcheries (fig. 1).

Most turkey hatcheries do not hatch poults continuously 12 months a year. Therefore, the output of these model hatcheries was reduced to the number of poults that could be hatched in a 34-week season (approximately 7 months). No change in the fixed investment occurred with this change in output. The average total cost per poult hatched in the 34-week season increased above the average total cost per poult hatched at full operation for 12 months. In model A, at 100 percent of capacity for 34 weeks or about 58 percent of annual capacity, the average total cost per poult is 5.06 cents. In model F at the same rate of use of capacity the average total cost is 3.18 cents. Again at 40 percent of their 34-week capacity or 23 percent of annual capacity, a level at which a good number of turkey hatcheries actually operate, the average total cost per poult is 9.14 cents in model A and 5.89 cents in model F (fig. 2).

In figures 1 and 2, the short-run cost curve for each size of hatchery reaches its lowest point at 100 percent of capacity. All short-run cost curves continued to curve downward until 100 percent of capacity was reached. However, to go beyond 100 percent of capacity, the technology used in the hatching operation would have to be changed, i. e., the infertile eggs would be pulled early in the incubating stage, this would change the structure of the models. To make a realistic comparison, it was deemed necessary to keep technology constant and use the most feasible and efficient least-cost methods known at the time of this study.

The costs synthesized in the development of these six model hatcheries were divided into fixed and variable costs. Variable costs consist of supplies, utilities, and labor. Fixed costs are those that do not change with changes in utilization of incubator capacity.

Fixed Costs

Fixed costs include equipment and building depreciation, maintenance and repairs, taxes, insurance, interest, and miscellaneous costs. Fixed costs per unit vary directly with the utilization of the capacity of the plant. The rates used to determine fixed costs are shown in table 18. These rates were developed from actual data received from responding hatcheries or were adapted from previous economies-of-scale studies.

Equipment Costs

The equipment in the six model turkey hatcheries was based on the type of equipment used by most of the hatcheries surveyed and the most efficient mechanized units now available from equipment manufacturers. The most expensive pieces of equipment needed by hatcheries were the incubators and hatchers. The number of incubators needed by each model hatchery was based on (1) the capacity of the incubator per setting, (2) 12 turnovers of incubator capacity per year, and (3) the size of each hatchery. The number of hatchers needed depends on the number of fertile eggs remaining after the infertile eggs are pulled from the incubator trays. In these six model hatcheries, 20 percent of the eggs set were assumed to be pulled as infertiles and 80 percent were put into hatchers.

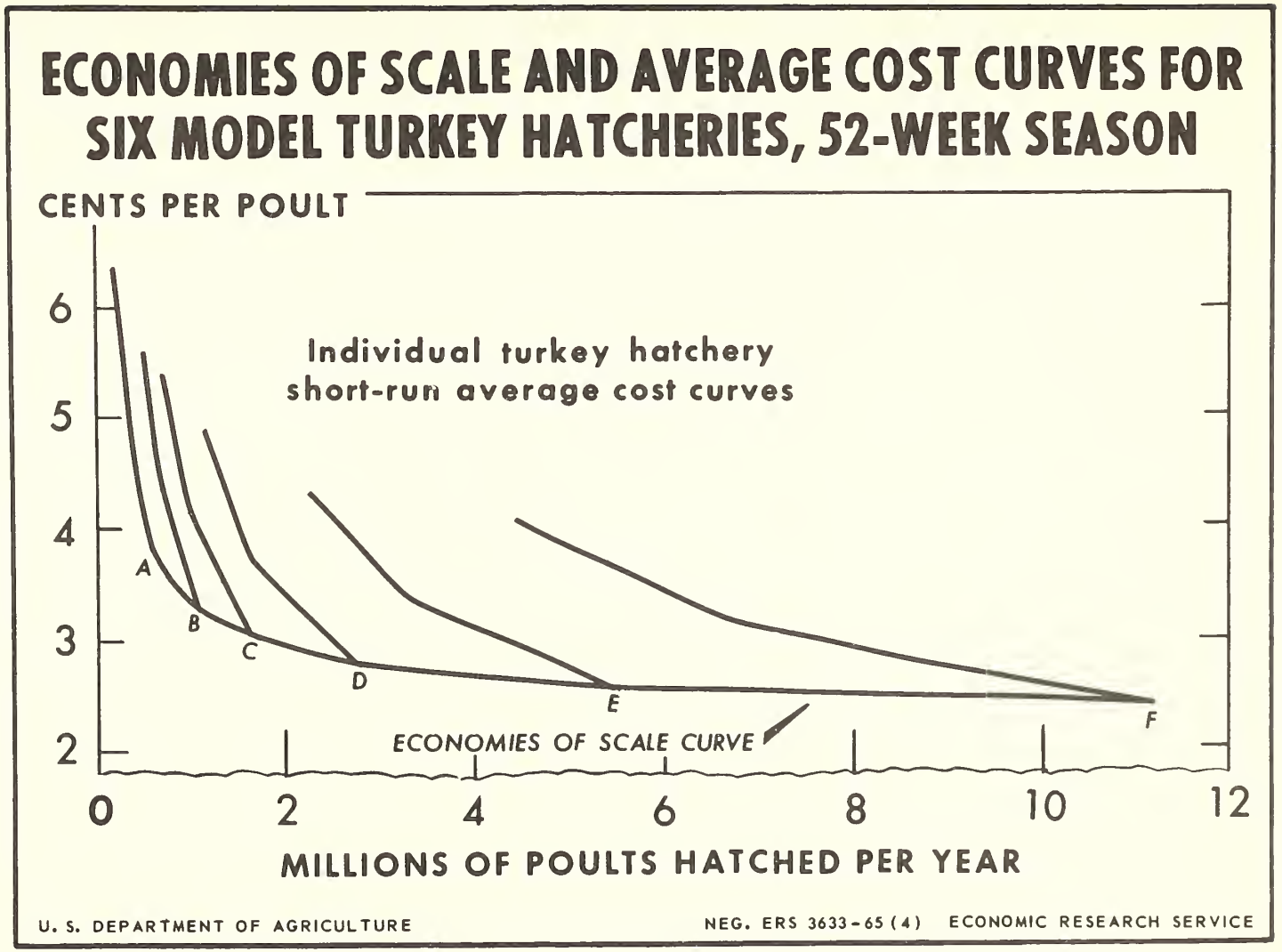
ECONOMIES OF SCALE AND AVERAGE COST CURVES FOR SIX MODEL TURKEY HATCHERIES, 52-WEEK SEASON
CENTS PER POULT
6
5
4
3
2
Individual turkey hatchery short-run average cost curves
A
B
C
D
E
F
ECONOMIES OF SCALE CURVE
0
2
4
6
8
10
12
MILLIONS OF POULTS HATCHED PER YEAR
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3633-65 (4) ECONOMIC RESEARCH SERVICE

