THE CHEESE INDUSTRY IN OKLAHOMA - STRUCTURAL CHANGES AND POTENTIAL

By

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Bachelor of Science

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Stillwater, Oklahoma

1962

Submitted to the faculty of the Graduate School of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1965

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Thesis Approved:

Thesis Adviser

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ACKNOWLEDGMENTS

Deep appreciation is extended to Dr. Leo V. Blakley, thesis adviser, for his assistance and cooperativeness during the course of this study and throughout all phases of the graduate program. Thanks are due Dr. Kenneth B. Boggs and Dr. John R. Franzmann for their helpful criticisms and suggestions.

I wish to express appreciation to the Agricultural Economics Department of Oklahoma State University for providing the financial assistance for making this study possible.

The invaluable information made available by Mr. M. C. Stanley and Mr. Clarence Davis of Armour and Company Creamery, Chickasha, Oklahoma, was also greatly appreciated.

I wish to recognize Mrs. Juanita Marshall, Memory Lewis, and Judy Tilton for the typing of the final and all other previous drafts.

Finally, I would like to express special appreciation and thanks to Mr. and Mrs. Troy Hines, and other members of the family, who have been a constant source of encouragement and assistance during my undergraduate and graduate study.

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CHAPTER I

INTRODUCTION

The dairy industry in the United States has undergone vast changes in the last 30 years. The relative importance of the products produced and consumed has changed as a result of improved technology and changing consumer demands. On the farm, total production of milk has increased with increases in production per cow more than offseting declines in dairy cattle numbers. The number of farms reporting milk sold decreased, but average sales per farm increased. Many of the same types of changes have been apparent for the dairy processing industry as for dairy production. Total annual production and consumption of processed dairy products have increased during the last 30 years, but plant numbers have decreased as average production per plant increased.

The dairy industry in Oklahoma has experienced many of the same trends evident for the United States. The fluid milk sector has become the most important outlet for milk marketed by Oklahoma farmers, and the producers are fewer in number with larger sales per farm. Whole milk sold by farmers increased from 30 percent of milk marketings in 1930 to 90 percent in 1960. Similar changes have occurred for the processors. They are fewer in number and have larger volumes per plant.

The growth of the fluid milk sector of the dairy industry in Oklahoma during the past 30 years resulted from several economic forces. Among the forces were increasing consumer incomes, increasing urbanization of the population, larger proportions of milk produced entering commercial channels, and higher returns from the sale of Grade A milk than from manufacturing milk or farm separated cream.

Even though the Grade A fluid milk sector has increased and the sale of manufacturing milk by dairy producers in Oklahoma has declined, the manufacturing milk sector of the dairy industry remains important. The major difference from 30 years ago is the source of the milk. Much of the milk used for manufactured dairy products is now obtained as a by-product from the Grade A fluid milk industry. Based on recent trends, this source could become the only source of manufactured milk supplies in future years.

Historically, cheese has been one of the major products utilizing manufacturing grade fluid milk in Oklahoma. Milk used in manufacturing cheese has represented from four to nine percent of milk marketed by Oklahoma farmers since 1942. The percentage has been quite variable from year to year, but no trend has been evident. In contrast, butter has represented a declining segment of the Oklahoma dairy industry as represented by the drastic decrease in the sales of farm separated cream. Butter now appears to be sufficiently competitive for supplies since the surplus Grade A milk from the fluid markets can be used in manufacturing butter and nonfat skim milk powder rather than in manufacturing cheese.

The future of the cheese industry in the state must depend on the market for cheese and the relative profitability of processing cheese as compared with manufacturing butter and other processed dairy products.

The purpose of this study, therefore, was to evaluate the potential of the cheese industry in the state by considering (1) trends in the production and consumption of cheese in the nation, (2) changes in the structure of the dairy industry of the state, and (3) relative costs and returns of processing the surplus Grade A milk into cheese.

The study was organized into six chapters in addition to the Introduction. In Chapter II, changes in the national market for cheese were examined. Trends in the production and utilization of cheese during the period 1930-1962 were analyzed.

Changes in the structure of the cheese industry of the state were analyzed in Chapter III. The analysis involves changes in the number and sizes of the plants manufacturing cheese and the relative importance of cheese manufacturing to the dairy industry. This analysis was based on data for the period 1942-1962 which were obtained from the Dairy Commissioner, State Department of Agriculture and the Statistical Reporting Service, U. S. Department of Agriculture.

The costs associated with manufacturing cheese were estimated in Chapter IV. The various cost estimates were those incurred in a model plant containing eight 10,000 pound cheese vats. The costs of manufacturing cheese in the specified model plant were based on (1) computed utility and labor requirements, (2) utility and wage rate schedules relevant to Oklahoma, and (3) estimated building, equipment, and land costs for a model plant.

An analysis of the effects of the seasonality of milk supplies on the costs of manufacturing cheese in the model plant were analyzed in Chapter V. This analysis consisted of computing cost levels associated with average daily milk receipts which corresponded with the estimated seasonality of milk supplies. Also, three alternative operating plans were investigated with regard to the profitability and feasibility of processing seasonal milk supplies into cheese in the model plant.

In Chapter VI, the cost estimates of Chapter IV were employed to determine the competitive position of cheese plants in the utilization of surplus milk supplies in Oklahoma. Milk supplies available to cheese plants were considered to include surplus Grade A and manufacturing milk. The supplies for potential Oklahoma milk manufacturing plants were estimated on the basis of total manufacturing milk and Grade A milk in excess of fluid and selected Class II product needs. By assuming that all the milk available for manufacturing purposes would be utilized in cheese production, three plans were investigated with respect to the number of plants needed to process the estimated milk supplies into cheese, and the type of seasonal operation most profitable for the plants involved.

CHAPTER II

PRODUCTION AND UTILIZATION OF CHEESE IN THE UNITED STATES

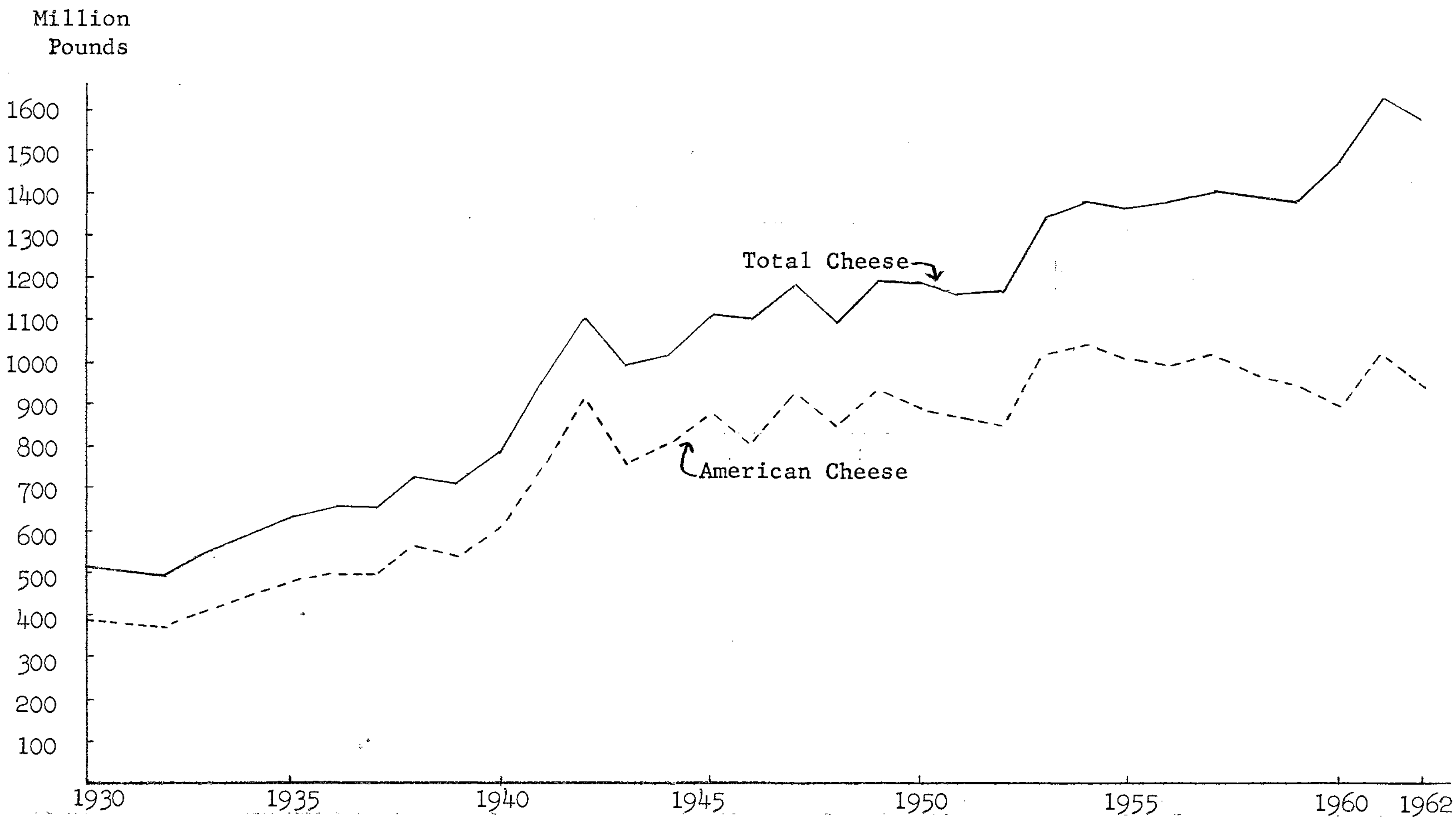
At the national level, cheese has been second only to butter as a manufactured dairy product. It has utilized from five to ten percent of total milk production of the United States since 1930 and about one-seventh of the whole milk sold by farmers.

Cheese has a fairly high value relative to transportation and handling costs, and its production has been centered in the Wisconsin-Minnesota area. However, the market for cheese is national in scope. Since cheese produced in Oklahoma has entered the national market, trends in consumption, production, and price at the national level will determine the present and potential future market conditions for cheese produced in the State.

Production of Cheese

Production of all varieties of cheese in the United States has more than tripled since 1930 (Figure 1). In 1930, total cheese production in the United States amounted to only 510 million pounds. This figure increased to a high, in 1961, of 1,635 million pounds.

The types of cheese produced in the United States have been primarily the American cheese varieties. These included cheddar, colby, washed or stirred curd, high and low moisture jack, monterey, and grandular cheese. Cheddar cheese was the most important of the American varieties and



Source: U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and Supplement for 1962.

Figure 1. Total and American Cheese Production, United States, 1930-1962.

represented approximately 90 percent of American cheese production. Even though the American cheese varieties represented the bulk of the cheese produced, its relative importance decreased slightly over the last 30 years. Approximately 76 percent of total cheese production was of the American varieties in 1930, and in 1945 it had risen as high as 78 percent. However by 1962, the percentage of total cheese produced as American cheese had decreased to 69 percent.

Types of cheese other than American varieties which are produced in the United States include Swiss, Brick, Munster, Limburger, Neufchatel, and the Italian varieties. Although production of these varieties of cheese increased substantially during the last 20 years, a large portion of the total domestic disappearance of these varieties came from imports.[1]

Consumption of Cheese

Domestic consumption of cheese followed the same strong upward trend as domestic production during the period 1930-1962. Total domestic disappearance of all cheese varieties increased from a low of 553 million pounds in 1932 to a high of 1,670 million pounds in 1962. Utilization of American cheese followed a similar upward trend in total quantity but was approximately constant as a percentage of total consumption over the complete period. The highest was in 1940, when domestic utilization of American cheese varieties accounted for 72.9 percent of the total domestic cheese consumption (Table I). This figure had declined to 66.5 percent

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[1]U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and Supplement for 1962.

TABLE I

PRODUCTION AND DOMESTIC UTILIZATION OF ALL CHEESE AND AMERICAN CHEESE, UNITED STATES, 1930-1962

Year	Production			Domestic Utilization			Consumption per Person	
		American			American			
	All Cheese Quantity	Quantity	Pct. of All Cheese	All Cheese Quantity	Quantity	Pct. of All Cheese	All Cheese	American
	(Mil. lbs.)		(Pct.)	(Mil. lbs.)		(Pct.)	(Pounds)	
1930	510	389	76	577	390	68	4.7	3.2
1931	499	383	77	562	388	69	4.5	3.1
1932	491	378	77	553	378	68	4.4	3.0
1933	548	419	76	570	397	70	4.5	3.1
1934	587	447	76	621	432	70	4.9	3.4
1935	628	482	77	675	482	71	5.3	3.8
1936	650	499	77	696	498	72	5.4	3.9
1937	653	500	77	716	507	71	5.6	4.0
1938	726	567	78	760	552	73	5.9	4.3
1939	710	543	76	776	559	72	5.9	4.3
1940	785	607	77	791	577	73	6.0	4.4
1941	956	757	79	780	574	74	5.9	4.3
1942	1,112	921	83	843	624	74	6.4	4.7
1943	993	770	78	637	395	62	4.9	3.0
1944	1,017	807	79	624	393	63	4.9	3.1
1945	1,117	876	78	861	613	71	6.7	4.8
1946	1,106	804	73	930	623	67	6.7	4.5
1947	1,183	938	79	989	743	75	6.9	5.2
1948	1,098	858	78	1,005	751	75	6.9	5.2
1949	1,199	936	78	1,075	786	73	7.3	5.3
1950	1,191	895	75	1,155	823	71	7.7	5.5
1951	1,161	874	75	1,095	773	71	7.2	5.1
1952	1,170	851	73	1,170	819	70	7.6	5.3
1953	1,344	1,022	76	1,163	793	68	7.5	5.1
1954	1,383	1,045	76	1,262	878	70	7.9	5.5
1955	1,367	1,005	74	1,281	870	68	7.9	5.4
1956	1,388	994	72	1,323	897	68	8.0	5.4
1957	1,407	1,026	73	1,297	864	67	7.7	5.1
1958	1,399	983	70	1,394	940	67	8.2	5.5
1959	1,383	948	69	1,404	908	65	8.0	5.2
1960	1,478	1,003	68	1,489	965	65	8.4	5.4
1961	1,635	1,156	71	1,544	1,022	66	8.6	5.7
1962	1,585	1,101	70	1,670	1,111	67	9.1	6.1

Source: U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and Supplement for 1962.

in 1962, slightly lower than in 1930. For all years, American cheese varieties represented a larger proportion of production than of consumption.

Social factors were important in causing increased cheese consumption. These include population, and other factors such as increasing incomes, changes in tastes, and other factors which were reflected as increasing per capita consumption. About one-third of the increase in cheese consumption was due to increases in population and the other two-thirds to increases in per capita consumption. Per capita consumption of total cheese increased from 4.4 pounds in 1932 to 9.1 pounds in 1962. This represented a 106.8 percent increase during the 30 year period.

Governmental Programs

The United States government, in attempting to increase the prices received by farmers for milk, extended support prices to cheddar cheese in 1950. The authority for the price supports was the Agricultural Act of 1949. This Act, together with subsequent amendments, provided the basic legislation for price supports for dairy products after 1950.[2] As implemented for dairy products, the Secretary of Agriculture announces the specific support level effective for the marketing year beginning April 1. The Commodity Credit Corporation is committed to buy butter, nonfat dry milk powder, and cheese at specified prices, if offered, according to set terms and conditions.

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[2]Anthony S. Rojko, The Demand and Price Structure for Dairy Products, U. S. Department of Agriculture Technical Bulletin No. 1168 (Washington, 1957), p. 157.

Purchases of cheddar cheese by the CCC since the time of initiation of the price support program have been quite erratic. In 1950, the first year of operation, government purchases totaled 108.9 million pounds of cheddar cheese. Purchases declined to only 800 thousand pounds in 1951, but rose to a high of 307.8 million pounds in 1953. Since 1953, price support purchases of cheddar cheese have varied from a low of 300,000 pounds in 1960 to a high of 214 million pounds in 1962.[3]

Utilization of Government Purchases in Domestic Markets

The development of outlets for dairy products acquired under the price support programs occurred simultaneously with the extension of the price support program to cheese. The major domestic programs for utilization of CCC stocks of cheese involved: (1) military agencies and the Veterans Administration, (2) the school lunch program, and (3) low income families. Transfers to military agencies and the Veterans Administration were stepped up under the Agricultural Act of 1954. This act directed CCC to make available to these agencies (without charge except for packaging costs) milk and dairy products acquired under the price support program. However, they were small during the period and represented only 1.4 percent of production (Appendix Table I and Figure 2).

The disposition of CCC stocks for the school lunch program was authorized under (1) Section 32 of the Agricultural Act of 1935, (2) Section 6 of the National School Lunch Act of 1946, and (3) as direct donations under Section 416 of the Agricultural Act of 1949. Section 416

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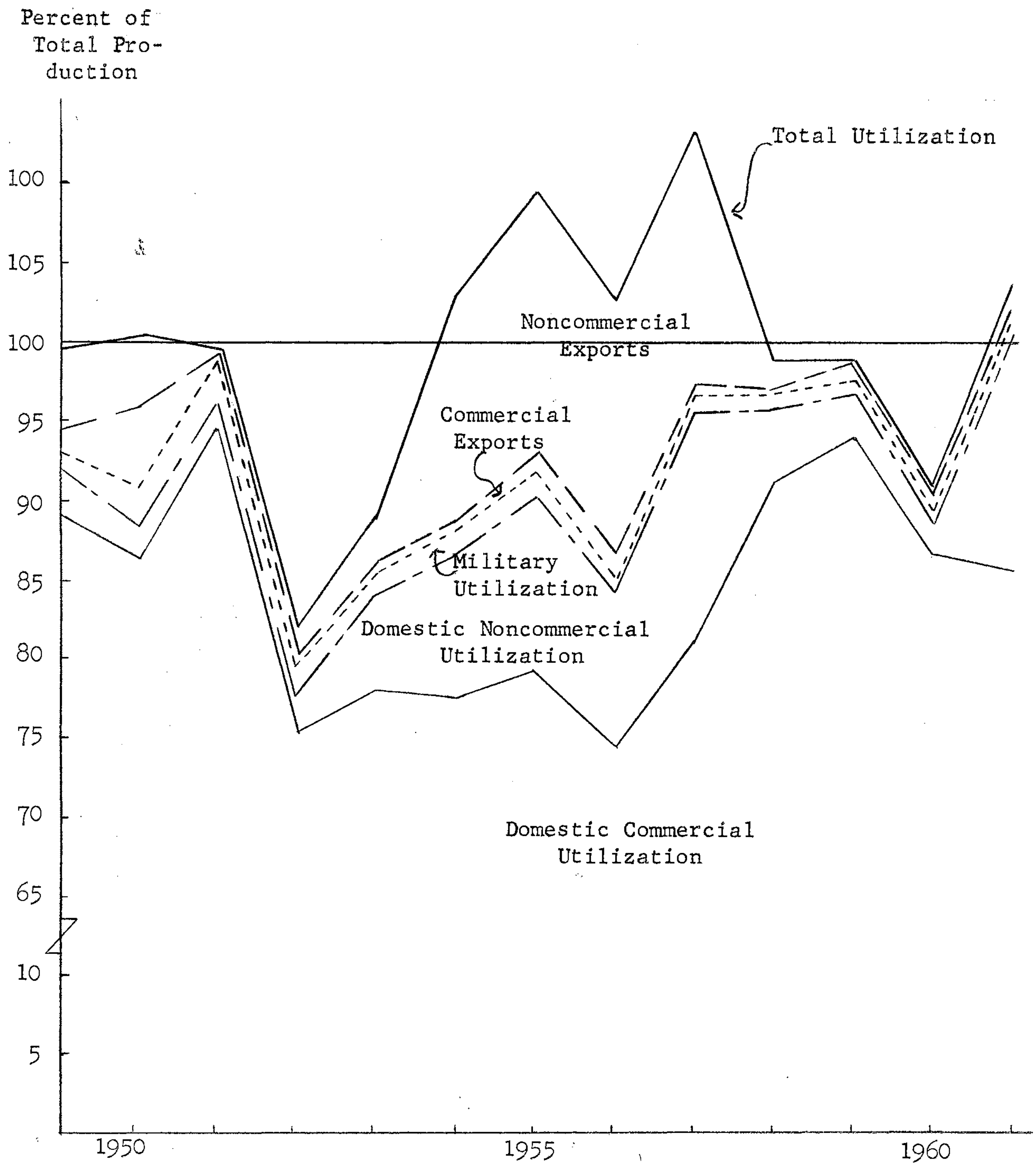
[3] _Dairy Statistics Through 1960_, Table 308.



Source: Appendix Table 1.

Figure 2. Utilization of American Cheese, United States, 1950-1962.

also authorized donations of cheddar cheese to charitable institutions and needy persons in this country and to United States private welfare agencies for foreign welfare uses.[4]

Noncommercial domestic utilization was rather erratic in terms of total volume and percent of annual production during the period 1950-1962 (Appendix Table I). Because of large government purchases during 1953 and 1954, this outlet was of greater importance in the period 1955-1958. Noncommercial domestic outlets decreased in importance during 1959-1961 but rose again in 1962 due to large government purchases in 1961. The noncommercial outlets ranged from a low of 17 million pounds of cheese in 1951 to a high of 163 million pounds in 1962. The 1962 figure accounted for 14.9 percent of the annual production of American cheese. Figure 2 shows domestic noncommercial utilization of American cheese expressed as a percentage of annual production during the period 1950-1962.

Foreign Trade

Foreign trade of cheese by the United States was rather erratic during the last 20 years. Imports of cheese consisted mainly of Swiss, and the Italian varieties. Exports were relatively large during World War II. After 1949, exports came largely from disposition of government surpluses acquired under the price support program.

Commercial Imports

United States commercial import volumes of cheese for 1950-1962 are shown in Table II. Imports were relatively stable during the period

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[4]Rojko, p. 170.

TABLE II

CHEESE IMPORTS, TOTAL AND SELECTED VARIETIES, UNITED STATES, 1950-1962

Year	Gross Imports: Total	Gross Imports: Pct. of Demand Utilization	Net Imports	Specified Variety Imports as Percent of Total Imports[a]: American	Swiss	Italian Varieties	Other
	(Mil. lbs)	(Pct.)	(Mil. lbs.)	(Pct.)		(Pct.)	
1950	56	4.8	-3	23	14	36	27
1951	52	4.7	-33	23	17	29	31
1952	49	4.2	40	12	20	39	29
1953	56	4.8	33	14	21	38	27
1954	50	4.0	12	6	24	40	30
1955	52	4.1	-100	6	23	39	33
1956	54	4.1	-127	6	22	39	33
1957	51	3.9	-130	4	26	37	33
1958	56	4.0	-110	7	23	38	32
1959	64	4.6	43	8	25	34	33
1960	63	4.2	49	43[b]	24	33	0
1961	76	4.9	61	22[b]	21	30	26
1962	77	4.6	48	18[b]	22	35	25

[a]Some years may not total 100 percent due to rounding.

[b]Includes Colby.

Source: U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and Supplement for 1962.

and consistently make up approximately 4.5 percent of total domestic consumption. Swiss cheese and the Italian varieties were most important. In 1950, imports of these two types of cheese accounted for 51.8 percent of the total cheese imports. In 1962, importation of these varieties accounted for 57.2 percent of total cheese imports.

After 1952, imports of American cheese were limited by an import quota placed on cheddar cheese. When the Defense Production Act of 1950 was extended in 1951, Section 104 was included which provided for import quotas on various dairy products. This act established an import quota of 9,775,000 pounds for cheddar cheese. Previous to the expiration date of this act, the President, acting under authority granted under Section 22 of the Agricultural Adjustment Act, as amended, directed the Tariff Commission to investigate the effects of unrestricted imports of dairy products on the Government's price support program. On the basis of the findings of the Tariff Commission, the annual import quota for cheddar cheese was established at 2,780,100 pounds per fiscal year (July 1-June 30).[5] This quota has been in effect for each successive fiscal year since that time.[6]

The United States also used tariffs effectively in controlling imports of cheddar cheese. As early as 1883, a tariff of four cents per pound was established on cheddar cheese to protect the U. S. market from large quantities of cheese imports caused by a relatively lower price on the world

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[5]Ibid., p. 221.

[6]National Archives and Record Service, General Service Administration, <u>Code of Federal Regulations</u>, Various Issues (Washington).

market.[7] The current tariff rates on dairy products were established under the General Agreement on Tariffs and Trade signed at Geneva on October 30, 1947.[8] Presently, the tariff rate on cheddar cheese is 15 percent minimum ad valorem.

Commercial Exports

Commercial exports of cheese from the U. S. during the period 1950-1962 accounted for only 1.2 percent of average annual production. During this period, they did not exceed 5.0 percent and seldom accounted for as much as 2 percent of total production (Appendix Table I and Figure 2). However, commercial exports of cheese were relatively important during the three year period 1947-1949. During this post war period, this outlet accounted for 11 percent of annual production of American cheese varieties.

Utilization of Price Support Purchases in Foreign Markets

A large percentage of total cheese exports from the United States during the period 1950-1962 were associated with disposition of government purchases of cheddar cheese. These noncommercial exports of cheddar cheese were made up largely of donations under Section 416 of the Agricultural Act of 1949. Donations to the International Cooperation Administration and the Foreign Agriculture Service accounted for much smaller volumes of the surplus cheese stocks.

Exports of cheese consisted primarily of American cheddar cheese during the period 1950-1962. They represented over 90 percent of total cheese

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[7]U. S. Department of Agriculture, ERS, The Dairy Situation, DS-300 (April, 1964), Table 11, p. 27.

[8]Ibid., DS-263 (December, 1957), Table 11, p. 28.

exports and, during the period 1955-1958 when government purchases were extremely high, exports of cheddar cheese accounted for an average of 98.4 percent of total cheese exports annually. Total noncommercial cheddar cheese exports during the four year period, 1955-1958, accounted for 94.0 of cheddar cheese imports, or 92.5 percent of total cheese exports. Table III shows total cheese and American cheese exports for the period 1950-1962.

TABLE III

CHEESE EXPORTS, UNITED STATES, 1950-1962

Year	All Cheese Quantity (Mil. lbs.)	All Cheese Pct. of Domestic Production (Pct.)	American Cheese Quantity (Mil. lbs.)	American Cheese Pct. of All Cheese Exported (Pct.)	American Cheese Pct. Exported Through Non-commercial Channels (Pct.)
1950	59	5	58	98	79
1951	85	7	84	99	46
1952	9	1	7	78	14
1953	23	2	22	96	77
1954	38	3	37	97	78
1955	152	11	150	99	96
1956	181	13	177	98	92
1957	181	13	179	99	92
1958	166	12	163	98	96
1959	21	2	18	86	83
1960	14	1	11	79	9
1961	15	1	12	80	2
1962	29	2	27	93	89

Source: U. S. Department of Agriculture, ERS, _Dairy Statistics Through 1960_, Statistical Bulletin No. 303 (Washington, 1962); and _Supplement for 1962_.

CHAPTER III

ORGANIZATIONAL AND STRUCTURAL CHANGES IN THE CHEESE INDUSTRY OF OKLAHOMA

Cheese in Oklahoma has been produced from manufacturing grade milk delivered directly to plants and dealers and from Class II Grade A milk diverted from the fluid milk markets. The relative importance of these two sources has changed significantly during the past 25 years.

During the early 1940's, the first years for which detailed state data were available, most of the milk was delivered directly from the farm in cans. Production for the war effort was fairly large, and the number of plants necessary to process the milk was also large.

By the early 1960's, although some milk was delivered direct to manufacturers, most of the milk was delivered to the fluid milk markets in bulk tanks. Milk entering manufacturing channels was diverted from these fluid markets. This change in milk procurement practices together with volume and technological changes in the dairy industry of the state resulted in drastic structural changes in the cheese industry of Oklahoma.

Oklahoma Cheese Production

Oklahoma has not been a major cheese producing state. At its peak in 1945, Oklahoma ranked 13th nationally in American cheese production with 1.8 percent of the national production. By 1960, cheese production decreased until Oklahoma ranked 18th and accounted for only 0.8 percent of the nation's American cheese production. Oklahoma's ranking would have been even lower if it had been based on all cheese production rather than on American cheese production since the manufacture of non-American type cheese was relatively unimportant in Oklahoma.

Production of American cheddar cheese in Oklahoma was rather erratic during the last 20 years. In 1942, Oklahoma's production amounted to 13,380,000 pounds. The highest annual production during the 20 year period was 15,776,000 pounds in 1945. In 1952, annual production amounted to only 4,642,000 pounds which was the low for the period.

During the 20 year period 1942-1962, Oklahoma's total cheese production was primarily American cheddar cheese. Other type cheese production in Oklahoma ranged from none to 41 percent of total production. Data pertaining to the specific types of cheese produced other than American cheese were not available because production volumes were not consistently significant or data were not published when less than three plants were producing the product within the state.

Utilization of Milk

American cheese production in Oklahoma declined in importance as an outlet for whole milk marketed by farmers during the period 1942-1962 (Figure 3 and Table V). The percentage of whole milk marketed utilized in American cheese production of 25 percent in 1942 was the record. By 1962, this figure had declined to 7 percent. The concurrent decreases in both cheese production and percent of milk utilized for cheese reflects the relative stability of milk marketings and the upgrading of milk to make it available for fluid milk usage.

TABLE IV

TOTAL AND AMERICAN CHEESE PRODUCTION, OKLAHOMA, 1942-1962

Year	All Cheese Quantity	American Cheese Quantity	American Cheese Pct. of All Cheese	Year	All Cheese Quantity	American Cheese Quantity	American Cheese Pct. of All Cheese
	(1,000 lbs.)		(Pct.)		(1,000 lbs.)		(Pct.)
1942	13,379	13,121	98	1953	10,270	7,009	68
1943	8,911	8,911	100	1954	9,953	6,713	67
1944	14,349	14,349	100	1955	8,675	7,619	88
1945	15,776	15,776	100	1956	8,077	8,077	100
1946	13,582	13,552	100	1957	7,314	7,314	100
1947	15,861	15,861	100	1958	6,329	6,329	100
1948	12,566	12,467	99	1959	7,753	7,753	100
1949	11,597	10,741	93	1960	8,211	8,211	100
1950	9,756	8,659	89	1961	12,452	12,452	100
1951	8,384	5,381	64	1962[a]	8,643	8,643	100
1952	7,858	4,642	59				

[a]Preliminary.

Source: U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and Supplement for 1962.

Figure 3. American Cheese Production, Oklahoma, 1942-1962.

TABLE V

UTILIZATION OF WHOLE MILK IN AMERICAN CHEESE PRODUCTION, OKLAHOMA, 1942-1962

	Whole Milk Marketed by Farmers	Used in American Cheese			Whole Milk Marketed by Farmers	Used in American Cheese	
Year	Total	Quantity	Pct. of Total	Year	Total	Quantity	Pct. of Total
	(Mil. lbs.)		(Pct.)		(Mil. lbs.)		(Pct.)
1942	500	123	25	1953	800	66	8
1943	555	83	15	1954	810	63	8
1944	600	134	22	1955	842	71	8
1945	630	148	23	1956	894	76	9
1946	680	127	19	1957	875	67	8
1947	690	148	21	1958	909	57	6
1948	670	118	18	1959	952	71	7
1949	720	101	14	1960	1,030	76	7
1950	760	81	11	1961	1,150	115	10
1951	720	50	7	1962[a]	1,150	79	7
1952	720	43	6				

[a]Preliminary.

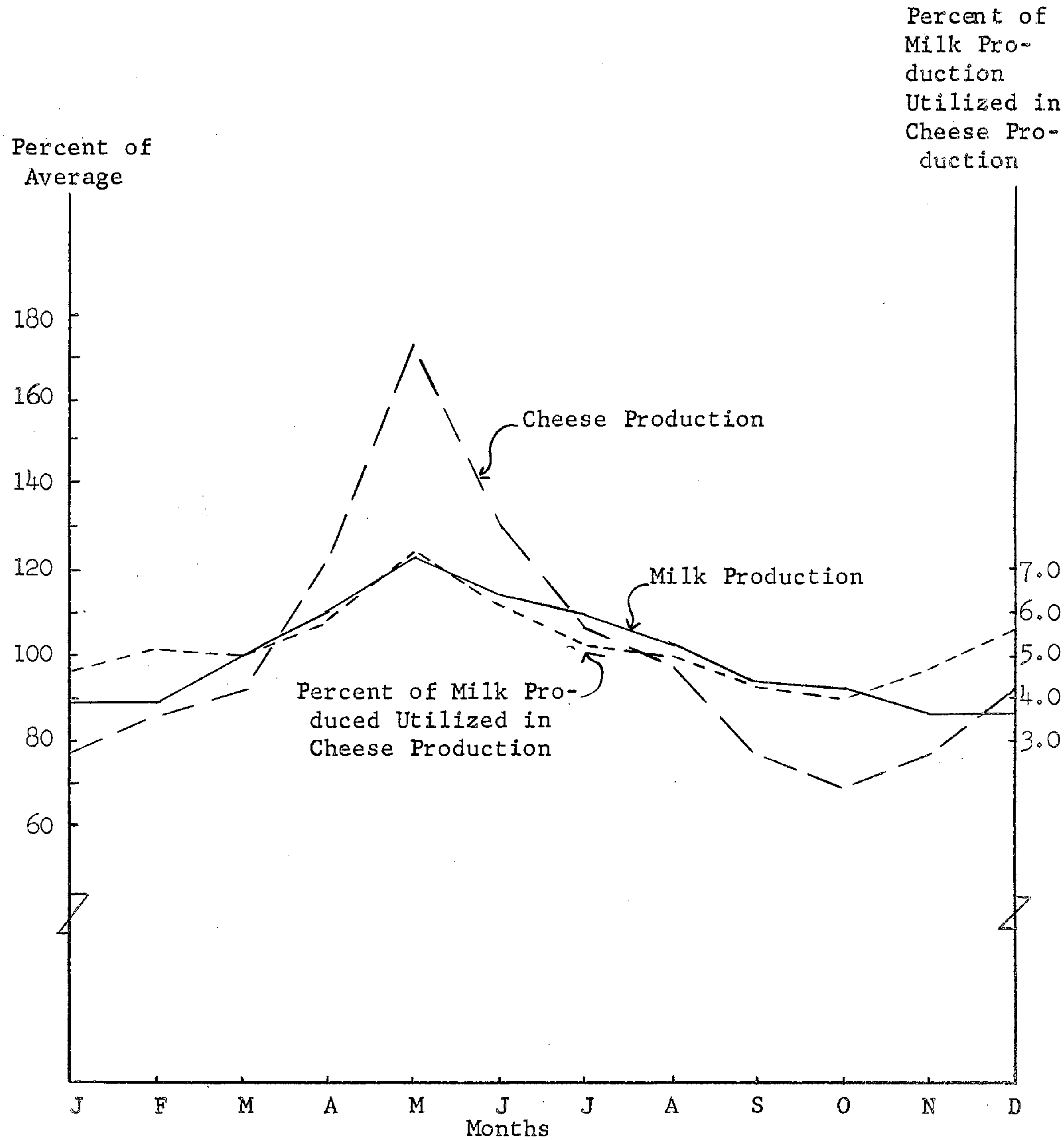
Source: U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and Supplement for 1962.

Seasonal Variation

Cheese production has been highly seasonal in Oklahoma (Figure 4). This high seasonality has been caused by the relatively large seasonality in milk production and in the disposition of surplus Grade A milk to cheese plants. During the spring months when milk production has been highest, cheese production has been even higher because more than an average percentage of milk has been utilized for cheese production. The converse has been true for months of low milk production. The fluctuations in seasonal milk utilization percentages suggest that consumption of fluid milk and the use in certain Class II dairy products are more stable and have first claim on available supplies.

Oklahoma Cheese Consumption

There were no data for cheese consumption by Oklahoma consumers. However, per capita consumption estimates for the U. S., combined with Oklahoma population data, could provide a rough estimate of the level of consumption in the state. Based on this procedure, consumption greatly exceeded production for most of the period 1945-1960 (Table VI). In 1945, Oklahoma cheese production exceeded the estimated consumption; but by 1960 a deficit (estimated consumption-production) of over 11 million pounds existed. This deficit represented 58 percent of the cheese consumed within the state in 1960. The increasing significance of this deficit has made it necessary to transport larger and larger amounts of cheese to Oklahoma from more important cheese producing states.



Source: U. S. Department of Agriculture, SRS, Milk Production and Dairy Products, Annual Statistical Summaries, Various Issues (Washington); and U. S. Department of Agriculture, SRS, and State Board of Agriculture, Manufactured Dairy Products, Various Issues.

Figure 4. Seasonal Variation of American Cheese and Milk Production, Oklahoma, 1953-1962.

TABLE VI

PRODUCTION AND ESTIMATED CONSUMPTION OF CHEESE, OKLAHOMA, SELECTED YEARS, 1942-1962

Year	Oklahoma Population	U.S. Per Capita Consumption	Estimated Oklahoma Consumption[a]	Oklahoma Production[b]	Deficit[c] Quantity	Deficit[c] Pct. of Consumption
		(lbs.)	(1,000 lbs.)		(1,000 lbs.)	(Pct.)
1945	2,284,892	6.7	15,309	15,776	-467	3
1950	2,233,351	7.7	17,197	9,756	7,441	43
1955	2,280,817	7.9	18,018	8,675	9,343	52
1960	2,328,284	8.4	19,558	8,211	11,347	58

[a]United States per capita consumption times Oklahoma population.

[b]Total cheese, excluding full-skim American and cottage cheese.

[c]Consumption minus production.

Source: U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and U.S. Department of Commerce, Bureau of the Census, Census of Agriculture, 1949 through 1959 (Washington).