Figure 1

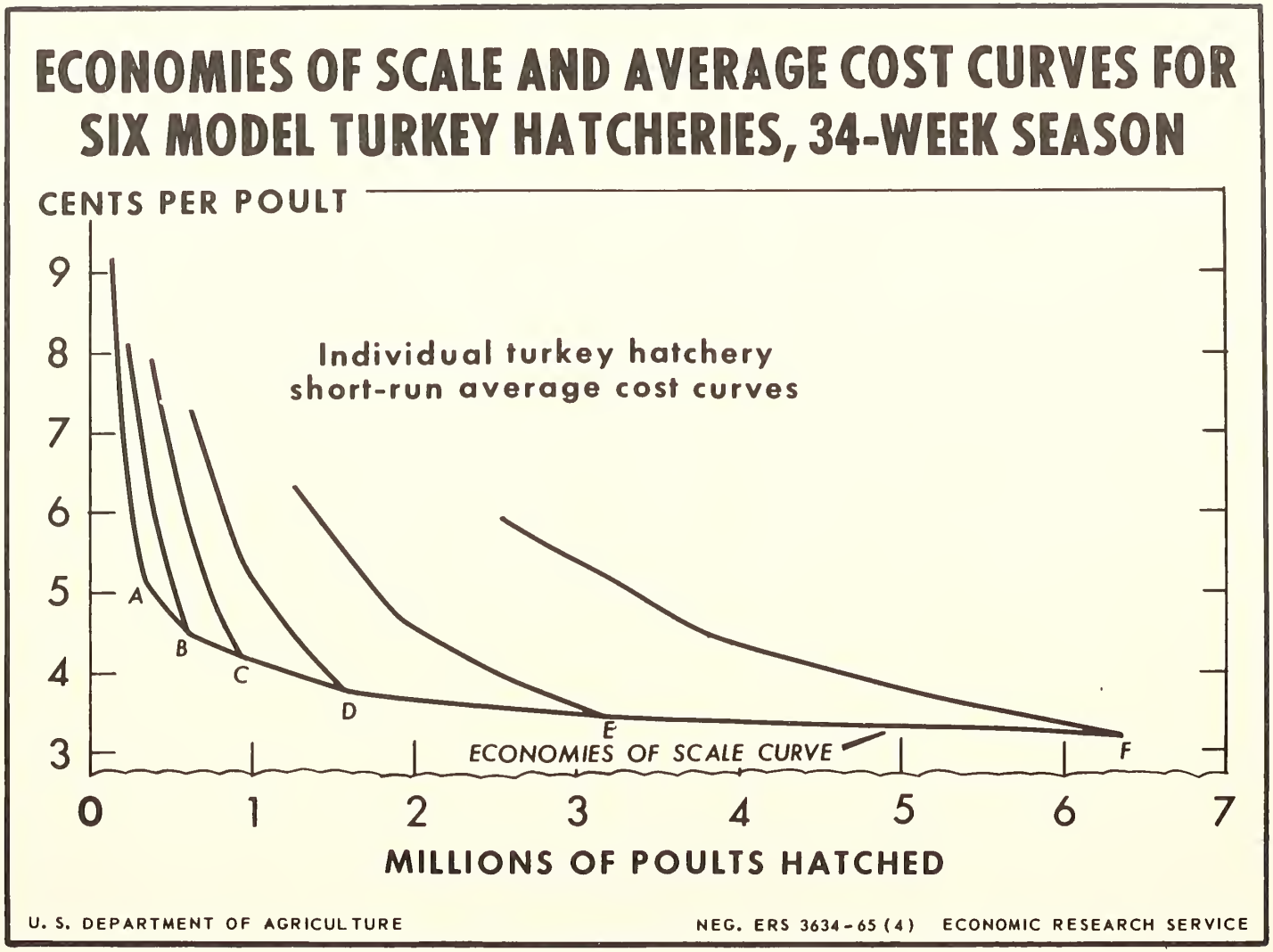
ECONOMIES OF SCALE AND AVERAGE COST CURVES FOR SIX MODEL TURKEY HATCHERIES, 34-WEEK SEASON
CENTS PER POULT
9
8
7
6
5
4
3
Individual turkey hatchery short-run average cost curves
A
B
C
D
E
F
ECONOMIES OF SCALE CURVE
0
1
2
3
4
5
6
7
MILLIONS OF POULTS HATCHED
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 3634-65 (4) ECONOMIC RESEARCH SERVICE

Figure 2

Table 18.--Rates (as percentage of costs of new building and equipment) used to determine fixed costs of investment in model turkey hatcheries

Item	Building	Equipment
	Percent	Percent
Depreciation	5	1/ 10
Repairs	3	3
Taxes	1	1
Insurance	1	1
Interest on new value	3	3

1/ Except standby generator, tray washer, and egg-room cooler, which are depreciated at 5 percent.

All model hatcheries were equipped with egg coolers and standby generators. The use of an egg-cooler room facilitates the scheduling of egg settings. A hatchery with an egg cooler can fully utilize its labor force and weekly work flow, since the eggs can be graded and trayed during a light work period, then returned to the cooler for future setting.

A standby generator is a form of insurance against power failure, which could result in total loss of all the eggs and poults in the incubators and hatchers. One 24- to 48-hour power failure could cost the hatchery owner more than the capital invested in a standby power unit. The loss of power for 4 or 6 hours could reduce the hatchability of eggs in an incubator. All standby generators were equipped with automatic line transfer equipment. Estimates on the type and size required by each model hatchery were developed from data on electricity demands and usage in operating the different sizes of hatcheries. These generators have sufficient capacity to meet minimum demands of the hatcheries.

All model hatcheries were equipped with a vacuum-lift egg-traying machine. Models A, B, and C were each equipped with one vacuum head while models D, E, and F were equipped with two vacuum heads.

Another large piece of equipment, used in models D, E, and F, was a tray-washing machine. Manual labor at $1.75 an hour for washing trays was more efficient in the three smaller model hatcheries. Miscellaneous equipment included tray carts, poult carts, various dollies, egg-case conveyors, worktables, flash-candling benches, and other minor items necessary for efficient operation of a hatchery.

Building Costs

The size of building required to hatch the quantity of poults desired was determined from analysis of: (1) the shape, size, and layouts of the hatcheries surveyed, (2) suggested floor plans of various incubator companies, and (3) floor plans in studies of broiler chick hatcheries. 6/ Space for storage of supplies was standardized for all models at a 4-week inventory of such items as poult boxes, pads, tray papers, and

6/ Gallimore, W. W., and Stemberger, A. P. Economies to Size in Hatching Chicks, Agr. Econ. Inform. Ser. 96, N. C. State Col., Raleigh, Nov. 1962, pp. 43-47.

egg cases. Space was allocated for a 2-day supply of assembled poult boxes in the three larger hatcheries, models D, E, and F. As the other three models did not pull a hatch 5 days a week, some vacant space in the poult room could be utilized for assembled box storage. The size of the egg-cooling room was standardized to hold enough eggs for 1 week's setting when the hatchery was operating at 100 percent of capacity.