Changes in Quantity of Whole Milk Sold and Cheese Production in Three Areas of Oklahoma, 1942-1962

Milk production in Oklahoma underwent changes similar to those in cheese production during the 20 year period. The number of farms reporting whole milk sold decreased from 21,904 in 1944 to 9,076 in 1959 while whole milk marketed per farm increased from 28,357 to 105,905 pounds in 1944 and 1959, respectively. These figures represent a decrease in number of farms of 58.6 percent and an increase in whole milk sold per farm of 273.5 percent. Table VII shows the number of farms reporting whole

TABLE VII

WHOLE MILK SOLD BY OKLAHOMA FARMERS BY AREAS, CENSUS YEARS 1944-1959

Year	Farms Reporting Whole Milk Sold	Whole Milk Sold	Whole Milk Sold Per Farm Reporting
	(No.)	(lbs.)	(lbs.)
		Area I (Western Oklahoma)	
1944	5,892	159,910,075	27,286
1949	4,940	148,249,792	30,010
1954	2,839	153,977,432	54,237
1959	2,010	228,674,298	118,361
		Area II (Central Oklahoma)	
1944	7,998	246,282,156	30,793
1949	7,265	268,662,047	36,980
1954	4,314	282,958,629	65,591
1959	3,186	364,520,370	114,413
		Area III (Eastern Oklahoma)	
1944	8,014	214,935,586	26,820
1949	6,096	232,211,504	38,092
1954	4,856	291,080,564	60,041
1959	3,880	359,739,943	92,716
		State	
1944	21,904	621,127,817	28,357
1949	18,301	649,123,343	35,469
1954	12,009	728,016,625	61,359
1959	9,076	952,934,611	105,905

Source: U. S. Department of Commerce, Bureau of the Census, Census of Agriculture, 1944 through 1959 (Washington).

milk sold and the average farm sales by three areas for the years of 1944, 1949, 1954, and 1959. These areas are shown in Figure 5. The trend toward smaller numbers of farms marketing whole milk and larger marketings per farm was of similar magnitude for the three areas during the period under consideration. The western area experienced the greatest change with a 65.9 percent decrease in the number of farms reporting whole milk sold and an increase in the quantity of whole milk sold per farm reporting of 333.8 percent. The eastern section of the state showed the smallest change although it was still a substantial adjustment. The number of farms reporting in the eastern section decreased 51.6 percent and the quantity of milk sold per farm increased 273.5 percent.

The number of cheese plants decreased in the three areas of the state as average plant production increased. Due to the small number of plants in areas II and III during 1954 and 1959, the presentation of annual production data was impossible without revealing individual plant production. Therefore, a comparison of average plant production in the three areas for 1954 and 1959 was not attempted. For the entire state, cheese plant numbers declined 68.4 percent from 1944 to 1959 while average plant production increased by 71.6 percent. Cheese plant numbers, average production per plant, and percentage of whole milk sold used in cheese production for the three areas are shown in Table VIII.

Changes in Cheese Plant Numbers and Size During the Period 1942-1962

During the last 20 years, the number of cheese plants in Oklahoma declined substantially. In 1942, there were 24 plants in Oklahoma. This number declined to five by 1962 and to three by 1964. Figure 5 shows the location of Oklahoma cheese plants in two representative years, 1944 and 1959.

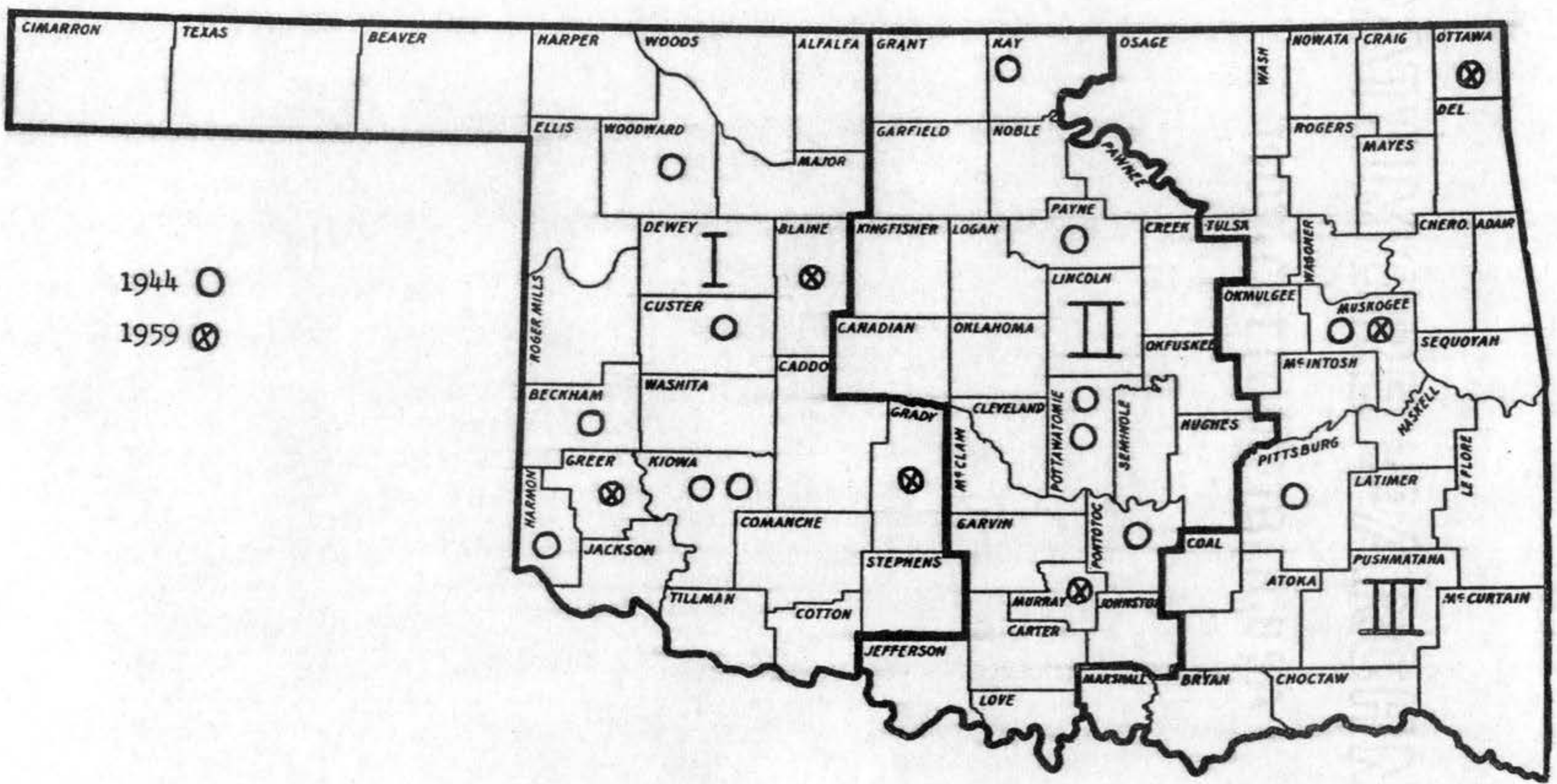


Figure 5. Location of Cheese Plants in Oklahoma by Areas, 1944 and 1959.

TABLE VIII

AMERICAN CHEESE PRODUCTION BY AREAS, OKLAHOMA, CENSUS YEARS 1944-1959

Year	Cheese Production	Number of Cheese Plants	Cheese Produced Per Plant	Whole Milk Sold, Cheese Equivalent[a]	Percentage of Whole Milk Sold Utilized in Cheese Production
	(1,000 lbs.)	(No.)	(1,000 lbs.)		(Pct.)
			Area I (Western Oklahoma)		
1944	7,906	9	878	17,042	46.4
1949	4,527	6	754	15,842	28.6
1954	2,988	3	996	16,452	18.2
1959	2,885	3	962	24,916	11.6
			Area II (Central Oklahoma)		
1944	4,132	6	689	26,246	15.7
1949	4,042	6	674	28,709	14.1
1954	b	1	b	30,234	b
1959	b	1	b	39,718	b
			Area III (Eastern Oklahoma)		
1944	2,274	4	569	22,906	9.9
1949	2,172	3	724	24,814	8.8
1954	b	2	b	31,102	b
1959	b	2	b	39,197	b
			State		
1944	14,312	19	753	66,194	21.6
1949	10,741	15	716	69,365	15.5
1954	6,713	6	1,119	77,789	8.6
1959	7,753	6	1,292	103,832	7.5

[a]Cheese equivalent based on the average cheese yield for each specified year.

[b]Production and utilization data were not given to avoid revealing individual plant's production.

Source: U. S. Department of Agriculture, ERS, <u>Dairy Statistics Through 1960</u>, Statistical Bulletin No. 303 (Washington, 1962); and U. S. Department of Commerce, Bureau of the Census, <u>Census of Agriculture</u>, 1949 through 1959 (Washington).

Table IX shows Oklahoma cheese plants classified according to annual production for selected years from 1942 to 1962. Average annual production in cheese plants in Oklahoma increased from 558,000 pounds in 1942 to 1,607,000 pounds in 1962. The large increase in average annual plant production indicated progressively fewer small producing plants over the period. In 1944 there were 17 plants producing less than one million pounds annually. By 1962 there were only two plants in this classification. Likewise, there were no plants producing over two million pounds in 1942; but in 1962, two plants were producing above this level. The percent of the total yearly production produced by plants of various production classification is shown in Table X. In 1944, 23.5 percent of the annual cheese production was produced in plants with a production of over one million pounds. By 1962 production of plants of this size accounted for 87.5 percent of the total cheese production.

Associated with the decline in the number of cheese plants, Oklahoma's cheese production became increasingly concentrated in the larger plants. Production from the three plants reporting the largest quantity of cheese produced in 1942 accounted for only 31 percent of the total production; but in 1962, this figure had risen to 88 percent of total production. The percent of Oklahoma's annual cheese production produced by the largest three plants during the period 1942-1962 is shown in Table XI.

TABLE IX

NUMBER OF CHEESE PLANTS BY SIZE CLASIFICATIONS, OKLAHOMA, CENSUS YEARS, 1949-1959 AND 1962

Year	0 to 99	100 to 399	400 to 699	700 to 999	1000 to 1499	1500 to 1999	2000 and Above	Total No. of Plants	Average Annual Production Per Plant
1944	0	2	8	7	0	2	0	19	753
1949	1	2	5	3	3	1	0	15	716
1954	0	1	2	0	1	1	1	6	1,119
1959	0	0	2	1	1	1	1	6	1,292
1962	1	0	0	1	1	0	2	5	1,607

Source: U. S. Department of Agriculture, SRS, and State Department of Agriculture, Oklahoma City, Oklahoma.

TABLE X

PERCENTAGE OF OKLAHOMA CHEESE PRODUCTION PRODUCED IN VARIOUS PLANT SIZE CLASSIFICATIONS, SELECTED YEARS, 1942-1962

Plant Size Classification	1944	1949	1954	1959	1962
(lbs. of cheese)		- Percent of Annual Production -			
0-99	-	a	-	-	
100-399	3.3	4.4	4.7	-	
400-699	31.7	25.1	15.6	25.8	25.8
700-999	41.3	21.3	-		
1000-1499	-	32.5	21.1		
1500-1999	23.5	16.0	27.9	74.1	87.5
2000-Above	-	-	30.7		

[a]Less than one percent.

Source: U. S. Department of Agriculture, SRS, and State Department of Agriculture, Oklahoma City, Oklahoma.

TABLE XI

NUMBER OF CHEESE PLANTS AND PERCENT OF PRODUCTION PRODUCED IN LARGEST THREE PLANTS, 1942-1962

Year	Number of Plants	Percent of Production from 3 Largest Plants
1942	24	31
1943	18	43
1944	19	30
1945	19	29
1946	18	30
1947	18	30
1948	17	39
1949	15	39
1950	12	48
1951	10	62
1952	7	83
1953	6	76
1954	6	80
1955	6	76
1956	6	72
1957	6	72
1958	7	68
1959	6	74
1960	7	68
1961	6	69
1962	5	88

Source: U. S. Department of Agriculture, SRS, and State Department of Agriculture, Oklahoma City, Oklahoma.

CHAPTER IV

COST OF MANUFACTURING CHEESE IN OKLAHOMA

The relative profitability of firms engaged in manufacturing cheese will determine in part the future of the cheese industry of the state. This profitability in turn depends upon the cost of manufacturing cheese. Since no estimates of costs were available for Oklahoma, costs were developed from original research and from results from other studies of the cheese industry.

In developing the costs of manufacturing cheese in Oklahoma, it was necessary to specify the number and type of firms in or expected to be involved in manufacturing cheese. In view of the analysis of Chapter III, one individual model plant was assumed to be sufficient to establish such cost data. The model plant synthesized for this study had a capacity of about 80,000 pounds of milk daily based on the use of eight 10,000 pound vats once each day. The actual average daily milk intake programmed for one year was 80,634 pounds. Costs were developed in such a way that storage costs would be excluded from the analysis if this function could be eliminated.

The costs of land and buildings for the model plant were obtained from secondary sources including local real estate agents and other studies of cheese plants. The costs of equipment were obtained from Damrow Brothers' and Stoelting Brothers' Companies, cheese plant equipment manufacturers in Wisconsin.

The cost of most of the other items involved in a cheese manufacturing plant were obtained from (1) application of price data to input-output data from an existing cheese plant in Oklahoma, (2) actual costs from a cheese plant in the state, and (3) cost data from other cheese plant studies.

Input-output data, particularly for the labor requirements were obtained from the Armour and Company Creamery plant at Chickasha, Oklahoma. Although the model plant was not a copy of the Armour plant, the plants were similar in size and type of processing equipment. The time requirements for the various functions performed in the Armour plant were used as a basis for estimating and allocating utility and variable labor costs. The time requirements were estimated from the results of a work sampling study.

In the work sampling study, a research person was stationed in the plant to observe the complete production process. The research person observed the workers at random times within an approximate 10-minute time interval and recorded his observations as to work or delay for the activity engaged in by each plant worker. The underlying theory of this work sampling procedure is that the percentage of observations for an employee performing a particular activity reflects, to a probable degree of accuracy, the average percentage of time actually engaged in that activity.

The observation process was conducted during three nonconsecutive days of operation. The production of cheese during these three days totaled 16,706 pounds and represented both full capacity and less than full capacity operations. Approximately 78 percent of the production was in the form of 40 pound blocks and 22 percent was in the form of longhorns. The time spent in manufacturing longhorns was much longer than for 40 pound blocks. For this reason the data were standardized on a 40 pound block basis.

Variable Costs

Variable costs incurred in the manufacture of cheddar cheese in the model plant included labor, utilities, and supply costs. These costs varied directly with daily milk receipts and were of major importance in estimating the profitability of the model cheese plant.

Labor

Labor was one of the largest costs involved in the cheese manufacturing process. The labor requirements for the model plant were estimated by the use of results from the work sampling study. In this study, the production process was divided into eight activities as follows: receiving milk, setting up equipment, setting and cooking the curd, drawing whey and matting and milling the curd, packaging, all cleaning operations, supervisory work, and lunch periods and delays. The time requirements and costs for labor are reported in this sequence. To estimate labor costs, a wage rate of $1.75 per hour was applied to all time requirements except time spent in supervisory work. A wage rate of $2.50 per hour was applied to this activity. It was assumed that this wage schedule would allow for social security and other employment benefits for plants in Oklahoma.

Receiving Milk

The milk receiving process included receiving, weighing, test sampling, and testing all milk received by the cheese plant. It was assumed for cost analysis that all milk would be received in cans. This assumption reflected actual conditions during seasons of somewhat low milk production when most of the milk received was manufacturing milk. However, Class II or surplus Grade A milk made up a large percentage of the plant's intake in the seasons of high milk production. The Class II milk was received in bulk tanks. For this reason actual milk receiving labor requirements in the high volume months were much lower than when all milk was received in cans.

All milk testing activities were included in the milk receiving process. In cheese plants, the milk testing activities included testing each farmer's milk for butterfat content and harmful bacteria. In the model plant, all testing of milk was performed by one part-time employee. This employee's work load varied directly with daily milk receipts. However, the average daily milk intake required approximately two hours for the milk testing activities.

The milk receiving activity required 6.3 percent of the total daily time requirements when all milk was received in cans. This requirement decreased to only 1.1 percent of the total daily labor requirements when the milk was received in bulk tanks. The labor cost of receiving all milk in cans was computed to be $1.72 per 1,000 pounds of cheese produced (Table XII).

Setting Up Equipment

This activity was performed largely by one worker before the regular work day began and required about four percent of the total daily labor requirement. The cost of labor for this function was $1.13 for each 1,000 pounds of cheese produced (Table XII). The set up activity consisted of preparing the plant equipment for the day's operations. Such activities as reassemblying the receiving equipment, separators, and pasteurizer, and connecting pipes were included here.

The labor involved in making the starter was also included in this subdivision.[1] Labor required in making the starter consisted of cleaning the small starter pasteurizers and adding powered milk, water, and bacteria culture to the pasteurizer.

Setting and Cooking Curd

Immediately after the milk entered the cheese vats, the starter was added. The starter amounted to one and one-half percent of the total volume of milk. Approximately 150 pounds of starter was added to a 10,000 pound vat. After the starter was added, the milk was allowed to set for approximately one and one-half hours with very little stirring or other labor required. The rennet was then added[2] and in approximately 10 minutes, the curd was cut. The curd cutting operation involved pulling two curd knives through the vat. The object of the cutting operation was to allow the whey to escape from the curd.

The curd was then cooked at approximately 100 degrees for about 20 minutes. During the cooking period, the curd was agitated (both mechanically and by hand) to prevent the curd from massing together which

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[1]The starter is a mixture of powdered milk and water to which a culture of coagulating bacteria has been added. This allows more rapid separation of curd and whey.

[2]Rennet is a milk coagulating enzyme from calves stomachs to aid coagulation.

TABLE XII

ESTIMATED VARIABLE LABOR REQUIREMENTS FOR PRODUCING CHEESE IN 40 POUND BLOCKS, ARMOUR AND COMPANY PLANT, OKLAHOMA, 1964

Item	Man Min. Per 1000 lbs. Cheese	Percent of Total Time	Labor Cost Per 1000 lbs. Cheese
		(Percent)	(Dollars)[a]
I. Receiving milk[b]	58.86	6.31	1.72
II. Set up equipment, make starter	38.72	4.15	1.13
III. Set and cook curd, testing vat	56.27	6.03	1.64
IV. Draw whey, matt, mill curd	133.71	14.34	4.18
V. Packaging	247.12	26.49	7.72
VI. All cleaning	234.75	25.17	6.85
VII. Supervisory work	82.85	8.88	3.45
VIII. Lunch and delay	80.48	8.63	2.35
Total	932.75	100.00	29.04

[a]Wage rates of $1.75 per man hour for all processes except $2.50 for supervisory work.

[b]Receiving milk in bulk tanks required 10.11 man minutes per 1000 pounds of cheese produced.

would make it difficult for the whey to separate properly. The heating process was necessary because at 86 degrees (setting temperature) the action of the rennet and acid alone were not sufficient to remove the whey from the curd in a reasonable length of time.

The variable labor requirements involved in this labor division included adding starter and rennet, and cutting and stirring the curd. Also, all vat testing activities were included within this division.[3] Setting and cooking the curd required about six percent of the daily labor required in producing cheddar cheese. The labor cost for this activity were $1.64 per 1,000 pounds of cheese (Table XII).

Drawing Whey and Matting and Milling Curd

Drawing the whey and matting or cheddaring the curd required a substantial quantity of variable labor.[4] Table XII shows that the labor cost of these operations was $4.18 per 1,000 pounds of cheese which represented approximately 14 percent of the total variable labor cost. The labor required in drawing the whey consisted mainly of stirring the curd to facilitate faster whey drainage. The matting process consisted of essentially two operations, piling or packing the curd and cutting the curd into strips. The packing process was continued until a low standardized moisture content was obtained. The milling operation consisted of placing the matted curd in the milling machine which cut the curd into small pieces. The salt was then added and mixed into the curd by mechanical and hand agitation.

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[3]Vat testing activities consist of performing an acidity test on each vat to aid in deciding when to start drawing whey, milling curd, etc.

[4]Whey is the vating portion of the milk which is separated from the coagulatable portion (curd) in the cheese manufacturing operation.

Packaging Operation

This operation included preparing cheese hoops, filling, weighing, and pressing each hoop, and all packaging activities. After the cheese was milled it was placed in the hoops, weighed, and each hoop placed in the cheese press. The cheese was generally left in the press overnight. After the cheese was pressed, it was taken from the hoops, wrapped in wax paper, weighed again, and placed in boxes. All labor activities involved in moving the boxed cheese into the cold storage room and from the building were included in this subdivision. The labor cost incurred in the packaging activity was estimated to be $7.72 per 1,000 pounds of cheese produced or about 26 percent of the total labor cost (Table XII).

Cleaning Activities

All cleaning activities were combined in this classification. The cleaning operation required approximately 25 percent of all labor required in producing cheddar cheese. Labor cost for cleaning activities were computed to be $6.85 per 1,000 pounds of cheese (Table XII). Activities included were periodic cleaning of floor and equipment, cleaning of vats and hoops, and clean up activities at the end of each day's operation. The final cleaning operation required disassembling and cleaning of all receiving equipment, pipes, storage tanks, pasteurizer, and separators.

Supervisory Work

Supervisory work included all time spent by the plant foreman in supervising the cheese room employees. It did not include the time the foreman spent in other activities such as aiding in the actual production processes. This activity required approximately nine percent of the daily labor requirements. The cost of labor was estimated at $3.45 per 1,000 pounds of cheese produced (Table XII).

Lunch Periods and Delays

Each worker was allowed 20 to 30 minutes per day for a lunch period. This allowance was considered at time worked for pay. In addition, there was some delay time involved when a worker was not performing any productive activity which could not be justifiably recorded within any of the above subdivision.[5] The labor cost of this division was $2.35 per 1,000 pounds of cheese, or 8.6 percent of the total variable labor cost of producing cheese in the Armour plant.

Total Labor

The variable labor requirement per pound of cheese produced was greatly affected by the daily intake of milk. The variable labor requirement per pound of cheese produced varied indirectly with the daily milk intake.

The variable labor requirement equation[5] was estimated as follows:

$$Y = 1.646 - .015118X + .00005916X^2 \qquad (4.1)$$

where

Y = man minute requirements per pound of cheese,

X = 1,000 pounds of milk intake per day.

This equation was estimated by the total daily labor requirements for the three days included in the work sampling study.

[5]The variable labor requirement equation had the following statistical properties: $R^2 = 1.0$; standard error = 0.0. This complete "fit" was due to the presence of only three observations.

The primary reason for the occurrence of this inverse relationship between milk intake and per unit labor requirement was the degree of fixity and indivisibility in the skilled sector of the cheese plant's variable labor supply. It was necessary to employ a permanent portion of the "so-called" variable labor the year around. This somewhat permanent labor supply was made up of a plant foreman, cheese maker, and other skilled laborers. This fixity caused a much higher per unit labor requirement in the seasons of short milk supply than in seasons of high milk supply. The actual time spent in such activities as lunch and rest periods and all cleaning of equipment and building were much higher in periods of high milk intake than in periods of low intake. The opposite was true of more productive functions such as milling curd, filling and pressing hoops, packaging, etc.

The permanent labor supply used in the actual production of cheese was classified as part of the variable labor supply in this study. The decision to classify this permanent labor, which includes plant foreman and cheesemaker, as variable was based upon the fact that the work performed by these permanent laborers was closely related to and many times the same as, the work performed by seasonal, highly unskilled labor.

The seasonal nonpermanent labor was hired during seasons of high milk intake, such as spring and early summer, and laid off when available milk supplies declined. This highly variable labor was generally unskilled and performed such duties as matting and milling curd, dressing and filling hoops, and packaging of the pressed cheese.

Utilities

Utility costs were computed by: (1) estimating the utility requirements for various items of equipment and for labor activities, and (2) applying local utility costs rate schedules to these requirements. The utility requirements associated with the labor activities were computed by using the time requirement obtained from the work sampling study; whereas utility consumption of the various items of equipment were calculated primarily by employing coefficients from other cheese plant studies.

Steam

The costs associated with the steam requirement were not computed directly but were included in the general water and gas utilities. However, it was necessary to compute the volume of steam required by the cheese plant in order to obtain these utility costs.

Steam was used for milk pasteurization, can washing, heating the building, cooking the curd, and heating water. The estimate for the pasteurization requirement was based upon the following factors: (1) the heat differential between the temperature of milk as it is taken from the cooling tanks and the pasteurization temperature (this heat differential was 100 degrees assuming 60 degrees cooling temperature and 160 degrees pasteurization temperature), (2) a specific heat of milk of .93, (3) 970 B.T.U.'s per pound of steam used, and (4) a boiler efficiency of 90 percent. By combining these four factors with a daily milk intake, a formula for the daily steam requirements for milk pasteurization was derived as follows:

$$\text{Daily requirement (pounds)} = \frac{100\ (.93)\ (\text{Pounds of Milk})}{970(.90)} \qquad (4.2)$$

Steam used for can washing was based upon direct steam consumption estimates of two pounds per can.[6] It was assumed that all milk intake would be received in cans and that each can contained 70 pounds of milk.

The steam requirement for heating the building was based on the assumption of one pound of steam used per five square feet of floor space. Clark had estimated the steam requirements for plant heating to be one pound of steam for each four square feet of floor space.[7] However, this estimate was for a plant in a region requiring more heating than for a plant located in Oklahoma. The downward adjustment in the heating requirement was based on assumption rather than a comparative study.

The estimated quantity of steam used in cooking the curd was 2.75 pounds per hundredweight of milk. This estimate was obtained from the Columbia Basin studies.[8] Steam for heating water was based on one pound of steam for ten pounds of water heated.[9]

The total daily steam requirement for the model plant is shown in Table XIII and was estimated to be 1,464 pounds. Milk pasteurization required 8,522 pounds of steam daily and accounted for 46.2 percent of the daily steam requirement. Washing cans and heating the building accounted for 12.3 and 6.5 percent of the total daily steam requirements,

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[6]T. R. Owens and W. T. Butz, Specifications and Cost for Processing Operations in Small Market Milk Plants, Pennsylvania State University, Agricultural Experiment Station Bulletin 625 (University Park, 1957), p. 33.

[7]D. A. Clarke, Jr., Class III Milk in the New York Milkshed: Cost of Manufacturing Dairy Products, U. S. Department of Agriculture, Marketing Research Report 400 (Washington, 1960), p. 27.

[8]U. S. Department of the Interior, Bureau of Reclamation, Columbia Basin Joint Investigations, Agricultural Processing Industries, Problem 24 (Washington, 1945).

[9]Ibid. This estimate is comparable to heating water approximately 100 degrees and using a formula similar to the one use for steam requirement for milk pasteurization.

respectively. Heating water required 4,256 pounds of steam daily which accounted for 23.1 percent of the total requirements. Cooking curd required 2,200 pounds of steam daily and 11.9 percent of the total steam requirements.

Water

Cheese manufacturing plants use large quantities of water for washing cans; cleaning; steam; refrigeration and cooling; personal use; heating the plant; and in actual cheese production. The daily water requirements for the model plant were subdivided into variable and fixed components. The water requirements for the model plant are shown in Table XIV.

TABLE XIII

DAILY STEAM REQUIREMENTS, MODEL CHEESE PLANT

Function	Quantity	Percent of Total
	(Pounds)	(Percent)
(a) Pasteurize milk	8,522	46.2
(b) Wash cans	2,286	12.3
(c) Heat building	1,200	6.5
(d) Heat water	4,256	23.1
(e) Cooking curd	2,200	11.9
Total	18,464	100.0

TABLE XIV

DAILY WATER REQUIREMENTS, MODEL CHEESE PLANT

Operation	Variable Requirement	Fixed Requirement	Total Requirements Quantity	Total Requirements Percent	Total Cost
	(Gallons)		(Gallons)		(cents/lb.)
Cooling of milk					
Washing cans	2,304		2,304	25.8	.0070
Cleaning operations	1,342	1,498	2,840	31.7	.0087
Steam production	1,549	74	1,623	18.1	.0049
Refrigeration and cooling	1,929		1,929	21.6	.0059
Personal use	125	125	250	2.8	.0008
Total	7,249	1,697	8,946	100.0	.0273

No water was assumed to be used for the cooling of milk because of the presence of an ice builder made additional water requirements extremely low.

The water requirement for can washing was based on two gallons of water per 70 pound capacity can and was assumed to be a variable cost item. This specific water requirement was based on the Pennsylvania study of milk processing operations,[10] and accounted for 25.8 percent of the total daily water requirement of the model plant. The cost of water for can washing was estimated to be .007 cents per pound of cheese produced.

The quantity of water utilized in cleaning the building and processing equipment was expressed as a function of the time the water was drawn

[10] Owens and Butz, p. 33.

and the rate of flow. According to the study by Owens and Butz, observations in well managed milk processing plants indicated that water was drawn during approximately half of the time of these cleaning activities. The rate of flow in these plants was three gallons per minute.[11] By using the data obtained from the work sampling study on total man minutes spent in cleaning, the following formula for cleaning water usage was derived as follows:

$$\text{Water usage in gallons} = \frac{\text{total cleaning time x 3 gal. per minute}}{2} \quad (4.3)$$

The fixed water required in cleaning was based on the assumption that periodic cleaning[12] and final cleaning operations were independent of daily milk receipts. All other cleaning activities varied with daily production.

The costs of water for all cleaning activities were computed to be .0087 cents per pound of cheese and represented 31.7 percent of total daily water costs.

Water required in the production of steam was based on the amount of steam lost in the can washer, pasteurizer, cooking curd, and in the heating of the plant and the water. The water requirement for steam production which accounted for 18.1 percent of the total daily water requirement consisted of fixed and variable elements. The fixed portion was calculated from the water required to produce steam for the fixed cleaning activities

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[11]Ibid.

[12]Periodic cleaning, which includes random cleaning of the building and equipment throughout the day's operation, had some degree of variability. Time spent in this process will often be higher for days of lower milk intake. This relationship is due largely to more time available for such cleaning activities by the existing labor supply. But, due to the high degree of fixity within a daily operation of this cleaning operation, the water requirement for this activity was assumed to be fixed.

which were independent of daily milk intake; whereas, variable requirements of water for steam production were based on the amount of steam used in the variable activities such as can washing and variable cleaning.

Cooling of the plant and operation of refrigeration equipment accounted for approximately 21.5 percent of the daily water requirement. The estimated amount of water used in the refrigeration operation was based upon the number of B.T.U.'s gained in the refrigeration room from the cheese, lights, and walls. The total B.T.U.'s gained were converted into h.p. hours by the use of a coefficient of .000393.[13] The water usage for refrigeration purposes was estimated from two assumptions as follows: First, one gallon of water would be used by the storage room compressor per horsepower hour.[14] Second, with a cooling tower, only 10 percent of this figure represented the net water consumption as cooling tower losses.[15] Water usage by the ice builder compressor was estimated on the assumption that this compressor was operating 15 hours per day and used one gallon of water per horsepower hour. This figure likewise was adjusted to 10 percent of the total water usage because of the presence of the cooling tower and represented net water consumption. The cooling and refrigeration were assumed to be completely variable. Water cost for these operations was computed to be .0059 cents per pound of cheese which represented 21.6 percent of the total water cost.

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[13]A. W. Farrall, Dairy Engineering, (New York, 1942), Table LXXXI, p. 391.

[14]Clarke, p. 23.

[15]Farrall, p. 128.

Water for personal use was developed on the basis of 25 gallons per employee per day and accounted for 2.8 percent of the daily water used in the model plant (Table XIV).[16] It was assumed that five workers would be needed in the cheese room every work day. Therefore, the fixed personal water requirement was 125 gallons.

The total daily water requirement for the model plant was estimated to be 8,946 gallons. This was about one-fourth smaller than Clarke's estimate of 11,546 gallons. Fixed daily water requirements were estimated to be 1,697 gallons. Water requirements per hundred pounds of milk intake vary with the daily milk intake due to the fixed element of the water requirements. By considering the water requirement for the model plant operating at the average daily milk intake of 80,634 pounds and the fixed daily water requirement estimate, following daily water requirement was estimated:

$$W = 1,700 + 9.0x$$

where:

W = gallons of water daily,

x = daily milk intake (cwt.).

The water cost was based on a monthly water rate schedule applicable in Chickasha, Oklahoma. The water rate schedule is found in Appendix Table II. Total daily water costs were computed to be .0273 cents per pound of cheese (Table XIV).

[16] Clarke, p. 25.

Gas

The gas requirements were calculated from estimates of the daily steam requirements, the number of B.T.U.'s per pound of steam, number of B.T.U.'s per cubic foot of gas (945), and an assumed boiler efficiency of 90 percent. The following formula was used to estimate daily gas requirements for a plant with an 80,000 pound milk intake capacity.

$$\text{Daily gas requirements} = \frac{\text{Lbs. of steam (daily) x B.T.U. per lb. of steam}}{\text{B.T.U.'s per cu. ft. of gas x boiler efficiency}} \qquad (4.5)$$

The gas rate schedule used was obtained from Oklahoma Natural Gas Company. This company serves many cities throughout Oklahoma.

Electricity

The daily electricity requirements for the plant were adjusted on a percentage basis from the Clarke study. The adjusted electricity requirements and costs are shown in Table XV for each function. Lighting of the building accounted for 41.8 percent of the total daily electricity requirements. The refrigeration and cooling used 32.4 percent of the electricity. Miscellaneous electricity requirements which included office, separator, and can washer requirements, accounted for 25.8 percent of the total daily electricity requirements. Daily electricity cost was computed as .1135 cents per pound of cheese.

Charges for electrical power consist of two elements, the energy charge and the demand charge. The energy charge is based on the amount of total electricity used during a specific month and is expressed as a cost per kilowatt hour. The demand charge is a monthly charge based on the maximum rate at which energy is required over a 15 minute interval. The demand charge measures the peak load for a month. Clarke estimated the demand charge for a similar cheese plant to be 42 kilowatts. This estimate was used here. It was assumed that this "peak load" was the same for each month of operation.

TABLE XV

DAILY ELECTRICITY REQUIREMENTS, MODEL CHEESE PLANT

Function	Quantity Consumption	Percent of Total	Cost
	(Kilowatt Hours)	(Percent)	(Cents/lb.)
(a) Lighting	152	41.8	.0475
(b) Refrigeration and cooling	118	32.4	.0367
(c) Miscellaneous	94	25.8	.0293
Total	364	100.0	.1135

The electricity rate schedule (Appendix Table II) used was obtained from Oklahoma Gas and Electric Company. This schedule is relevant in many cities throughout Oklahoma.

Supplies

The cost of supplies was broken down into the five components of (1) rennet, salt, and starter; (2) packaging supplies; (3) cleaning materials; (4) office supplies; and (5) laboratory supplies. The rennet cost was $8.00 per gallon and was used at a rate of approximately 2.5 ounces per 1,000 pounds of milk intake. The salt cost was approximately $1.50 per hundredweight and was used at a rate of 3.5 pounds per 1,000 pounds of milk intake. Starter was used at a rate of 1.5 percent at a cost of $0.35 for 1,000 pounds of milk intake. These input ratios and cost estimates were obtained from the Armour and Company plant. The total cost of rennet, salt, and starter per pound of cheese produced was estimated to be .6116 cents.

Packaging cost which consisted of costs of wrapping paper and boxes to store and transport the cheese was estimated by the accountant of an Oklahoma cheese plant to be .36 cents per pound of cheese.

Cleaning supply estimates were obtained directly from Clarke's study. Clarke estimated cleaning supply costs to be .48 cents per one hundred pounds of milk intake. Office and laboratory supply costs were taken from a study by J. N. Boles pertaining to evaporated milk plants in California.[17] These two costs were estimated by Boles to be .7 cents and .4 cents per one hundred pounds of milk intake, respectively.

Fixed Costs

The fixed costs incurred in the model plant were assumed to be given for each year's production. Fixed costs included the costs of maintaining the building, equipment, and land in terms of depreciation, maintenance and repairs, interest, taxes, and insurance. Operating capital, management costs (fixed labor), and miscellaneous expenses were also classified as fixed costs.

Labor

Fixed labor cost was estimated to be $20,000 annually for the model plant. Included in the fixed labor cost was a salary for the plant manager, one bookkeeper, one comptroller, and a secretary.

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[17] J. N. Boles, "Economies of Scale for Evaporated Milk Plants in California," Hilgardia, Vol. 27, No. 21 (Berkeley, 1958), p. 682.

Land

Land cost for dairy processing plants varied greatly with respect to the type of location desired and the particular city of installation. Two general types of locations on which a cheese plant may be built are a city lot and land in an industrial tract. In this study, land costs were estimated to be $5,000. This estimate was consistent with a cost of $100 per front foot for a 50x140 foot city lot or, alternatively, the cost of an acre of land in an industrial tract inside or outside the city limit. The cost estimates were obtained by correspondence with real estate agents and city officials regarding such sites from various towns throughout the state.

Building

It was estimated that 8,000 square feet of floor space was sufficient for the 80,000 pound capacity plant. With a building cost of $12.00 per square foot, the investment in the building totaled $96,000. This did not include storage space which was calculated independently since storage costs might or might not be included, depending upon the availability of cheese outlets to the cheese plant operation. The $12.00 per square foot cost was within the range of building cost estimates of an economies of scale study of butter-powder and cheese plants in Oregon.[18] In the Oregon study, cost per square foot varied from $10.11 for the largest plant to $13.81 for the smallest plant. The 12 plants studied ranged in size from

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[18] G. T. Nelson, Input-Output Relationships in Specialized Butter-Powder and Cheese Plants, Oregon Agricultural Experiment Station Technical Bulletin 32 (Corvallis, 1956), p. 9.

4,680 to 39,460 square feet. In a North Carolina study of cheese plant operations, $12.00 per square foot was used for a plant containing 13,400 square feet.[19]

The expected life of the building was assumed to be 30 years. The annual depreciation charge, assuming 10 percent salvage value, was $3,200.

Equipment

Equipment costs were obtained through correspondence with various equipment manufacturing companies and from other studies of cheese plants. The annual depreciation charge for each item of equipment was based on the years of useful life, 10 percent salvage value, and the straight line method of calculating depreciation. Estimates of useful life of each item of equipment were drawn largely from other published sources and Bulletin F of the U. S. Internal Revenue Service.

The initial cost of all equipment in the model plant was $149,479.70. The annual depreciation charge on equipment was $10,947.88. Details for all equipment items as well as each item's initial cost, years of useful life, and the annual depreciation charge are included in Appendix Table III.