Building costs were estimated for each size of model hatchery and ranged from $7.50 to $7 per square foot, including electricity, heating, plumbing, and airconditioning based on Southern California's climate (table 19). 7/ This estimate was for a one-story building constructed of cinderblock walls with steel reinforcement, concrete floors, pitched roof, clear span construction where possible, and insulated ceiling. For a comparable building in Minnesota it would be necessary to add 15 percent for extra insulation and heavier construction, including an extra row of columns to withstand weight of snow on the roof. Cost of the site for each model hatchery was estimated at $500 per acre and the size of the site did not allow space for expansion (table 19).

Table 19.--Estimated cost of six model turkey hatchery buildings with utilities and land sites 1/

Model hatchery	Building structure			Building site 2/			Total cost
	Size	Cost per square foot	Cost 3/	Size	Cost per acre	Cost	
	Sq. ft.	Dollars	Dollars	Acres	Dollars	Dollars	Dollars
A	2,400	7.50	18,000	1	500	500	18,500
B	4,550	7.50	34,000	1	500	500	34,500
C	6,450	7.50	48,000	1	500	500	48,500
D	4/ 9,900	7.25	72,000	2	500	1,000	73,000
E	4/17,350	7.25	126,000	2	500	1,000	127,000
F	4/29,900	7.00	209,000	3	500	1,500	210,500

1/ Includes electricity, heating, airconditioning, and plumbing, based on Southern California climate.
2/ Does not allow space for expansion.
3/ Building costs are rounded to nearest $1,000.
4/ Clear span construction in all models except D, E, and F, where one row of columns is required.

These estimated building costs seemed high compared to the estimated costs of model broiler chick hatcheries in North Carolina, where building costs were estimated at $5.50 per square foot. 8/ However, in a recent broiler chick hatchery study in New Hampshire the estimated building cost ranged from $8.45 to $6.85 per square foot. 9/

7/ Building costs were estimated by John A. Hamann, Agricultural Economist, and Heber D. Bouland, Civil Engineer, Transportation and Facilities Research Division, Agriculture Research Service, United States Department of Agriculture.
8/ Gallimore and Stemberger, Agr. Econ. Inform. Ser. 96, p. 20.
9/ Burbee, Clark R., and Bardwell, Edwin T. Marketing New England Poultry. 6. Economies of Scale in Hatching and Cost of Distributing Broiler Chicks. Agr. Expt. Sta. Bul. 483, Univ. N. H., Dunham, in cooperation with Univ. Mass., Amherst, and Econ. Res. Serv., U.S. Dept. Agr., May 1964. p. 17.

The model turkey hatcheries contained central airconditioning which was not suggested in the broiler chick hatchery studies cited. Only a few of the turkey hatcheries visited had airconditioning in their buildings. The managers of these hatcheries specifically mentioned that after the hatchery was airconditioned two immediate advantages were noticeable: (1) the in-plant employees increased their work output considerably, and (2) the morale of the employees improved.

The floor space per building did not increase proportionately with the increase in incubator capacity. Such areas as the office, boiler room, tray-washing areas, and restrooms are not directly related to capacity, and they increase in size at a slower rate. As the size of the model hatchery increased from 2,400 square feet to 29,900 square feet, the annual egg capacity per square foot of floor space went from 410 in model A to 660 in model F.

Miscellaneous Costs

Such items as office supplies, lawn supplies, dues, contributions, and subscription fees were included. These costs were estimated from the actual costs reported by firms surveyed. The cost of office supplies represented the largest item of this group followed by contributions to local school and other community activities. These costs were a very minor part of the total annual average cost per poult hatched in each model hatchery and did not exceed 0.3458 cent per poult hatched.

Variable Costs

The in-hatchery costs included in variable costs were labor, management, supplies, and utilities. Total variable costs vary with changes in output. Less labor, utilities, and supplies are needed with a small output than with a large output. In the six model hatcheries a larger portion of total costs was represented by variable costs than by fixed costs.

Labor Costs

Labor requirements for the six model hatcheries were based on the actual labor used by hatcheries in the survey, from specifications on output per man-hour suggested by equipment manufacturers, and from other studies. These labor requirements were based on use of the latest laborsaving equipment available at the time of this study (table 20). When a hatchery sets close to a million eggs a year it can utilize all the mechanized equipment that the larger hatcheries use except the automatic tray washer. A hatchery must set about 4 million eggs a year before the tray washer will be less costly than hand labor when wage rates are $1.75 per hour. There are some additional economies in the transfer and pulling of infertiles and the grading and traying of eggs as size increases. The economies of scale in labor inputs are relatively small and by themselves would not warrant a hatchery operation of over 5 million eggs set a year.

Laborsaving equipment used in these model hatcheries reduced the labor costs from a low of over 3 cents in observed hatcheries to slightly over 1 cent per poult hatched in all the models, even at 40 percent of capacity.

The largest laborsaving device in the model hatcheries was the vacuum egg-traying equipment. With a mechanized egg traver, one man can transfer 20 turkey eggs from the egg case to the incubator tray with one motion. Using the typical hand-traying

Table 20.--Labor productivities in 6 model turkey hatcheries: Crew sizes and quantities of eggs per man-hour

[Numbers in parenthesis are crew sizes; other numbers are eggs per man-hour]

Operations performed	Model					
	A	B	C	D	E	F
Receive and store eggs	(2) 30,000	(2) 30,000	(2) 30,000	(2) 30,000	(2) 30,000	(2) 30,000
Grade and tray eggs	(1) 4,000	(1) 4,000	(1) 4,000	(3) 4,500	(3) 4,500	(3) 4,500
Vacuum and clean incubators	(1) 38,000	(1) 38,000	(1) 38,000	(1) 38,000	(1) 38,000	(1) 38,000
Set eggs in incubator	(1) 20,000	(1) 20,000	(1) 20,000	(1) 20,000	(1) 20,000	(1) 20,000
Transfer and pull infertiles	(2) 1,300	(2) 1,600	(2) 2,000	(2) 2,800	(4) 2,800	(6) 2,800
Clean hatchers	(1) 14,000	(1) 14,000	(1) 14,000	(1) 14,000	(1) 14,000	(1) 14,000
Vacuum and clean building	(1) 10,000	(1) 10,000	(1) 10,000	(1) 10,000	(1) 10,000	(1) 10,000
Clean hatcher trays						
By hand	(1) 7,000	(1) 7,000	(1) 7,000	--- ---	--- ---	--- ---
By tray washer	--- ---	--- ---	--- ---	(1) 28,000	(1) 28,000	(1) 28,000
Pull infertile eggs 7 to 9 days after set	(2) 1,500	(2) 1,800	(2) 2,200	(2) 3,000	(4) 3,000	(6) 3,000
Consolidate eggs in trays and reset	(1) 12,000	(1) 12,000	(1) 12,000	(1) 12,000	(1) 12,000	(2) 12,000
Transfer eggs	(2) 3,000	(2) 4,000	(2) 6,000	(2) 7,000	(2) 7,000	(2) 7,000
	Quantity of poults per man hour					
Make poult boxes	(1) 4,000	(1) 4,000	(1) 4,000	(1) 4,000	(1) 4,000	(1) 4,000
Pull hatch, grade, count, and box poults	(2) 2,500	(2) 2,500	(2) 2,500	(2) 2,500	(4) 2,500	(8) 2,500
Load out poults	(2) 20,000	(2) 20,000	(2) 20,000	(2) 20,000	(2) 20,000	(2) 20,000

method, most workers can move only four eggs from the egg case to the tray in one motion. The mechanized method is five times faster than the conventional hand-traying technique. A time allowance for removal of cracked or low-quality eggs from the tray and replacing them by hand may reduce the efficiency to only four times faster than the hand-traying method. Therefore, with a vacuum egg trayer one man can tray 15 more cases of turkey eggs per hour than by conventional hand methods. In models D, E, and F, the two operators of the vacuum egg trayers are supplied with eggs from the cooler by another worker. With a constant supply of eggs, these operators can further increase their output (table 20).