Operating Capital

In any business operation there are varying amounts of money tied up in operating capital. For the model cheese plant, it was assumed that an

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[19] R. L. Simmons, The Economic Feasibility of Additional Milk Manufacturing Plants in North Carolina, Agricultural Economics Information Series No. 99, Department of Agricultural Economics, North Carolina State College (Raleigh, 1963), p. 35.

average of $60,000 would be invested in existing inventories of cheese, supplies, accounts receivable, etc. at any given time. With a 6.0 percent interest charge, the annual interest cost of the investment in operating capital was estimated at $3,600.

Taxes

The amount of tax expense depends largely on the particular location of the plant. For this reason it was difficult to attribute any specific cost to taxes. In this study total annual tax charges were calculated by using 1.2 percent of the initial investment in equipment, building, and land. This method was used by Simmons[20] and is equivalent to a rate of 60 mills on a valuation of 20 percent of cost of building and equipment of a new plant. On the basis of a mail survey in small Pennsylvania communities, Owens and Butz estimated a tax rate of 60 mills on an average valuation of 30 percent of the actual construction cost of the buildings and the initial cost of equipment.

Insurance

Insurance cost was estimated on the basis of 1.0 percent of the original investment in building and equipment. This figure was also used by Simmons[21] and Boles.[22]

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[20] Ibid., p. 41

[21] Ibid.

[22] Boles, p. 670.

Interest

Interest is a charge for the use of capital invested and is a cost of doing business. The magnitude of this charge will vary from one plant to another and from one type of business to another, depending on the return this capital could bring in its best alternative use. For the model plant, a rate of 6 percent of the average annual investment was assumed. This was equal to 3.3 percent of the initial investment, assuming that the investment would decrease to 10 percent of the initial investment at the end of its useful life. Annual interest charges for the different types of investment were as follows: equipment $4,932.83, building $3,168.00, land $300.00, and operating capital $3,600.00. Total annual interest charges amounted to $12,000.83.

Maintenance and Repairs

Costs incurred through maintenance and repair of cheese plant equipment were assumed to be four percent per year of the initial investment. The maintenance and repair cost of the building was two percent per year of the original investment. These percentages were taken from the study by Simmons.[23] The annual costs of maintenance and repair for the equipment and building were $5,979.19 and $1,920.00, respectively.

Miscellaneous Expenses

This cost category included such items as telephone, postage, travel, etc. An annual cost of these items was arbitrarily selected to be $3,000.

[23]Simmons, p. 41.

Storage Costs

The cost of storing the cheese produced in the model plant depended upon the length of time the cheese was stored. The length of storage time likewise depended upon the availability of cheese outlets and the time necessary for producing an amount large enough for practical shipment. The storage cost consisted of both fixed and variable elements; but due to occurrence of the storage cost depending greatly upon external factors such as available cheese outlets, it was treated as an independent cost item.

For this study, it was assumed that the production of the model plant could be stored within the plant for an average of 14 days. This would allow the plant to hold the cheese until a sufficient quantity could be accumulated for more practical shipment or processing.

The production of the model plant for a 14 day period averaged approximately 107,240 pounds. Assuming that one 40 pound block occupied one cubic foot of storage space and allowing for sufficient overflow space and air circulation, a storage area with 540 square feet was estimated to be adequate for storage facilities. Assuming the building cost of storage facilities to be $20 per square foot, the cost of construction was estimated to be $10,800. Depreciation, repair and maintenance, interest, taxes, and insurance on such an investment were calculated to be $1,134 annually. The storage of cheese also increased the electricity and water costs due to additional refrigeration requirements. These additional utility costs were estimated to be approximately $45 monthly. The storage cost of cheese for the 14 day period was estimated to be .06 cents per pound.

Total Manufacturing Costs

Table XVI shows the various cost items computed for the model plant. The total cost per pound of cheese produced was estimated as 6.1030 cents. Variable labor constituted the largest portion of the total cost amounting to 2.4348 cents per pound of cheese which represented 39.9 percent of the total cost. Total utility costs accounted for .2151 cents per pound, or 3.5 percent of the total cost. Supply costs were computed as 1.1379 cents per pound. Total variable costs made up 63 percent of total cost.

Management cost was estimated as .7253 cents per pound of cheese, or 11.9 percent of total cost. The fixed annual expenses of land, building, equipment, operating capital, and miscellaneous expenses totaled 1.5299 cents per pound. Total fixed costs represented 37 percent of the total cost.

Storage cost was computed as .06 cents per pound of cheese and represented one percent of the total unit manufacturing cost.

TABLE XVI

MANUFACTURING COSTS IN THE MODEL CHEESE PLANT, 80,634 POUNDS AVERAGE DAILY MILK INTAKE

Item	Annual Cost (Dollars)	Cost Per Pound of Cheese (Cents)	Percent of Total Cost (Percent)
Variable Cost			
1. Variable labor	67,143.68	2.4348	39.9
2. Utilities			
a. Water	752.84	.0273	
b. Gas	2,048.95	.0743	
c. Electricity	3,129.95	.1135	
Total	5,931.74	.2151	3.5
3. Supplies			
a. Rennet, salt, and starter	16,865.89	.6116	
b. Packaging	9,927.60	.3600	
c. Cleaning	1,393.62	.0505	
d. Office	2,032.40	.0737	
e. Laboratory	1,160.98	.0421	
Total	31,379.49	1.1379	18.6
Total variable cost	104,454.91	3.7878	62.0
Fixed Cost			
1. Fixed labor	20,000.00	.7253	11.9
2. Equipment			
a. Depreciation	10,947.88	.3970	
b. Main. and repair	5,979.19	.2168	
c. Interest	4,932.83	.1789	
d. Taxes	1,793.76	.0650	
e. Insurance	1,494.80	.0542	
Total	25,148.46	.9119	14.9
3. Building			
a. Depreciation	2,880.00	.1044	
b. Repair and Main.	1,920.00	.0696	
c. Interest	3,168.00	.1149	
d. Taxes	1,152.00	.0418	
e. Insurance	960.00	.0348	
Total	10,080.00	.3655	6.0
4. Land			
a. Interest	300.00	.0109	
b. Taxes	60.00	.0022	
Total	360.00	.0131	0.2
5. Operating Capital	3,600.00	.1305	2.1
6. Miscellaneous Expenses	3,000.00	.1089	1.8
Total fixed cost	62,188.46	2.2552	36.9
Storage cost	1,654.60	.0600	1.0
Total Manufacturing Cost	168,297.97	6.1030	100.0

CHAPTER V

COSTS AND REVENUES FOR A MODEL CHEESE PLANT UNDER ALTERNATIVE OPERATING PLANS

The highly seasonal nature of milk supplies available to manufacturing milk plants presents many problems to the management of those plants. For example, a plant which is optimum in size with respect to the expected milk receipts for the month of May may have too large an overhead structure (fixed costs) to be optimum in the months of low milk receipts such as October. Likewise, a smaller plant which may represent a more nearly optimum size plant with respect to October's milk supply, may be far too small to process all milk available in the spring months.

The primary aim of this chapter was to develop and analyze the various implications of high seasonality in milk receipts at cheese plants in Oklahoma. This involved an analysis of seasonal cost and revenue structures of the model plant under alternative plans of operation. Three alternative plans were considered and, on the basis of the estimated net returns, the feasibility and profitability of the three plans of operation were evaluated.

The seasonality of milk receipts at the model plant was estimated from monthly data on Oklahoma cheddar cheese production for 1962-1963.[1]

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[1]U. S. Department of Agriculture, SRS, and State Board of Agriculture, Manufactured Dairy Products, Various Issues.

Although there were six plants producing cheddar cheese in the state during these two years, it was assumed that the model plant would produce one-fourth of the state's production for each month of the year. This seasonal cheese production pattern was converted to milk equivalent on the basis of 100 pounds of milk receipts, containing 3.5 percent butterfat, for each 9.5 pounds of cheese produced.[2] The seasonal variation of milk receipts is shown in Table XVII. Average seasonal milk volumes (daily basis) ranged from a high of approximately 149 thousand pounds in May to a low of approximately 52 thousand pounds in October. The average daily milk receipts for the month of May required that eight 10,000 pound vats be filled approximately twice each day, whereas in October, the available daily milk supply required filling only five of the vats each day. The estimated milk supply in May and October represented approximately 186 and 65 percent of full capacity, respectively, in the model plant.

The seasonality of manufacturing costs in the model plant was based on seasonal milk volumes and the per unit cost estimates developed in Chapter IV. Variable labor and water costs were assumed applicable to all seasonal volumes of milk by using the equations developed for them. The utility costs of gas and electricity for varying milk volumes were computed by assuming that utility requirements were linear with respect to milk receipts. Finally, all fixed costs were unchanged on a monthly basis but declined on a per unit basis with increasing milk volumes.

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[2]In the initial calculations, differences in seasonal butterfat percentages were not considered. However, these differences would tend to increase seasonality of milk receipts to a small degree. Also, since the average annual butterfat percentage is approximately 3.85 instead of 3.5 percent, these calculations slightly overestimate the milk volumes going to the model plant.

TABLE XVII

SEASONAL VARIATION OF MILK RECEIPTS AND CHEESE PRODUCTION, MODEL CHEESE PLANT, OKLAHOMA, 1961-1962

Month	Oklahoma Cheese Production: Total	Oklahoma Cheese Production: Average Per Plant	Average Milk Intake Per Plant: Monthly	Average Milk Intake Per Plant: Daily	Vats[a]
	(1,000 pounds)		(1,000 pounds)		(No.)
January	1,411	176.375	1,856.523	61.884	6
February	1,520	190.000	1,999.940	66.665	7
March	1,760	220.000	2,315.720	77.191	8
April	2,029	253.625	2,669.657	88.989	9
May	3,402	425.250	4,476.182	149.206	15
June	2,662	332.750	3,502.527	116.751	12
July	2,054	256.750	2,702.551	90.085	9
August	1,924	240.500	2,531.503	84.383	8
September	1,402	177.500	1,868.365	62.279	6
October	1,191	148.875	1,567.058	52.235	5
November	1,242	155.250	1,634.162	54.472	5
December	1,447	180.875	1,903.890	63.460	6

[a]Rounded to an even number of 10,000 pound vats.

Source: U. S. Department of Agriculture, SRS, and State Board of Agriculture, Manufactured Dairy Products, Various Issues for 1961 and 1962.

In establishing seasonal cost estimates, the total manufacturing cost per pound of cheese was computed for daily milk volumes for the months of March, May, June, August, and October. These months represented a cross-section of the seasonal milk volumes and hence seasonal cost levels for the year. The total cost computations for each of these months are found in Appendix Tables IV through VIII. The total manufacturing cost for the month of May was computed as 4.6379 cents per pound of cheese. October's total manufacturing cost was estimated at 7.9700 cents per pound of cheese or an increase of 3.3321 cents per pound over the costs incurred in May. May and October represented the low and high total per unit manufacturing cost for the year, respectively.

A short run average cost curve for the model plant was estimated by applying the least squares technique to the five monthly cost estimates. The average total unit manufacturing cost curve estimated is as follows:

$$y = 12.8940 - \underset{(10.74)^{**}}{.1169408X} + \underset{(7.85)^{**}}{.000414727X^2} \qquad (5.1)$$

$$R^2 = 99.6$$

where:

y = average total manufacturing cost per pound of cheese,

X = daily milk intake (thousand pounds).

Cost of Milk

The cost of the raw material, milk, was the greatest cost involved in producing cheddar cheese in the model plant. Several steps were involved in estimating the cost of this milk for the model plant. The functional steps of such calculations used here were: (1) obtain seasonal data of wholesale prices received by Oklahoma farmers for manufacturing milk during the period 1959-63; (2) adjust these prices to the 1963 support price level; (3) obtain seasonal butterfat percentages of milk received by handlers in the Oklahoma Metropolitan Marketing Area from 1959-63 and adjust these seasonal butterfat percentages to a 3.85 percent butterfat level (the 3.85 percent represents the average butterfat percentage of all milk sold by Oklahoma farmers during the period 1957-61);[3] (4) adjust these data to a 3.5 percent butterfat basis, and (5) assume a yield of 9.5 pounds of cheese per 100 pounds of 3.5 percent butterfat milk and compute the raw milk cost per pound of cheese. The data and cost estimates are shown in Appendix Tables IX through XII.

The season milk prices paid to Oklahoma farmers by manufacturing milk plants during the period 1959-63 ranged from a high in October of 32.74 cents per pound of cheese to a low of 31.37 cents per pound of cheese in June. The weighted average annual price of manufacturing milk used by the model plant was calculated at 31.8619 cents per pound of cheese. The weighted average price of milk was added to the total manufacturing cost equation to obtain an average total unit cost equation as follows:

$$y = 44.7559 - .1169408X + .000414727X^2 \qquad (5.2)$$

where:

y = average total unit cost,

X = daily milk intake (thousand pounds).

Table XVIII shows the seasonal variation of Oklahoma manufacturing milk prices from 1959 to 1963. The seasonal variation of milk prices per hundredweight and per pound of cheese is illustrated in Figure 6.

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[3] U. S. Department of Agriculture, SRS, and State Board of Agriculture, Oklahoma Agriculture, 1963, p. 130.

TABLE XVIII

AVERAGE MONTHLY COST OF MILK PER POUND OF CHEESE AND RELATED STATISTICS, OKLAHOMA, 1959-1963

Month	Average Price of Manufacturing Milk[a]	Average Butterfat Content	Price Per Pound of Butterfat	Price of Milk Adjusted to 3.5 Percent Butterfat	Price of Milk Per Pound of Cheese[b]
	(Dol./cwt.)	(Percent)	(Cents)	(Dol./cwt.)	(Cents)
January	3.49	4.04	86.39	3.02	31.79
February	3.45	3.92	88.01	3.08	32.42
March	3.33	3.87	86.05	3.01	31.68
April	3.22	3.74	86.10	3.01	31.68
May	3.17	3.69	85.91	3.01	31.68
June	3.18	3.73	85.25	2.98	31.37
July	3.19	3.72	85.75	3.00	31.58
August	3.22	3.72	86.56	3.03	31.89
September	3.31	3.80	87.11	3.05	32.11
October	3.47	3.91	88.75	3.11	32.74
November	3.53	3.99	88.47	3.10	32.63
December	3.50	4.04	86.63	3.03	31.89

[a]Prices are adjusted to 1963 price support level.

[b]9.5 pounds of cheese per 100 pounds of milk.

Source: Appendix Tables XI and XIII.

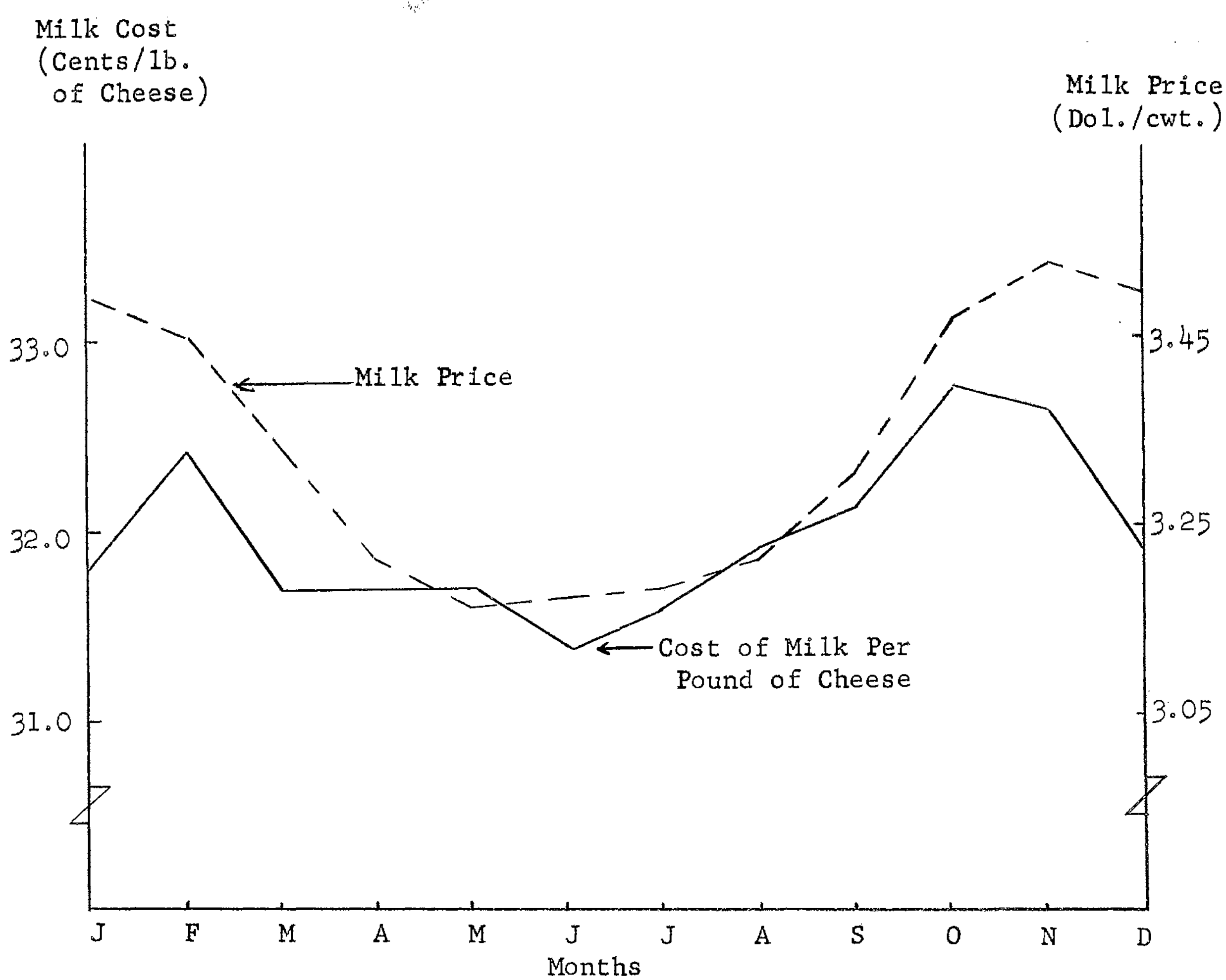

Figure 6. Seasonal Variation in Milk Prices per Hundredweight and Milk Cost Per Pound of Cheese, Oklahoma, 1959-1963.

Revenue Concepts

The total revenue accruing to the model plant consisted of revenue from the sale of cheese and butterfat. The revenue from the sale of cheese was based on the seasonal prices received for American cheddars on the Wisconsin Cheese Exchange from 1960 to 1963. The prices from this base point were increased by two cents per pound to obtain a relevant cheese price for Oklahoma. The Wisconsin-Oklahoma price differential was estimated by considering the transportation cost of cheddar cheese between the two locations. The seasonal variation of Wisconsin and Oklahoma cheese prices are shown in Appendix Table XIII. The weighted monthly average price of cheese received by the model plant was 36.1877 cents per pound.