The operations of pulling infertile eggs on the 24th day of the hatching cycle and transferring the fertile eggs from the incubator to the hatchers can be completed in less time than most hatcheries were using. Moving the turkey eggs across mass candling lights while still in their incubator trays can save time. The infertile eggs are pulled immediately and placed in regular egg cases for shipment to mink or fox farms or to a rendering plant. The fertile eggs are transferred to a hatchery tray and the tray is placed on a cart for movement to a hatcher when the cart is full. The use of a cart to transport trayed eggs to the hatchers may not be a significant timesaver in a small hatchery where the hatchers and incubators are close by. However, in a large hatchery where an employee must walk several feet to take a tray of eggs from the incubator to the worktable and candling bench and then to a hatcher in another section of the hatchery, the use of a cart will be a great timesaver. This method of pulling infertile and transferring fertile eggs is twice as fast as individual flash candling of each egg and handcarrying each individual tray.

Another saver of manual labor is the use of a mechanized tray washer in the three largest hatchery models. A tray washer has a capacity of washing 200 trays an hour, compared with only 50 trays per man-hour by hand. Before the trays are washed, waste must be cleaned out and put into barrels. The trays are then moved by dollies to the washing area. After the trays are washed, they are placed on carts and when sufficiently dry they are moved into the transfer area for future use.

In the model hatcheries all boxes, trays, and egg cases (full or empty) were moved on dollies or carts. If the proposed schedules of operations shown in tables 14 through 17 are used, then the supplies needed for nearly every operation will be in large enough quantities to utilize dollies or carts. The use of easy-to-move dollies and carts can save many trips and man-minutes for the hatchery employees. It will also minimize the amount of lifting necessary to operate an efficient hatchery.

The number of in-hatchery employees needed varied from 2 in models A and B to 12 in model F (table 21). In the first four model hatcheries some part-time help was employed. Because of the irregularity of tasks performed from day to day in the hatchery cycle, more help was needed on certain days than on other days (table 22). In models A, B, and C, no overtime work was required, although the manager had to check the machines occasionally for malfunctions on Sunday. In the larger models overtime was paid to employees for transferring and pulling infertile eggs on Sunday (table 21). The hatchery employees in models D, E, and F shared the Sunday chores on a rotation basis and all drew equal overtime pay.

Labor efficiency in the six model hatcheries showed a great increase in productivity over the plants surveyed. The number of poults hatched per man-hour was 286 in model A, 327 in model B, 356 in model C, and 431 for models D, E, and F. The increased use of laborsaving equipment and the refined definition of in-hatchery activities caused the productivity per man-hour to be higher than was shown in table 11 for hatcheries in the survey.

Table 21.--Number of employees and hours worked per week in 6 model turkey hatcheries at 100 percent of capacity

Use of man-hours	Model											
	A		B		C		D		E		F	
	Men	Hrs.	Men	Hrs.	Men	Hrs.	Men	Hrs.	Men	Hrs.	Men	Hrs.
Regular	(1	7.0	1	25.1	1	17.0	1	10.0	5	40.0	12	40.0
hours per	(				1	40.0	1	30.0				
man	(1	30.0	1	40.0	1	32.9	2	40.0	2	20.0	---	---
Overtime hours per man	---	---	---	---	---	---	1/2	1.8	1/2	3.6	1/2	7.1
Total men and man-hours per week	2	37.3	2	65.1	3	89.9	4	123.6	6	247.2	12	494.2

1/ Two men every Sunday are paid overtime for transferring and pulling infertile eggs. Men rotate so all will draw equal overtime pay.

Table 22.--Weekly labor requirements for 6 model turkey hatcheries when infertile eggs are pulled on the 24th day of the hatching cycle

Day of the week	Model					
	A	B	C	D	E	F
	Man-hours					
Monday	7.70	12.55	15.50	22.17	44.36	89.08
Tuesday	8.50	11.05	12.35	20.66	41.32	76.74
Wednesday	3.50	8.50	13.40	20.66	41.32	76.74
Thursday	1.00	5.65	15.70	22.71	45.42	91.22
Friday	14.60	17.85	16.15	18.27	36.54	86.16
Saturday	1.00	8.50	15.80	12.33	24.64	47.08
Sunday	1.00	1.00	1.00	6.80	13.60	27.18
Total	37.30	65.10	89.90	123.60	247.20	494.20

Labor costs in the model hatcheries were restricted to those costs inside the hatchery; i.e., costs started when the hatching eggs were placed on the conveyor for entrance into the cooler and ended when the poults were loaded out into the delivery vehicles. The actual total labor costs in the hatcheries studied included such costs as public relations, some sales, and flock recordkeeping.

In the model hatcheries, a 60 percent hatchability rate was used whereas most active hatcheries had less than 60 percent hatchability. The quantity of salable poults, on which total costs per poult were based, was obtained for each model hatchery by deducting from the quantity of eggs set 20 percent for infertile eggs, 20 percent for nonhatchable eggs, 2 percent for culls, and 2 percent for extras. Therefore, the number of salable poults equaled 56 percent of the number of eggs set. Most actual turkey hatcheries are still trying to achieve this goal of selling poults from 56 percent of all eggs set.

Managerial Costs

The management of a hatchery can often provide the difference between a profitable, efficient modern hatchery and a hatchery that is operating on its undepreciated capital. Each manager of the three smaller hatchery models was responsible for the entire in-plant hatchery operation, including the office duties. The managers in models B and C relied on one of their employees to handle the essential items if they had to be away from the hatchery. In model A the manager was the only full-time employee of the hatchery. Therefore, he would have to plan to be away from the hatchery only on the days when his workload was light, as on Thursday and Saturday when he only needed to check the machines for malfunctions.

In all the model hatcheries, the plant manager and supervisors were working employees in the hatchery. In models A, B, and C, the manager performed two functions, (1) as decision maker and (2) as a production worker. As the hatcheries increased in size his role as a production worker decreased. The salaries of the managers and supervisors were established on the basis of their increasing responsibility as the model hatcheries became larger (table 23). In models E and F, the supervisor was responsible for a good portion of the plant operation, and the manager divided his time between management of the office and plant. Only in the largest

model was a separate office manager needed to handle the in-plant hatchery bookkeeping, payroll accounts, inventory accounts, producer accounts, and ordering of hatchery supplies. Also in model F the owner-office manager was responsible for supervising four office employees and assisting the plant manager with management decisions (table 23).