The revenue from the butterfat recovered from the whey in cheese manufacturing was relatively small but of great importance in the financial makeup of a model cheese plant operation. Krause stated that there are six pounds of milk solids in every one hundred pounds of whey.[4] Of this six pounds of solids, about five percent is fat. By using Krause's figure, it was estimated that there was .002715 pounds of butterfat per pound of milk intake. Assuming a loss of .00023 pound of butterfat in the whey separating process,[5] the net butterfat recovered per pound of milk intake was .0025 pound. This figure was equivalent to .0263 pound of butterfat per pound of cheese produced.

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[4] O. E. Krause, Marketing Whey from Cheese Factories, Wisconsin Special Bulletin No. 44 (Madison, 1954), p. 2.

[5] This estimate was obtained for a cheese plant manager and represents an average separator loss. However, this figure can vary somewhat according to the condition of the separation, fat content of the whey, etc.

The revenue obtained from the sale of butterfat recovered from the whey was based on data pertaining to the seasonal prices paid for butterfat in Oklahoma during the period 1959-63. The seasonal variation in Oklahoma butterfat prices is shown in Appendix Table XII. The weighted average revenue from the sale of butterfat by the model plant was 1.3946 cents per pound of cheese produced. The average total revenue from one pound of cheese was estimated at 37.5823 cents.

Estimated Optimum Points of Operation of the Model Plant

The average total unit costs, marginal costs, and average revenues for the model plant were plotted in Figure 7. The optimum daily milk intake of the model plant was shown to be approximately 150,000 pounds. The daily production from this amount of milk receipts was approximately 14,250 pounds of cheese, and required that each vat be filled twice daily.

The variable labor requirements equation (4.1) discussed in Chapter IV suggested that the optimum daily production of 14,250 pounds of cheese required 168.48 man hours of cheese room labor. It took approximately 12 hours to complete the manufacturing of 15 vats (10,000 pounds of milk each) of cheese. Therefore, the optimum production required 14 workers employed for 12 hours to complete the production. Of course, due to proper labor scheduling, the labor was rotated so as to shorten the individual work day, increase the number of laborers, and have the correct amount of labor present at various times of the operating day. For instance, the early processes of setting up the equipment and filling the first vats required only one or two workers. But, as the cooking of the curd and drawing of the whey began, more labor was needed. Also, some of the initial workers were released after the first vats were finished.

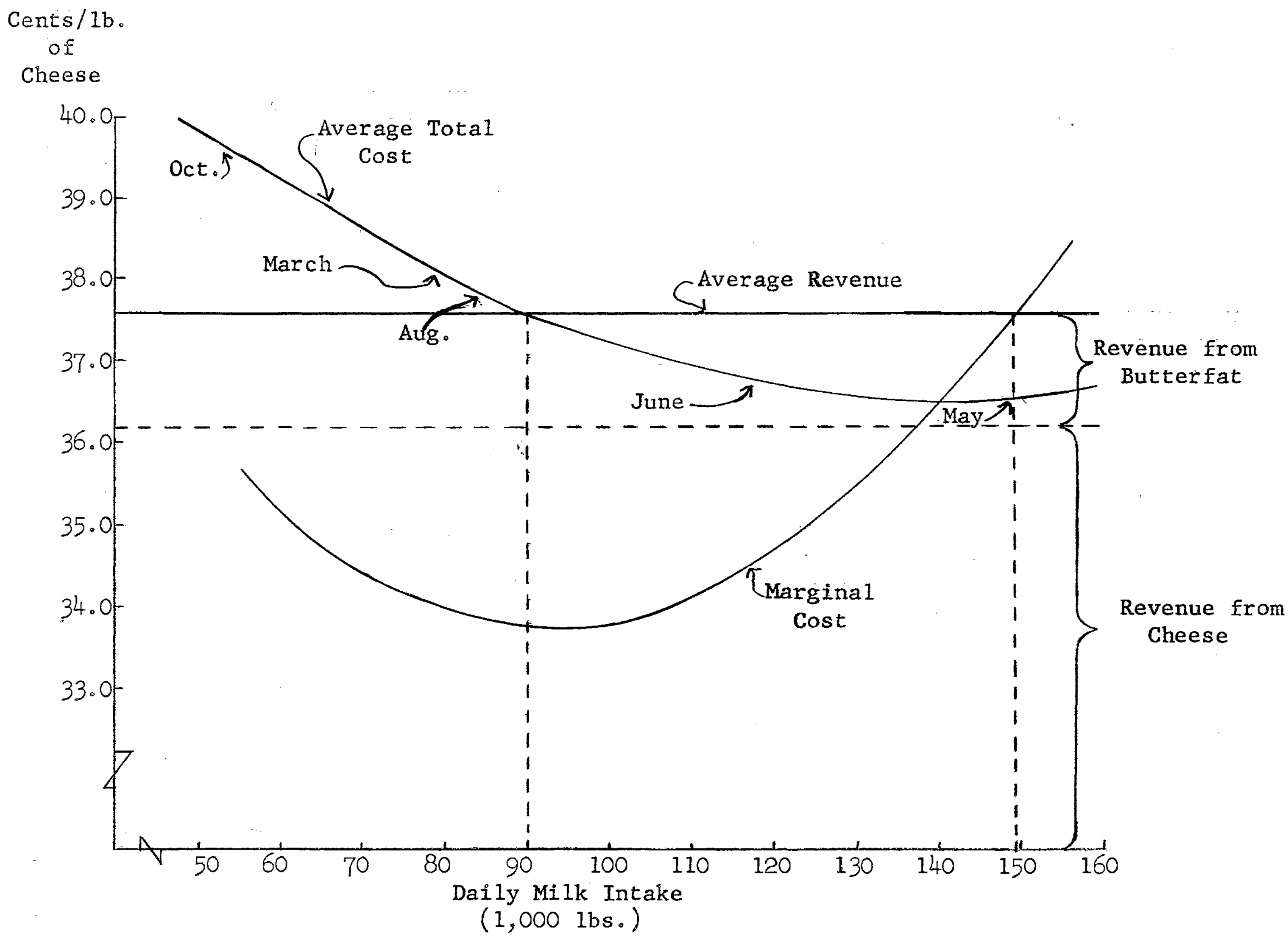


Figure 7. Costs and Revenues Per Unit, Model Cheese Plant, Oklahoma, 1964.

Figure 7 shows that to avoid a loss in the manufacturing operation, the model plant needed a daily milk intake of at least 90,000 pounds. This break-even intake was reached when the average total revenue is equal to the average total unit cost and required roughly 12 workers working an 8-hour day to manufacture the 8,550 pounds daily yield of cheese.

It is evident from Figure 7 that a fairly wide range in seasonality of receipts could exist and still have average costs less than average revenues. However, this range did not include operation at or less than 100 percent of capacity with capacity defined in terms of the single use of the vats. Some multiple use of vats was necessary each day for profitable operation.

Alternative Plans of Operation

The financial success of a cheese plant operation depends upon the management's ability to choose a plan of operation which best fits the seasonal milk supplies, the availability of seasonal labor, and the layout of the existing plant. In this study, three alternative plans were analyzed with regard to feasibility and profitability of producing cheddar cheese under high seasonality of milk receipts.

The three plans of operation selected for this study are: (1) operating the plant 30 days a month for the entire year, (2) operating the plant for the six months of largest milk supply and closing the plant the remaining six months, and (3) operating the plant 30 days a month for six months and only 15 days per month for the remaining six months. The volume of product for the model plant outlined in Table XIX averaged 7,660 pounds per day, or 100.8 percent of capacity. This volume was such that the

TABLE XIX

BASIC PRODUCTION, COST, AND REVENUE DATA, MODEL CHEESE PLANT, OKLAHOMA, 1964

Month	Milk Receipts[a] (1,000 lbs.)	Cheese Production (lbs.)	Butterfat Recovered (lbs.)	Production Cost (Dol.)	Revenue (Dol.)
January	1,857	176,370	4,641	68,847	68,441
February	2,000	189,994	5,000	74,469	72,218
March	2,316	219,993	5,789	83,638	83,377
April	2,670	253,617	6,674	94,984	93,544
May	4,476	425,237	11,190	154,610	155,972
June	3,503	332,740	8,756	120,665	122,028
July	2,703	256,742	6,756	95,778	94,413
August	2,532	240,493	6,329	91,073	89,426
September	1,868	177,495	4,671	69,808	67,822
October	1,567	148,871	3,918	60,527	57,801
November	1,634	155,245	4,085	62,804	60,586
December	1,904	180,870	4,760	70,599	70,768

[a]Monthly milk receipts were rounded to 1,000 pounds after cheese yield calculations were made.

maximum volume in May could be handled in two shifts or two uses of each vat each day.

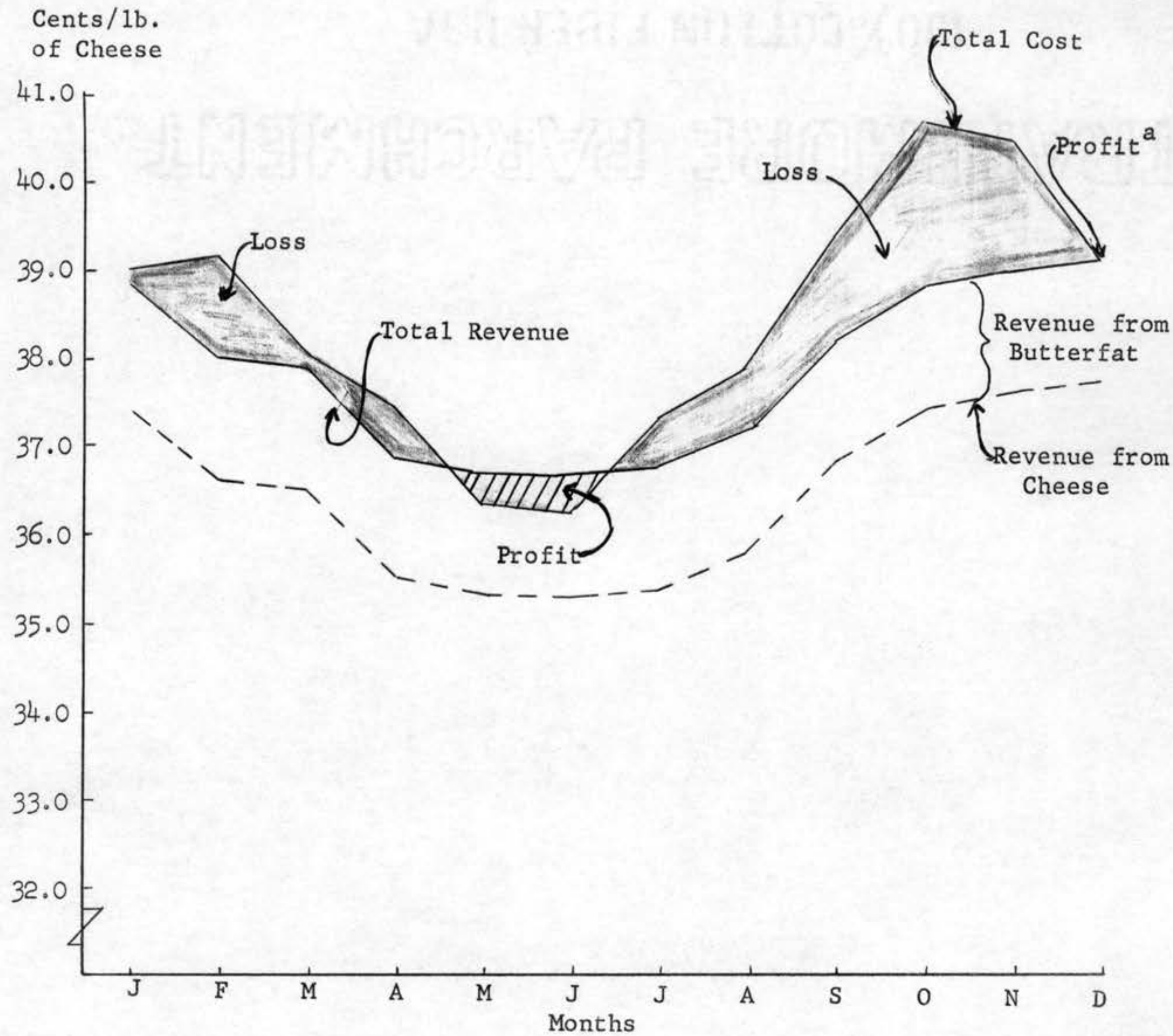
Plan I encompassed the cost and revenue curves presented in Figure 7 and the seasonality of milk receipts shown in Table XVII. It is assumed that each day's milk supply was processed immediately upon receipt with no excess storage facilities used or available. The seasonality of profits and losses which occurred to the model plant under such an operating schedule are shown in Table XX and Figure 8. The months for which profits existed were May, June, and December; and only May, June, and July had milk volumes which exceeded the estimated break-even volume of 90,000 pounds. The month of July with a daily volume approximately equal to 90,000 pounds failed to make a profit largely because of the relatively low cheese and butterfat prices paid to the plant as compared to the plant's cost of raw milk. A loss was sustained during the other months. October, which represented the lowest monthly production, had the greatest monthly loss of $2,726. The total annual loss under Plan I was $11,406.

Plan II was designed to examine the effects on the annual returns of the cheese producing operation if the plant closed down for the six months of shortest milk supplies. This alternative at first seemed to offer good opportunities for increasing the financial success of the operation. However, because of the large quantity of fixed annual costs and the relatively small margins which already existed, such a plan was found to be highly unprofitable (Table XX). Even the month of May, which initially had been near the optimum level of production, yielded a loss to the plant when operating only six months. The higher level of fixed cost

TABLE XX

TOTAL REVENUE AND NET RETURNS UNDER THREE ALTERNATIVE PLANS OF OPERATION FOR A MODEL CHEESE PLANT, OKLAHOMA CONDITIONS, 1964

Month	Total Revenue Per Pound of Cheese (Cents)	Net Returns: Plan I Monthly (Dollars)	Plan I Per Pound of Cheese (Cents)	Plan II Monthly (Dollars)	Plan II Per Pound of Cheese (Cents)	Plan III Monthly (Dollars)	Plan III Per Pound of Cheese (Cents)
January	38.8052	-406	-.2303			1,266	.7175
February	38.0106	-2,251	-1.1847			-947	-.4987
March	37.8999	-261	-.1184	-4,902	-2.2284	-357	-.1622
April	36.8842	-1,440	-.5676	-6,081	-2.3976	-1,536	-.6056
May	36.6789	1,362	.3204	-3,273	-.7696	1,266	.2978
June	36.6736	1,363	.4095	-3,262	-.9805	1,267	.3808
July	36.7736	-1,365	-.5314	-5,986	-2.3314	-1,461	-.5688
August	37.1843	-1,647	-.6850	-6,289	-2.6150	-1,743	-.7250
September	38.2106	-1,986	-1.1190			-312	-.1760
October	38.8264	-2,726	-1.8308			-1,373	-.9223
November	39.0262	-2,218	-1.4286			-630	-.4054
December	39.1264	169	.0933			1,841	1.0179
Total		-11,406		-29,793		-2,719	



[a]The profit for December of .0933 cents per pound of cheese could not be shown graphically.

Figure 8. Plan I, Seasonal Variation of Costs and Revenues, Model Cheese Plant, Oklahoma, 1964.

could not be covered. The annual loss under the second plan was $29,793 almost three times as large as under Plan I. Figure 9 compares the manufacturing cost associated with Plan II with the costs of Plans I and III.

Plan III consisted of operating only 15 days a month during the six months of lowest milk supplies and 30 days during the six months of highest milk supplies. This type of operation required additional milk storage facilities since one day's milk supply was stored for processing the following day. Given the daily milk receipts for the low month's production found in Table XVII, this required two additional 6,000 gallon storage tanks at an average annual cost of $1,155.40, or $96.28 average monthly cost. It was assumed that the existing model plant had sufficient space for installing the new storage facilities. On a daily basis, the fixed cost doubled during periods when the cheese manufacturing took place only every other day. The additional utility costs associated with storage of milk were not considered.

The additional fixed cost of the storage tanks was far out-weighed by the increases in labor efficiency resulting from the doubling of daily milk volumes during the months of low milk production. Table XX and Figure 10 show that the annual loss incurred by this operation was only $2,719 as compared with a loss of $11,406 and $29,793 for Plans I and II, respectively. A great drawback to this type of an operation would be obtaining labor that was willing to work only every other day.

In conclusion, the three alternative operating plans resulted in negative returns. Plan III offered the lowest amount of loss for a cheese plant operation given the existing level and seasonality of milk supplies per plant, the milk cost, and the prices of cheese and butterfat. However,

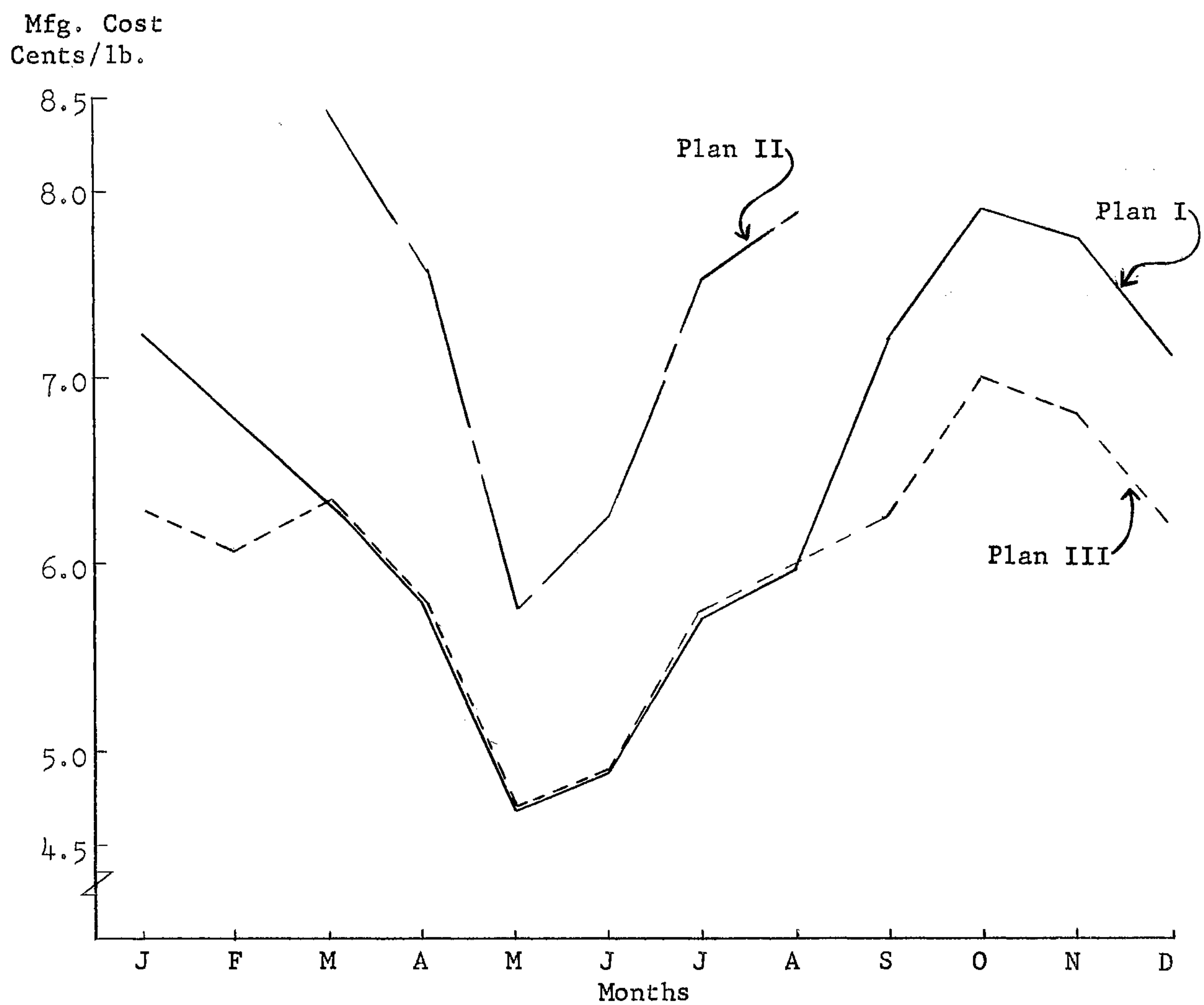


Figure 9. Seasonal Variation in Manufacturing Costs for the Model Cheese Plant Under Three Plans of Operation.