Table 23.--Managerial, supervisory, and secretarial labor requirements for the in-hatchery operation of 6 model turkey hatcheries

Model hatchery	Managerial		Supervisory 1/		Secretarial		Total salaries per year
	Number	Salary per year	Number	Salary per year	Number	Salary per year	
		Dollars		Dollars		Dollars	Dollars
A	1	3,722	---	---	---	---	3,722
B	1	4,123	---	---	---	---	4,123
C	1	5,200	---	---	½ time	1,820	7,020
D	1	6,500	---	---	1	3,640	10,140
E	1	7,800	1	4,160	2	7,280	19,240
F	(1	(7,800					
	(1	(6,240	1	5,200	4	14,560	33,800

1/ Supervisors work a minimum of 40 hours a week in the hatchery, with no office duty.

Management efficiency was difficult to calculate because most hatcheries were operated in connection with other enterprises and the management staff had a multitude of jobs to perform. In these six models, management was responsible for scheduling the in-plant operations, office procedures, employee performance, and actually working in the hatchery. The division of weekly man-hour inputs for the manager of each model hatchery is shown in table 24. Since this study is limited to in-hatchery activities, the management in these models was not responsible for turkey-breeding operations, egg procurement, assembling, sales of poults, advertising, distribution of poults, and service to the producers of the hatching eggs or the growers of the poults. These excluded functions would require a number of additional service personnel which some actual hatcheries currently have. However, if the turkey hatchery is a segment of an integrated turkey operation then the functions of sales, advertising, and egg procurement from independent producers would be avoided.

Table 24.--Division of manager's weekly man-hour inputs between hatchery and office in six model turkey hatcheries

Model hatchery	Weekly man-hours in--	
	Hatchery	Office
A	30.3	10.0
B	25.1	20.0
C	32.9	10.0
D	30.0	10.0
E	20.0	20.0
F	1/40.0	2/40.0

1/ Fulltime in-hatchery manager.
2/ Fulltime office and general manager.

Cost of Supplies

Supplies were purchased every 4 weeks in large enough quantities to fulfill the hatchery needs until the next purchase date. The unit cost of egg cases, pads, boxes, and lids decreased slightly with increased volume purchases.

The costs per poult for supplies varied slightly. In each model hatchery the costs per poult were the same whether the hatchery operated at 80 or 100 percent of capacity. However, the number of poults hatched at 40 and 60 percent of capacity required smaller quantities of supplies, and so the price per unit went up. For instance, in model A the costs of supplies per poult hatched was 0.6173 cent at 100 percent of annual capacity, and 0.6260 cent at 40 percent of capacity. In the largest hatchery, model F, costs per poult varied from 0.5503 cent at 100 percent of annual capacity to 0.5603 cent at 40 percent of capacity.

Costs of Utilities

Costs of utilities were estimated by using the lower rates obtained by the more efficient hatcheries in each size group. Such rates were adjusted to a 12-month average for the hatcheries that were active for 7 or more months a year.

The greater the use of electricity, water, and fuel, the lower the rate paid by the firm. A few firms obtained even lower rates on utilities by using them for the hatchery, feed mill, and occasionally their processing plants. The cost of these utilities will vary depending on the weather from year to year, the condition and insulation of the building, quality and type of equipment, and the location of the hatchery in the United States. The expense of a telephone was omitted from these model hatchery costs.

Summary of Costs

The average total cost per poult hatched in the six model hatcheries decreased as the volume of poults hatched increased. A cost comparison of each hatchery operating on an annual basis and for a 34-week period is given in this section. Each hatchery is operating at 100 percent of capacity during the established period.

Annual Operation

With infertile eggs pulled on the day of transfer, operating costs per poult ranged from 3.88 cents in the smallest model to 2.39 cents in the largest model. The two largest cost items in models A and B were utilities and labor. In the four larger models, labor and supplies were the largest cost components. In all six hatcheries, the total variable costs were considerably greater than the total fixed costs.

Economies of scale are evident in all cost components except miscellaneous costs and labor. Miscellaneous costs, which represented not over 4.6 percent of the average total costs of any model, show diseconomies in all models larger than model A (table 25). This was essentially due to the increased needs for office supplies and donations to community activities which larger firms are expected to make.

Diseconomies in labor costs were evident only in model C. In this model the manager's salary was $100 a week, compared to $70 per week in models A and B. Also, a half-time secretary was necessary in model C. Another factor that increased

Table 25.--Summary of estimated hatching costs per poult for 6 model turkey hatcheries at 100 percent of capacity, with infertilies pulled on day of transfer, 52-week season

Cost components	Model					
	A	B	C	D	E	F
	Cents					
Fixed costs:						
Equipment depreciation	0.4608	0.3753	0.3690	0.3532	0.3445	0.3365
Building depreciation	.1624	.1534	.1443	.1299	.1137	.0943
Building repairs and maintenance	.1001	.0934	.0875	.0790	.0687	.0570
Equipment repairs and maintenance	.2625	.1625	.1339	.1125	.0982	.0821
Taxes	.0823	.0713	.0663	.0639	.0545	.0542
Insurance	.0823	.0713	.0663	.0639	.0545	.0542
Interest	.2470	.2140	.1990	.1918	.1634	.1625
Miscellaneous costs	.0902	.1353	.1383	.1119	.0938	.0947
Average total fixed costs	1.4876	1.2765	1.2046	1.1061	.9913	.9355
Variable costs:						
Utilities	.9968	.6797	.4964	.3869	.3214	.2509
Supplies	.6173	.6069	.5859	.5709	.5603	.5503
Labor	.7766	.6986	.7342	.6792	.6604	.6508
Average total variable costs	2.3907	1.9852	1.8165	1.6370	1.5421	1.4520
Average total costs	3.8783	3.2617	3.0211	2.7431	2.5334	2.3875
	Poults					
Number of salable poults per year	554,214	1,108,425	1,662,636	2,771,060	5,542,118	11,084,236

the labor cost per poult hatched from 0.6986 cent in model B to 0.7342 cent in model C was labor productivity, which decreased at an increasing rate as the size of hatchery moved from 2 million eggs set to 3 million eggs set (table 20).

34-Week Operation

The average total cost of hatching turkey eggs increases as the length of hatching season is shortened. With a hatching season of 34 weeks, where hatches were pulled for 30 weeks of the season, the average total cost per poult was 5.06 cents in model A and 3.18 cents in model F (table 26). These costs per poult hatched were considerably greater than when these two model hatcheries were operated on an annual basis (table 25). The major increase in cost was due to the larger fixed costs involved with the smaller number of poults hatched. The total fixed cost in actual dollars does not change with the reduction in quantity of poults hatched. Whether a hatchery operates at 50 percent of capacity or at 100 percent of capacity, the dollar value of fixed costs of depreciation, interest, taxes, and insurance will not change significantly with a given size of hatchery.