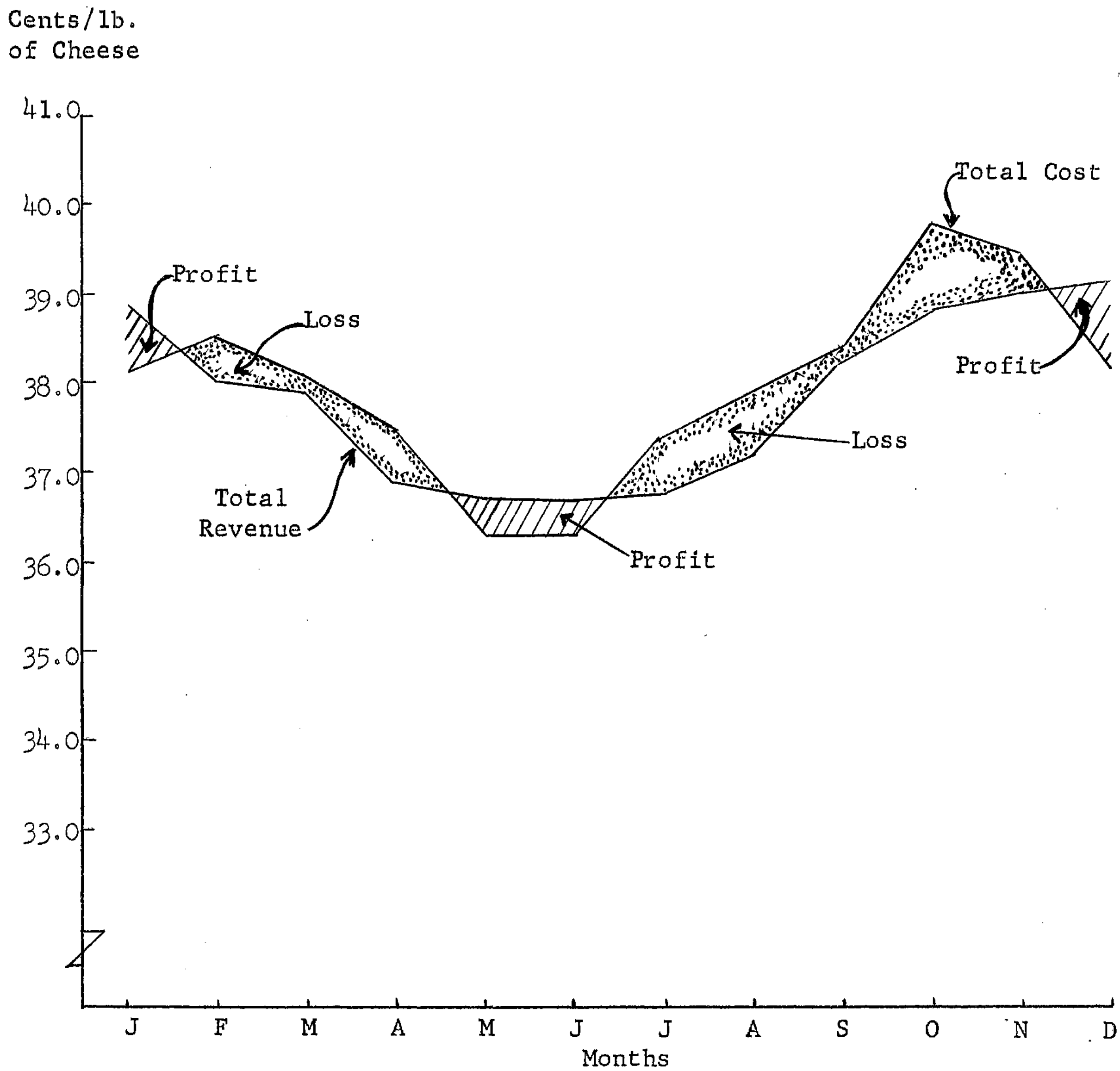


Figure 10. Plan III, Seasonal Variation in Costs and Revenues, Model Cheese Plant, Oklahoma, 1964.

the three alternative plans could be altered somewhat by various assumptions that have not been presented. For example, the average operating capital might be decreased to $20,000 from the initial $60,000. This $40,000 reduction in operating capital could be accomplished by decreasing accounts receivable or more importantly, through obtaining a ready outlet for cheese production. This outlet would allow for faster movement of cheese inventories, therefore, decreasing the operating capital and the need for storage facilities. The reduction in fixed cost on an annual basis would total $2,400, and building and utility expenses would decrease by .06 cents per pound of cheese.

CHAPTER VI

ANALYSIS OF THE COMPETITIVE POSITION OF CHEESE PLANTS IN OKLAHOMA

Milk supplies available to Oklahoma cheese plants consist of manufacturing and surplus Grade A milk. The success of future cheese plant operations within the state depends largely upon the annual volume and the seasonality of these two sources of milk supply. Also, much depends upon the degree of variability of milk production from year to year.

In analyzing the competitive position of cheese plants in Oklahoma, an attempt was made to estimate the total milk available for manufacturing purposes. Secondly, by assuming that all the available milk which has in the past been converted to butter or cheese would be utilized in cheese production, three alternative plans were investigated with respect to the number of plants needed to process the milk into cheese, and the type of operation most profitable for the plants involved.

No attempt was made to find the optimum size of plant. There was some reason, however, to believe that the model plant may be near the optimum size with respect to the seasonality of milk receipts, increased procurement cost associated with larger plants, and the uncertainty of available milk supplies associated with milk manufacturing plants in Oklahoma. This reasoning was based primarily on the existence of similar size plants in Oklahoma that have continued to operate while other cheese plants of smaller capacity discontinued operations during the last 20 years.

Available Milk Supplies

Milk supplies available to cheese plants consist of manufacturing grade milk and Class II Grade A milk. The estimate of manufacturing milk available for cheese production was derived from data obtained from the Oklahoma Livestock and Crop Reporting Service pertaining to manufacturing milk receipts of individual plants in 1962.

The estimate of surplus milk was obtained from Class II utilization data reported in the monthly bulletins of the Market Administrators for the Oklahoma Metropolitan and the Red River Valley milk marketing areas. Approximately 30 percent of total milk receipts in these two areas in 1962 and 1963 was classified as Class II milk.[1] By examining data of the various sources of the utilization of Class II milk in the Oklahoma Metropolitan Area, it appeared that approximately 70 percent of the Class II milk receipts in the areas could be made available for cheese production.[2] This percentage was used to estimate the availability of surplus milk for cheddar cheese production.

The estimated total quantity of manufacturing grade and Class II Grade A milk that could be made available for cheese production annually

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[1]It was estimated that 66 percent of the Red River Valley milk receipts came from Oklahoma. This was based on, in part, the percent of the total population of the marketing area living in the eight Oklahoma counties included in the market order. For information concerning the two milk marketing areas, see: U. S. Department of Agriculture, SRS, _Fluid Milk and Cream Report_ (Washington).

[2]It was assumed that all surplus milk except that utilized in ice cream and stock feed production and listed as shrinkage and dumped could be made available for cheese production.

was 139 and 162 million pounds, respectively. This was less than 30 percent of total deliveries of whole milk by farmers.

Since the seasonality of milk receipts can be a very important factor in the profitability of cheese plant operations, the seasonality of this aggregate milk supply was computed. It was based on the seasonality of milk supplies utilized in cheese and butter production in Oklahoma during the period 1958-1962, as shown in Table XXI. The seasonality for this supply was somewhat smaller than that used for the model plant in Chapter V. This situation suggests that butter production has been much more stable seasonally than cheese production in Oklahoma which, in turn, implies that butter production has had first claim on available manufacturing and surplus milk supplies.

Figure 11 illustrates the effects of the lowered seasonality of milk receipts on the total cost structure of the model cheese plant operating the entire year. The average total unit costs associated with the seasonality of milk receipts estimated on the basis of (1) past cheddar cheese production in Oklahoma (Chapter V); and (2) past cheese and butter production in Oklahoma which was used in the analysis of the present chapter. The two cost structures were compared with total unit revenue to show seasonal profits or losses associated with the two degrees of seasonality.

The shaded areas in Figure 11 represent the profit or loss under the new milk seasonality estimated by using the milk utilized seasonally in past butter and cheese production. The area between the total unit cost of Chapter V (dotted line) and the total revenue represents the loss or profit under the initial seasonal milk supplies. A comparison of the net returns associated with the two yearly milk supply sequences shows that

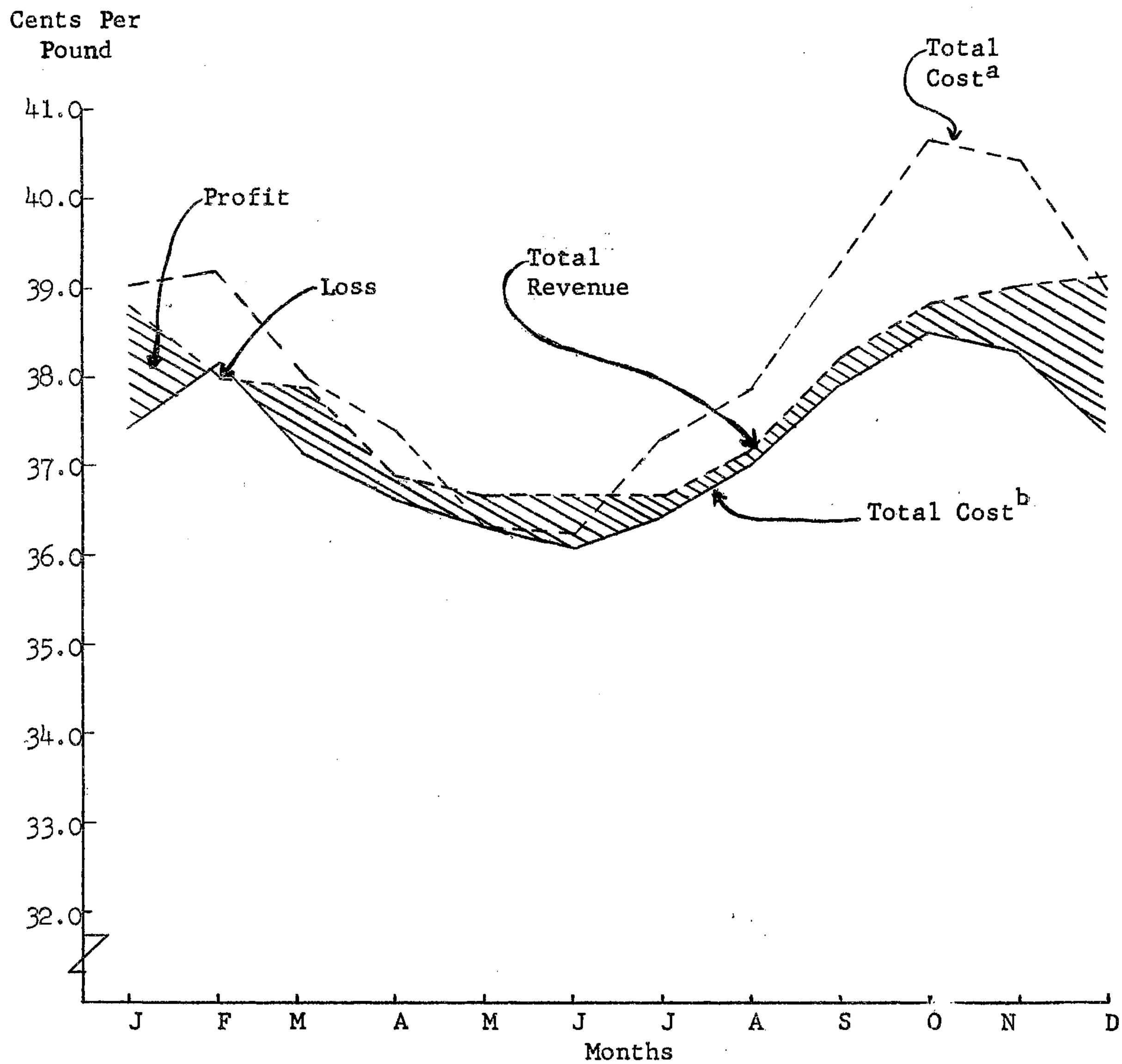
TABLE XXI

GROSS REVENUE FROM SURPLUS MILK SUPPLIES IF USED EXCLUSIVELY FOR CHEDDAR CHEESE PRODUCTION, OKLAHOMA, MONTHLY

Month	Surplus Milk Supply	Cheddar Cheese Production Potential[a]	Revenue Potential	
			Total[b]	Per Pound of Cheese
	(Mil. lbs.)	(Thou. lbs.)	(Dol.)	(Cents)
January	22.0	2,090	811,030	38.8053
February	21.7	2,062	783,770	38.0102
March	23.3	2,214	839,099	37.8997
April	27.4	2,603	960,096	36.8842
May	35.3	3,354	1,230,205	36.6787
June	30.4	2,888	1,059,136	36.6737
July	28.3	2,689	988,838	36.7734
August	25.3	2,404	893,902	37.1839
September	21.2	2,014	769,560	38.2105
October	21.4	2,033	789,339	38.8263
November	22.0	2,090	815,650	39.0263
December	22.9	2,176	851,382	39.1265

[a]These calculations assume a yield of 9.5 pounds of cheese per 100 pounds of milk. The difference in cheese yield due to seasonal butterfat differences accounted for by adjusting milk intake to a 3.5 butterfat per-cent in the computation of milk cost per pound of cheese (Table XVIII).

[b]Includes an allowance for the recovery of butterfat from whey and subsequent sale at the average price of butterfat during that month.



[a]Representative of actual seasonality of cheese production.

[b]Based on the use of all excess milk in cheese production

Figure 11. The Effects of the Seasonality of Milk Receipts on Costs and Returns, Model Cheese Plant Operating the Entire Year, 30 Days per Month.

the loss incurred with the initial seasonality totaled $11,406, but under the new milk sequence the model plant realized a profit of $19,262. The difference of $30,668 was the result of greater efficiency of variable inputs, particularly labor, and better year-round utilization of the fixed resources in the model cheese plant.

Included in Table XXI are the revenue potentials from the use of the surplus milk in cheddar cheese production. The largest revenue potential per pound of cheese was in December. However, the largest total revenue occurred in May when volume was at a maximum.

Alternative Firm Numbers and Operating Plans for Use of All Surplus Milk in Cheese Production

In attempting to find feasible and profitable methods of utilizing the estimated annual surplus milk supply in cheddar cheese production, three aggregate alternatives were investigated. These were: (1) Plan A--eight plants operating 30 days per month for 12 months; (2) Plan B--eight plants operating six months for 30 days per month and only 20 days for each of the remaining six months; and (3) Plan C--six plants operating 30 days per month for 12 months.

Plan A involved eight plants of the model plant size operating each day of the year. The number of plants was determined from the total quantity of milk available, and the maximum capacity of the model plant size. The net returns under Plan A are shown in Table XXII. Total annual net returns for this plan was $19,262 for each of the eight plants. The month of June had the lowest production costs per pound of cheese which resulted from efficiencies possible from relatively high volume of daily milk receipts and from the seasonally low costs of milk. However,

TABLE XXII

COSTS AND RETURNS PER MODEL PLANT UNDER PLAN A FOR PROCESSING SURPLUS MILK IN OKLAHOMA

Month	Average Daily Milk Receipts	Costs Per Pound of Cheese: Manufactured	Costs Per Pound of Cheese: Total	Net Returns: Per Pound of Cheese	Net Returns: Total
	(Thous. lbs.)	(Cents per lb.)		(Cents)	(Dollars)
January	91.7	5.6609	37.4509	1.3544	3,539
February	90.4	5.7118	38.1318	-0.1216	-313
March	97.1	5.4492	37.1292	0.7705	2,133
April	114.2	4.9481	36.6281	0.2561	833
May	147.1	4.6660	36.3460	0.3327	1,395
June	126.7	4.7352	36.1052	0.5685	2,052
July	117.9	4.8716	36.4516	0.3218	1,082
August	105.4	5.1757	37.0657	0.1182	355
September	88.3	5.8017	37.9117	0.2988	752
October	89.2	5.7627	38.5027	0.3236	822
November	91.7	5.6609	38.2909	0.7354	1,922
December	95.4	5.5123	37.4023	1.7242	4,690
Total					19,262

revenues per pound of cheese were lowest in June. December had the greatest net returns per pound of cheese and the largest total monthly net returns. The high net returns for December came largely from seasonally high revenues per pound of cheese. Production costs in December were still above average.

Plan B was similar to Plan II of Chapter V in that it investigated the possibilities of increasing total annual net returns from the eight plants by operating only 20 days per month during the six months of shortest milk supplies. This type of operation increased fixed cost substantially because of the necessity of acquiring additional storage facilities to store the daily milk intake for the ten days the plants were closed, and the additional daily fixed costs which had to be absorbed as a result of closing the plant ten days each month. Nevertheless, the increase in labor and overall plant efficiency resulted in a lower per unit manufacturing cost than under Plan A. For example, average total unit manufacturing costs in January decreased from 5.6609 to 5.3166 cents as a result of this increased efficiency brought about by larger daily milk volumes. The total annual net returns under Plan B shown in Table XXIII was computed to be $24,779 which was one-fourth greater than the net returns for Plan A.