The quantity of equipment used for the 34-week operation was the same as in the annual operation of each model hatchery. This may have some drawbacks when a hatchery operates less than 52 weeks. The tray washer in model D is an example of this problem. A tray washer will justify its capital cost and be more efficient than tray washing by hand when 4 million or more eggs are set a year. In the annual operation of model D more than 4 million eggs are set a year, but in the 34-week hatching season only 2.8 million eggs are set. Therefore, total costs in a 34-week season could be reduced in model D if the tray washer was not installed and the trays were hand washed. If a hatchery manager decided that he would never set over 4 million eggs a year, then he would not purchase the tray washer but would use more hours of labor and do the job by hand.

The average total variable costs will differ with the length of season a hatchery is operated, with the change in discounts for quantity purchases of utilities and supplies, and with the availability of competent labor for less than full-time operation. In all model hatcheries operating only 34 weeks a year, the average total variable costs per poult increased over the costs on an annual basis (tables 25 and 26). Labor costs increased slightly, due to the cost of management and supervisory labor. In the 34-week season of operation, it was assumed that competent labor could be obtained that could attain the output per man-hour utilized in the full-time hatcheries (table 20).

The scheduling of eggs set for a 34-week season differs from the annual system, in which incubators are set and poults are hatched every week. The first 4 weeks in a 34-week hatch season are limited to setting eggs, and transferring eggs on the 24th day. No poults are pulled until the 28th day of each hatching cycle. Therefore, the amount of labor needed during the first 3 weeks is limited to the man-hours required for receiving, storing, grading, traying, and setting the hatching eggs. Some time is also required for surveillance, cleaning the hatchery, and getting organized for a full-scale operation. In the 4th week, the pulling of infertiles and transferring of eggs to the hatchers requires additional labor. The next 26 weeks are duplicates of the schedules shown in tables 14 to 17. The last 4 weeks of the 34-week hatching season are basically limited to transferring eggs from incubators to hatchers, pulling hatches, grading, counting, and boxing poults. During these 4 weeks no eggs are received, graded, trayed, or set, since this would prolong the hatching season. Part of the time is used to prepare the hatchery for closing down.

Table 26.--Summary of estimated hatching costs per poult for 6 model turkey hatcheries at 100 percent of capacity, with infertiles pulled on day of transfer, 34-week season

Cost components	Model					
	A	B	C	D	E	F
	Cents					
Fixed costs:						
Equipment depreciation	0.7988	0.6505	0.6396	0.6121	0.5971	0.5833
Building depreciation	.2815	.2658	.2502	.2252	.1970	.1634
Building repairs and maintenance	.1736	.1619	.1517	.1370	.1192	.0988
Equipment repairs and maintenance	.4550	.2817	.2321	.1950	.1702	.1424
Taxes	.1427	.1236	.1150	.1108	.0944	.0939
Insurance	.1427	.1236	.1150	.1108	.0944	.0939
Interest	.4282	.3709	.3450	.3324	.2831	.2817
Miscellaneous costs	.1564	.2346	.2398	.1939	.1626	.1642
Average total fixed costs	2.5789	2.2126	2.0884	1.9172	1.7180	1.6216
Variable costs:						
Utilities	1.0550	.9050	.7500	.4974	.3879	.3150
Supplies	.6225	.6140	.6050	.5869	.5719	.5635
Labor	.8073	.7235	.7701	.7183	.6966	.6845
Average total variable costs	2.4848	2.2425	2.1251	1.8026	1.6564	1.5630
Average total costs	5.0637	4.4551	4.2135	3.7198	3.3744	3.1846
	Poults					
Number of salable poults	319,738	639,475	959,213	1,598,688	3,197,376	6,394,752

Effects of Pulling Infertile Eggs 8 to 9 Days After Set

To increase the number of poults hatched per hatchery, management could decide to pull and replace infertile eggs 8 to 9 days after they are set. Pulling infertile eggs on the 8th or 9th day after being set, instead of waiting until the 24th day when the eggs are transferred to hatchers, usually increases the capacity of a hatchery up to 30 percent.

Labor Requirements

Pulling the infertile eggs early required additional labor (tables 27 and 28). In the smallest model hatchery, where eggs were set only once a week, 7.6 additional man-hours were required. The additional operations were consolidating the fertile eggs to make full trays, resetting, replacing the infertile eggs with fresh eggs, transferring and pulling infertiles of small set, and pulling the extra hatch. Additional time was also required for cleaning hatch trays, hatchers, incubators, and portions of the hatchery. Recordkeeping becomes more important when more than one setting goes into a single incubator.

Table 27.--In-hatchery labor requirements per week to perform specified jobs, 6 model turkey hatcheries at 100 percent of capacity

Jobs performed	Model and Number of eggs set per year					
	A (989,664)	B (1,979,328)	C (2,968,992)	D (4,948,320)	E (9,896,640)	F (19,793,280)
	Man-hours					
Receive and store eggs	0.7	1.3	2.0	3.3	6.7	13.3
Grade and tray eggs	5.0	10.0	15.0	22.2	44.4	88.8
Set eggs	1.0	1.9	2.8	4.8	9.5	19.0
Transfer and pull infertiles	14.6	23.8	28.6	34.0	68.0	135.9
Make poult boxes	2.7	5.4	8.0	13.3	26.7	53.3
Pull hatch, grade, count, and box poults	4.6	9.1	13.7	22.8	45.7	91.4
Load out poults	.5	1.1	1.6	2.7	5.3	10.7
Clean hatchers	1.1	2.2	3.3	5.6	11.1	22.2
Clean hatcher trays by:						
Tray washer	--	--	--	2.9	5.8	11.5
Hand	2.2	4.5	6.7	--	--	--
Clean hatchery	1.9	3.8	5.7	9.5	19.0	38.1
Clean and vacuum incubators	.5	1.0	1.5	2.5	5.0	10.0
Check machines	2.5	1.0	1.0	--	--	--
Total in-hatchery man-hours per week	37.3	65.1	89.9	123.6	247.2	494.2

Table 28.--In-hatchery labor requirements per week to perform specified jobs, when infertile eggs are pulled on eighth or ninth day of hatching cycle, 6 model turkey hatcheries at 114 percent of capacity 1/

Jobs performed	Model and number of eggs set per year					
	A (1,130,064)	B (2,260,128)	C (3,390,192)	D (5,650,320)	E (11,300,640)	F (22,601,280)
	Man-hours					
Receive and store eggs	0.7	1.5	2.2	3.7	7.6	15.2
Grade and tray eggs	5.7	11.5	16.2	23.3	48.2	96.4
Set eggs	.9	1.8	2.7	4.5	9.0	18.0
Transfer eggs	4.8	7.2	7.2	10.4	20.6	41.2
Pull infertiles	12.0	20.0	24.6	30.2	60.2	120.2
Consolidate eggs into trays and reset	1.5	3.0	4.5	7.5	15.0	30.0
Transfer and pull infertiles	2.8	4.5	5.4	6.4	12.9	25.8
Make poult boxes	3.5	7.0	10.5	17.5	35.0	70.0
Pull hatch, grade, count, and box poults	5.6	11.1	16.7	27.8	55.8	111.6
Load out poults	.7	1.4	2.1	3.5	7.0	14.0
Clean hatchers	1.5	3.0	4.0	6.5	13.0	26.0
Clean hatcher trays by:						
Tray washer	--	--	--	3.1	6.2	12.4
Hand	2.3	4.6	6.9	--	--	--
Clean hatchery	1.4	2.7	6.5	10.9	21.6	43.5
Clean and vacuum incubators	.5	1.0	1.5	2.5	5.0	10.0
Check machines	1.0	--	--	--	--	--
Total in-hatchery man-hours per week	44.9	80.3	111.0	157.8	317.1	634.3

1/ Infertile eggs were pulled on the ninth day of the hatching cycle in models A and B; on the eighth day in models C, D, E, and F. Twenty percent of initial set of eggs at 100 percent of capacity are infertile. When replaced with fresh eggs, the annual number of eggs set per hatchery is increased by 14.18 percent.

The number of regular employees increased with the change in operations. For example, in model F the increase was from 12 to 15 full-time employees (tables 21 and 29).

In the largest hatchery, model F, the labor required per week when infertiles were pulled early was 634.3 man-hours compared to only 494.2 man-hours when infertiles were pulled on the day of transfer (tables 27 and 28). The added 140.1 man-hours handled the additional hatching of 54,000 eggs a week. This was equivalent to 30,240 extra salable poults each week, or a productivity per man-hour of 385.4 poults. When the infertile eggs were pulled on the regular day of transfer, the productivity per man-hour was 431 poults. Therefore, on the basis of labor inputs alone, the extra effort to pull infertiles early increased the cost per poult hatched.

Schedule of Hatchery Operations

The scheduling of weekly in-hatchery functions used in these models resulted in the man-hour requirements shown in table 30. A number of variations are apparent. In model A, the work of pulling infertiles, shuffling eggs to obtain full trays, and replacing infertile eggs with fresh eggs caused the man-hour requirements to be higher on Wednesday than on the other days of the week. The large set of eggs was made on Monday of each week in model A and the infertile eggs were pulled on the ninth day, the second Wednesday after setting. Infertile eggs could be pulled on the eighth, ninth, or tenth day of the cycle. To level out the work flow in the models, infertiles were pulled on the ninth day in models A and B and the eighth day in models C, D, E, and F. In model B, Wednesday became a slack day since the major time-consuming activities were shifted to the other 4 main workdays of the week (table 30).

The daily man-hour requirements in model C had the least variation of any model, ranging from a low of 16.5 man-hours on Saturday to 19.0 man-hours on Tuesday (table 30). In model C the infertile eggs were pulled on a different day than the day the turkey eggs were graded and trayed. These two activities were the largest time-consuming chores in a hatchery; therefore, arranging them to occur on different days would help to better distribute the daily work load. The work schedule was the same for models D, E, and F except that the number of incubators set per day was doubled each time. In these three models, the egg grading and traying were bunched into 3 days, Monday, Wednesday, and Friday.

Increase in Capacity

The number of salable poults hatched when infertile eggs were pulled on the eighth or ninth day of the hatching cycle increased more than 11 percent over the number of poults hatched when infertile eggs were pulled on day of transfer. If 20 percent of the original setting was infertile eggs, the hatcheries theoretically could hatch at 114 percent of capacity as previously defined.

The increase in use of capacity could cause problems in utilization of incubators. As an example, assume a hatchery sets only one incubator a week and the first set is on Monday (hereafter called large set). Nine days later the infertile eggs are pulled and placed loose in egg cases. The remaining fertile eggs are shuffled around to fill trays, then reset. At the same time, previously trayed fresh eggs (the small set) equivalent to the number of infertile eggs are set and placed in the same incubator. Fifteen days later, the large set is transferred to the hatchers, leaving only the small set in the incubator. At this time a large set is reset after the incubator is quickly

Table 29.--In-hatchery regular and overtime labor requirements per week when infertile eggs are pulled on the eighth or ninth day, 6 model turkey hatcheries, at 114 percent of capacity

Use of man-hours	Model											
	A		B		C		D		E		F	
	Men	Hrs.	Men	Hrs.	Men	Hrs.	Men	Hrs.	Men	Hrs.	Men	Hrs.
Regular hours per man	(1	14.0	1	40.0	2	40.0	1	7.4	7	40.0	15	40.0
	(1	30.9	1	15.0	1	31.0	2	40.0	1	17.3	---	---
	---	---	1	25.3	---	---	2	30.0	---	---	---	---
Overtime hours per man	---	---	---	---	---	---	1/2	5.2	1/3	6.6	1/7	4.9
Total men and in-hatchery man-hours per week	2	44.9	3	80.3	3	111.0	5	157.8	8	317.1	15	634.3

1/ These men are paid overtime for transferring eggs, pulling infertiles, and making poult boxes on Sunday. Men rotate so all will draw equal overtime pay.

Table 30.--In-hatchery labor requirements by day of week, 6 model turkey hatcheries when infertile eggs are pulled on the eighth or ninth day of the hatching cycle 1/

Day of week	Model					
	A	B	C	D	E	F
	Man-hrs.					
Monday	7.5	16.8	17.7	24.9	50.0	99.8
Tuesday	3.9	15.1	19.0	25.5	51.9	103.8
Wednesday	14.4	6.8	18.8	28.3	55.6	111.3
Thursday	5.7	14.7	16.6	24.6	53.3	106.7
Friday	4.4	13.4	17.1	24.1	45.7	91.6
Saturday	8.0	11.3	16.5	20.0	40.8	81.7
Sunday	1.0	2.2	5.3	10.4	19.8	39.4
Total	44.9	80.3	111.0	157.8	317.1	634.3

1/ Infertile eggs were pulled on the ninth day of the hatching cycle in models A and B; on the eighth day in models C, D, E, and F.

vacuumed out and cleaned. However, this set would be smaller than the first large set by the size of the first small set. Four days later the large hatch is pulled from the hatchers, and the poults are graded, counted, and boxed. Five days later the first small set is transferred to the hatchers after the infertiles are pulled to allow more room for hatching. This same day the infertiles of the second large set can be pulled and the second small set can be completed. This second small set will be larger than the first small set. After a period of several settings, the size of each large and small setting will become fairly uniform. Thus, the cycle continues with each function being performed on a different day, which results in uneven weekly work scheduling. The first large set was on a Monday, the second large set on a Thursday, and the third large set on a Sunday.

Therefore in the model hatcheries, large settings were made on the same days each week and the small settings were placed in the incubators on a regular basis, which facilitates a systematic hatching cycle, helps regulate the labor inputs, and provides for a consistent weekly hatch schedule. In model A only one large setting was made a week, every Monday. In model B there were 2 large settings a week, every Tuesday and Saturday. Model C was operated with large settings on Monday, Wednesday, and Friday, or 3 times a week. The remaining 3 models, D, E, and F, each operated with 5 large settings a week, every Monday, Tuesday, Wednesday, Thursday and Friday. With these schedules the incubators were not always filled to maximum capacity, but the advantage of a regular weekly work schedule outweighed the disadvantage of the incubators not being completely filled all the time. This disadvantage became negligible when large settings were made on 2 or more days of the week. 10/

If a hatchery plans to operate only 34 weeks a year, the manager may profit by pulling a specified number of infertile eggs each time from the first large setting to the last large setting. This will help regulate the size of each set, both large and small, the number of poults available each week, and the weekly in-hatchery schedule of activities. A hatchery that operates year-round will set a uniform number of eggs

10/ Weekly schedules of these activities are shown in detail in the supplement to this report.

each time if a certain percentage of infertiles are assumed and only that many are pulled. Otherwise, the number of infertiles pulled will vary with the seasons of high-fertility and low-fertility eggs. A variation in the number of infertiles pulled from each large setting will require an elaborate recordkeeping system, a variation in labor requirements, and possibly larger overtime payments for additional grading and traying of eggs and for the removal of the extra infertile eggs. Late in the hatching season another problem sometimes develops as some of the eggs explode in the incubator, causing cleaning and contamination problems. However, if the hatchery has a large demand for poults, solving these extra problems may be worthwhile.

The increase in number of salable poults can be seen in comparing table 25 with table 31 for annual operations and table 26 with table 32 for a 34-week hatching season.

Changes in Cost Components

The additional labor cost of pulling infertile eggs 8 to 9 days after set were offset by the decrease in all other costs per poult. The fixed costs were reduced because of the larger output of poults. The utility and supply costs were reduced because of the quantity discounts given to larger users of these products. Hence, if the assumptions used in this analysis were reasonable, then it would pay turkey hatchery managers to have the infertile eggs pulled as soon as they can be easily detected when placed over mass candling lights.

In model A, operating on an annual basis, where one incubator was set a week and the infertiles were pulled on the ninth day after being set, the cost per poult was 3.6113 cents compared to 3.8783 cents when the infertile eggs were pulled on the 24th day of the hatching cycle (table 33). In the largest hatchery, model F, the cost per poult was 2.2982 cents when infertiles were pulled on the eighth day and 2.3875 cents when infertiles were pulled on the day of transfer. As the size of hatchery increased, the spread in cost per poult decreased between one system and the other. In the annual operation of hatchery model A, the spread was 0.2670 cent per poult and in model F it was 0.0893 cent per poult. Thus, when the hatcheries were operated on an annual basis the decrease in cost per poult became less significant as the hatchery grew in size. In the 34-week hatching season, the same trend was noticeable but not as pronounced. The spread in model A was 0.3239 cent and in model F it was 0.1840 cent per poult (table 33).

Itemized costs per poult hatched are shown in tables 31 and 32. The trend is the same as when the infertile eggs were pulled on day of transfer except the fixed costs per poult are lower and labor costs are higher. Here again, the labor costs per poult hatched in model C was higher than in model B or model D.

Table 31.--Summary of estimated hatching costs per poult in 6 model turkey hatcheries at 114 percent of capacity, infertile eggs pulled on the eighth or ninth day after set, 52-week season

Cost components	Model					
	A	B	C	D	E	F
	Cents					
Fixed costs:						
Equipment depreciation	0.4036	0.3287	0.3232	0.3093	0.3017	0.2947
Building depreciation	.1422	.1343	.1264	.1138	.0996	.0826
Building repair and maintenance	.0877	.0818	.0766	.0692	.0602	.0499
Equipment repair and maintenance	.2299	.1423	.1173	.0985	.0860	.0719
Taxes	.0721	.0625	.0581	.0560	.0477	.0474
Insurance	.0721	.0625	.0581	.0560	.0477	.0474
Interest	.2163	.1874	.1743	.1680	.1431	.1423
Miscellaneous costs	.0790	.1185	.1211	.0980	.0822	.0830
Average total fixed costs	1.3029	1.1180	1.0551	.9688	.8682	.8192
Variable costs:						
Utilities	.9050	.6797	.4964	.3850	.3100	.2509
Supplies	.6140	.6069	.5859	.5670	.5585	.5503
Labor	.7894	.7212	.7532	.7029	.6915	.6778
Average total variable costs	2.3084	2.0078	1.8355	1.6549	1.5600	1.4790
Average total costs	3.6113	3.1258	2.8906	2.6237	2.4282	2.2982
	Poults					
Number of salable poults	632,836	1,265,672	1,898,508	3,164,179	6,328,358	12,656,717

Table 32.--Summary of estimated hatching costs per poult in 6 model turkey hatcheries at 114 percent of capacity, infertile eggs pulled on the eighth or ninth day after set, 34-week season

Cost components	Model					
	A	B	C	D	E	F
	Cents					
Fixed costs:						
Equipment depreciation	0.6995	0.5697	0.5602	0.5361	0.5229	0.5108
Building depreciation	.2465	.2328	.2191	.1972	.1726	.1431
Building repair and maintenance	.1520	.1417	.1328	.1200	.1044	.0865
Equipment repair and maintenance	.3985	.2467	.2033	.1708	.1491	.1247
Taxes	.1250	.1083	.1007	.0970	.0827	.0822
Insurance	.1250	.1083	.1007	.0970	.0827	.0822
Interest	.3750	.3248	.3021	.2911	.2480	.2467
Miscellaneous	.1369	.2054	.2100	.1698	.1424	.1438
Average total fixed costs	2.2584	1.9377	1.8289	1.6790	1.5048	1.4200
Variable costs:						
Utilities	1.0500	.9050	.7500	.4974	.3650	.3150
Supplies	.6200	.6140	.6050	.5869	.5680	.5635
Labor	.8114	.7318	.7798	.7306	.7172	.7021
Average total variable costs	2.4814	2.2508	2.1348	1.8149	1.6502	1.5806
Average total costs	4.7398	4.1885	3.9637	3.4939	3.1550	3.0006
	Poults					
Number of salable poults	365,100	730,200	1,095,300	1,825,470	3,651,000	7,301,940

Table 33.--Summary of average costs per poult in 6 model turkey hatcheries, annual and 34-week seasons, with infertile eggs pulled at different times in the hatching cycle

Process performed	Model					
	A	B	C	D	E	F
	Cents					
Annual operation when:						
Infertiles are pulled on day of transfer	3.8783	3.2617	3.0211	2.7431	2.5334	2.3875
Infertiles are pulled on eighth or ninth day of cycle	3.6113	3.1258	2.8906	2.6237	2.4282	2.2982
Difference	.2670	.1359	.1305	.1194	.1052	.0893
34-week operation when:						
Infertiles are pulled on day of transfer	5.0637	4.4551	4.2135	3.7198	3.3744	3.1846
Infertiles are pulled on eighth or ninth day of cycle	4.7398	4.1885	3.9637	3.4939	3.1550	3.0006
Difference	.3239	.2666	.2398	.2259	.2194	.1840

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