Plan C consisted of six model size plants operating 30 days per month for 12 months. The purpose in developing Plan C was to permit increased net returns allowing each plant to operate at a higher level of capacity through the year. Since the previous plans were set up to process all surplus milk available to the plants, not all the surplus milk could be processed into cheese under Plan C. During the flush months, the extra amount of milk had to be handled at a loss. Under Plan C, all milk above 160,000 pounds, the daily capacity of the model plant, was sold at a

TABLE XXIII

COSTS AND RETURNS PER MODEL CHEESE PLANT UNDER PLAN B[a] FOR PROCESSING SURPLUS MILK IN OKLAHOMA

Month	Average Daily Milk Receipts	Production Cost Per Pound of Cheese: Manufacturing[b]	Production Cost Per Pound of Cheese: Total	Net Returns: Per Pound of Cheese	Net Returns: Total
	(Thous. Lbs.)	(Cents)		(Cents)	(Dollars)
January	137.6	5.3166	37.1066	1.6987	4,439
February	135.6	5.3329	37.7529	0.2573	663
March	97.1	5.4495	37.1295	0.7702	2,132
April	114.2	4.9484	36.6285	0.2557	832
May	147.1	4.6662	36.3462	0.3325	1,394
June	126.7	4.7355	36.1055	0.5682	2,051
July	117.9	4.8719	36.4519	0.3215	1,081
August	105.4	5.1760	37.0660	0.1179	354
September	132.5	5.3668	37.4768	0.7337	1,847
October	133.8	5.3521	38.0921	0.7342	1,866
November	137.5	5.3169	37.9469	1.0794	2,820
December	143.1	5.2878	37.1778	1.9487	5,300
Total					24,779

[a]Under Plan B eight plants operate six months for 30 days a month and six months for 20 days a month. The 20-day months include January, February, and September through December.

[b]Includes additional fixed cost of storage tanks of $96.28 per month for 12 months. Also, for the six months of 20 days of operation includes additional fixed cost incurred by shutting plant down for 10 days ($1,727.29 monthly).

20 percent loss.[3] The net effect of this plan was to increase the daily milk volumes per plant, and it required that excess milk be sold at a loss only during the two months of May and June. The annual net returns per plant from Plan C was $28,298 (Table XXIV). This was an increase of almost one-half over Plan A, and an increase of about one-seventh over Plan B.

In summary, Plan C would appear to offer the best alternative for organizing the cheese industry of the state if all manufacturing and available surplus milk supplies were to be used in cheddar cheese production. Much would depend on the possibilities of selling the excess milk supplies in May and June and at what loss the plant would incur in these transactions. At worst, the butterfat could be separated from milk and sold as butter or butterfat. However, a process of this sort would entail a larger loss for the excess. The loss in value of the product would be approximately 37 percent as compared with the budgeted 20 percent loss.[4] When considering the labor and utility costs incurred in the separating process, the total loss would be somewhat higher than 37 percent.

Even though Plan C would result in a higher return per plant than Plan B, it would not result in higher returns to all plants in the state as a group. In fact, the net returns to the group of plants would be about

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[3]Milk in excess of 160,000 pounds daily could not be processed into cheese because of difficulty in labor scheduling due to extremely long hours of operation. The 160,000 pounds of milk would require filling each vat twice and operating approximately 16 hours daily.

[4]In December, for example, milk cost was $3.50 per cwt. and revenue from the butterfat separated from the milk would be $2.19.

TABLE XXIV

COSTS AND RETURNS PER MODEL CHEESE PLANT UNDER PLAN C FOR PROCESSING SURPLUS MILK IN OKLAHOMA

Month	Average Daily Milk Receipts	Costs per Pound of Cheese		Net Returns	
		Manufacturing[b]	Total	Per Pound of Cheese	Monthly Total
	(Thous. Lbs.)	(Cents)		(Cents)	(Dollars)
January	122.2	4.7969	36.5869	2.2184	5,797
February	120.6	4.8228	37.2428	.7674	1,978
March	129.4	4.7062	36.3862	1.5135	4,189
April	152.2	4.7027	36.3827	.5015	1,632
May	196.1	4.8005[a]	36.4805	.1982	-6,031[b]
June	168.9	4.8005[a]	36.1705	.5032	119[b]
July	157.2	4.7596	36.3396	.4338	1,458
August	140.6	4.6506	36.5406	.6433	1,933
September	117.8	4.8735	36.9835	1.2270	3,090
October	118.9	4.8528	37.5928	1.2335	3,134
November	122.2	4.7969	37.4269	1.5994	4,179
December	127.2	4.7293	36.6193	2.5072	6,820
Total					28,298

[a]Costs computed on an average daily milk intake of 160,000 pounds.

[b]Includes a net loss on the sale of surplus milk of $6,862 in May, and $1,698 in June.

one-seventh less under Plan C than under Plan B. This, combined with potentially lower assembly costs, might be sufficient to justify the larger number of plants on strictly economic grounds.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The primary objectives of this study were to: (1) analyze changes in the U. S. cheese production and consumption during the period 1930-1962; (2) study the changes in the number and size of cheese plants in Oklahoma from 1942 through 1962; and (3) determine the relative size and structure of the cheese industry in the state in future years on the basis of milk supplies, availability, and costs of manufacturing cheese.

Cheese production and consumption in the United States followed a strong upward trend during the period 1930-1962. Total cheese production increased from 510 to 1,635 million pounds. The American cheese varieties made up about 75 percent of total cheese production, and cheddar cheese represented approximately 90 percent of all American cheese production. Consumption increased along with production because of increases in population and, more importantly, large increases in per capita consumption. Per capita consumption of cheese more than doubled during the period relevant to this study.

Commercial domestic consumption served as the major outlet for domestically produced cheese. Since 1950, only about 84 percent of all cheese produced in the United States went to the domestic market. Noncommercial domestic utilization and noncommercial exports, which were made possible by the government price support program, assumed a rather important role as outlets for U. S. American cheese production. During the period 1950-1962, noncommercial domestic outlets accounted for an annual average of 6.4 percent of the total U. S. American cheese production. These outlets included utilization by the school lunch program, military agencies, the Veterans Administration, and low income families. Foreign noncommercial utilization (foreign relief programs) served as an outlet for an average of 6.2 percent of American cheese during the same period. Other outlets of lesser importance were purchases by military agencies and commercial exports which accounted for 1.4 and 1.2 percent of total production, respectively.

Foreign trade of cheese consisted primarily of noncommercial exports of surplus CCC stocks of cheddar cheese and commercial imports of Swiss cheese and the Italian varieties. Imports accounted for an average of about 4.5 percent of annual U. S. domestic utilization of all cheese during the period 1950-1962.

Cheese production in Oklahoma from 1942-1962 was rather erratic from year to year and consisted almost entirely of cheddar cheese. Cheese plant numbers decreased from 24 plants in 1942 to only five plants in 1962, and to three in 1964. However, during this same period, average production per plant increased from 558 thousand pounds in 1942 to 1,607 thousand pounds in 1962. The percentage of whole milk sold by Oklahoma farmers utilized in cheese production declined from 25 percent in 1942 to six percent in 1958. It was estimated that cheese consumption within the state greatly exceeded production with the gap getting larger each year.

Estimates of costs, revenues, and seasonal milk supplies were used to evaluate the profitability of actual and potential cheese plant operations in Oklahoma. The manufacturing cost estimates were derived primarily by the synthetic model procedure and through personal contacts with a cheese plant in Oklahoma. The model plant was equipped with eight 10,000 pound vats and had an investment in land, building, and equipment of $250,480. Variable labor and supply costs were found to be the largest and the most important costs of the model cheese plant excluding the cost of the milk.

The cost of milk, estimated by the use of manufacturing milk prices and a yield of 9.5 pounds of cheese per 100 pounds of 3.5 percent milk, was computed as 31.8619 cents per pound of cheese. The average total unit cost was 37.9960 cents per pound of cheese for the year. The total revenue consisted of revenue from the sale of cheese produced and butterfat recovered from the whey. Revenue from cheese was based on a cheese price of two cents per pound above the Wisconsin Cheese Exchange price. This price differential allowed for transportation charges between Wisconsin and Oklahoma. Revenue from the recovered butterfat was also computed. The average total revenue was 37.5823 cents per pound of cheese. The break-even daily milk volume was computed as approximately 90,000 pounds. Therefore, the profitable range of daily operations did not include less than 100 percent daily capacity in the model plant.

The seasonality of milk volumes going to the model plant was estimated by the use of data pertaining to the past seasonality of cheddar cheese production in Oklahoma. This seasonality was found to be of great significance in determining the profitability of cheese production in Oklahoma. Milk volumes ranged from a high in May to a low in October. To predict the profitability of cheese plant operations, it was necessary to develop the costs and revenue concepts for different seasons of the year. Average daily milk volumes for each month were estimated by assuming the plant would operate 30 days per month. The estimation of manufacturing costs in the model plant for different milk volumes corresponding to the seasonality of milk was accomplished by the use of (1) variable labor and water requirement equations, (2) assumptions of linearity regarding other utility requirements, and (3) linear supply requirements taken from other milk plant studies. Seasonal milk costs and total revenue were derived from seasonal price data for milk, cheese, and butterfat.

Net returns (revenue minus costs) per pound of cheese were found to be highest in the month of June (.4095 cents) and lowest in the month of October (-1.8308 cents). Given the estimated seasonality of milk receipts, only the production in the months of May, June, and December proved profitable. Total annual losses of producing cheese every day of each month were calculated as $11,406 for the model size plant.

Two alternative operating plans were investigated to determine possible ways of reducing losses or increasing profits of cheese plant operations. One alternative plan was that of operating the cheese plant only during the six months of largest available milk volumes. This proved to be even more unprofitable than operating the plant each day during the entire year. The fixed costs associated with the six months with no production were too large to be offset by economies of operation during the remaining months. Yearly losses under this type of operation were $29,793. The other plan required operating the plant only 15 days per month during the six months of smallest milk supplies and 30 days per month during the remaining six months. This plan was estimated to have an annual loss of only $2,719 which proved to be the most feasible of the three operating plans.

From the seasonal costs and available milk supply estimates, an attempt was made to analyze the competitive position of cheese plant operations in Oklahoma. Available milk supplies were estimated by using data on manufacturing milk and the portion of the surplus Grade A milk which could be used for manufacturing purposes. It was estimated that 301 million pounds of milk could be made available for manufactured dairy products. It was assumed that all the milk would be utilized in cheese production. The seasonality of these aggregate milk receipts was based on the past seasonality of butter and cheese production in Oklahoma.

In order to find the most profitable way of utilizing the estimate available milk supply into cheese production, three aggregate plans were investigated. These plans were based on the costs and revenue structure of the model plant but different seasonality of milk receipts due to including milk used in past butter production with seasonality computations. Plan A, which consisted of eight plants operating the entire year, resulted in an annual net return per plant of $19,262. The weighted average total revenue and cost associated with the new seasonality were 37.7119 and 37.1734 cents per pound of cheese, respectively. These compare to a per unit revenue of 37.5823 and a per unit cost of 37.9960 for the model plant operating under the initial estimated seasonality. Plan B called for these same eight plants to operate only 20 days per month for the six months of shortest milk supply. Plan B was computed to have $24,779 net returns annually for each plant.

Plan C was based on the operations of only six plants. These plants sold all milk in excess of daily capacity at a 20 percent loss. Although this plan required that each plant sell relatively large quantities of milk during the months of May and June, the total annual net returns for each plant was $28,298, almost one-half larger than under Plan A. The increase was attributed to greater annual production per plant and to a smaller effect of seasonality on plant use. In addition, the net returns to all plants as a group were less under Plan C than under Plan B.

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A P P E N D I X

APPENDIX TABLE I

UTILIZATION OF AMERICAN CHEESE PRODUCTION, UNITED STATES, 1960-1962

Year	Prod.	Domestic Utilization: Commercial[a]		Domestic Utilization: Noncommercial[a]		Domestic Utilization: Military		Foreign Utilization: Commercial Exports		Foreign Utilization: Noncommercial Exports[b]		Total Utilization as Pct. of Total Prod.
	(Mil. lbs.)		(Pct)[c]	(Mil. lbs.)	(Pct)[c]	(Mil. lbs)	(Pct)[c]	(Mil. lbs)	(Pct)[c]	(Mil. lbs)	(Pct)[c]	(Pct)[c]
1950	895	798	89.2	25	2.8	11	1.2	12	1.3	46	5.1	99.6
1951	974	756	86.5	17	1.9	21	2.4	45	5.1	39	4.5	100.4
1952	851	805	94.6	14	1.6	21	2.5	6	0.7	1	0.1	99.5
1953	1,022	770	75.3	23	2.3	19	1.9	5	0.5	17	1.7	81.7
1954	1,045	816	78.1	62	5.9	15	1.4	8	0.8	29	2.8	89.0
1955	1,005	780	77.6	90	9.0	15	1.5	6	0.6	144	14.3	103.0
1956	994	789	79.4	108	10.9	14	1.4	14	1.4	163	16.4	109.5
1957	1,026	764	74.5	100	9.7	10	1.0	14	1.4	165	16.0	102.6
1958	983	797	81.1	143	14.5	11	1.1	7	0.7	156	15.9	113.3
1959	948	864	91.1	44	4.6	10	1.1	3	0.3	15	1.6	98.7
1960	996	937	94.1	28	2.8	8	0.8	10	1.0	1	0.1	98.8
1961	1,149	994	86.5	24	2.1	11	1.0	10	0.9	2	0.2	90.7
1962	1,094	937	85.6	163	14.9	13	1.2	3	0.3	24	2.2	104.2
Average			84.1		6.4		1.4		1.2		6.2	99.3

[a] U. S. Department of Agriculture, ERS, The Dairy Situation, D.S. 292 (November, 1962), Table 17, p. 28.

[b] Deliveries by U. S. Department of Agriculture.

[c] Percent of Annual U. S. Production.

Source: U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and Supplement for 1962.

APPENDIX TABLE II

RATE SCHEDULE FOR WATER USED MONTHLY BY THE MODEL CHEESE PLANT, OKLAHOMA

Gallons	Cost
(a) First 2,000 gallons	$2.00
(b) Next 8,000 gallons	$0.50 per thousand gallons
(c) Next 90,000 gallons	$0.35 per thousand gallons
(d) Next 1,900,000 gallons	$0.15 per thousand gallons
(e) All above 2,000,000 gallons	$0.08 per thousand gallons

Source: Chickasha City Water Department Rates, Effective December 5, 1959, Chickasha, Oklahoma.

RATE SCHEDULE FOR GAS USED MONTHLY BY THE MODEL CHEESE PLANT, OKLAHOMA

Cubic Feet of Gas	Cost per 1,000 Cubic Feet of Gas
(a) First 1,000 cu. ft. or fraction thereof	$1.60
(b) Next 99 thousand cu. ft.	$0.46
(c) Next 1,900 thousand cu. ft.	$0.23
(d) Next 2,000 thousand cu. ft.	$0.19
(e) Next 6,000 thousand cu. ft.	$0.18
(f) Next 20,000 thousand cu. ft.	$0.175
(g) All over 30,000 thousand cu. ft.	$0.17

Source: Industrial Gas Service Rate Schedule "D," Oklahoma Natural Gas Company, Oklahoma City, Oklahoma.

RATE SCHEDULE FOR ELECTRICITY USED MONTHLY BY THE MODEL CHEESE PLANT, OKLAHOMA

Demand Charge
- $22.90 for first 10 KW demand or less
- $ 1.50 per KW for next 290 KW demand
- $ 1.27 per KW for all additional KW demand

Energy Charge
- 1.83¢ per KWH first 5,000 KWH
- 1.54¢ per KWH next 5,000 KWH
- 1.24¢ per KWH next 30,000 KWH
- 1.03¢ per KWH next 60,000 KWH
- 0.66¢ per KWH for all additional KWH

Source: Industrial Power Rate Schedule LP-1, Oklahoma, Oklahoma Gas and Electric Company, Oklahoma City, Oklahoma.

APPENDIX TABLE III

COSTS AND DEPRECIATION OF EQUIPMENT FOR THE MODEL CHEESE PLANT, 80,000 POUNDS CAPACITY

No. of Items	Item	Initial Cost (Dollars)	Expected Life (Years)	Salvage Value (Dollars)	Annual Depreciation (Dollars)
1	Conveyor, complete with drive units and turns	6,850.00	14	685.00	440.36
1	Weighing tank (750# stainless steel)	4,365.00	12	436.50	327.38
1	Drop tank (2000#)	1,560.00	17	156.00	82.59
1	Scales	1,187.00	15	118.70	71.22
1	Automatic sampler	711.00	12	71.10	53.33
1	Sample cooler - 240 (8 oz.) bottles	1,045.00	15	104.50	62.70
1	Can washer (12 cans per min.)	7,150.00	14	715.00	459.64
1	Storage tank (6,000 gal.)	5,600.00	20	560.00	252.00
1	Preheater with 2 hp. circulating pumps and air control 33,000 lbs. per hr.	2,544.00	10	254.40	228.96
2	Whey separator	12,404.00	20	1,240.40	558.18
1	Pasteurizer (20,000 lbs. per hr.)	15,000.00	15	1,500.00	900.00
4	Cheese vats (20,000 lb. capacity)	15,100.00	20	1,510.00	679.50
2	Milk Pump (50,000 lbs. per hr.)	760.00	14	76.00	48.86
4	Cheese vat agitator	6,140.00	15	614.00	368.40
3	Cheese presses (32' double rows)	7,830.00	14	783.00	503.36
24	Stirring paddles	720.00	11	72.00	58.91
16	Curd forkers	560.00	11	56.00	45.82
100	Wilson hoops (40# blocks)	2,270.00	11	227.00	185.73
50	Cheddar hoops	990.00	11	99.00	81.00
100	Longhorn hoops	1,200.00	11	120.00	98.18
2	100 gal. pasteurizer for bulk starter	3,462.50	20	346.25	155.81
1	Set wide curd knife (1/4" cut)	195.00	11	19.50	15.95
1	Curd mill	740.00	10	74.00	66.60
2	Curd forks	43.60	11	4.36	3.57
1	Curd rack	35.00	11	3.50	2.86
1	Flat side curd pail	40.00	11	4.00	3.27
2	Vat squeeges	20.00	11	2.00	1.64
2	Cheese and butter scales	242.00	20	24.20	10.89
2	Curd scoops (no. 3)	30.00	11	3.00	2.45
1	Wash sink	115.00	20	11.50	5.18
1	All testing equipment	790.00	7	79.08	101.67
4	Vat thermometers with brackets	98.00	11	9.80	8.02
4	Dairy pails	22.80	11	2.28	1.87
4	Vat strainers	116.00	11	11.60	9.49
4	Strainer curd pails	56.00	11	5.60	4.58
	Sanitary piping and fitting	3,435.00	14	343.50	220.82
2	Steel whey tank (5,000 gal.)	1,400.00	15	140.00	84.00
1	Variable speed pump to separator	1,887.00	14	188.70	121.31

APPENDIX TABLE III (Continued)

No. of Items	Item	Initial Cost (Dollars)	Expected Life (Years)	Salvage Value (Dollars)	Annual Depreciation (Dollars)
2	Small centrifugal pumps (1 1/2 hp)	500.00	18	50.00	25.00
1	Cold storage compressor (10 hp)	2,500.00	15	250.00	150.00
1	Air compressor (3/4 hp)	355.00	14	35.50	22.82
1	Steam generator (150 boiler hp)	14,000.00	20	1,400.00	630.00
1	Wax machine, tank, heating unit, fan	590.00	20	59.00	26.55
1	Wrapping and sealing machine	800.00	22	80.00	32.73
1	Whey pump (3 hp)	2,342.00	16	234.20	131.74
1	Ice builder (15,000 lbs.)	3,877.00	15	387.70	232.62
1	Part washer	800.00	10	80.00	72.00
	Cans ($13.50 each, 1000 cans)	13,500.00	4	135.00	3,037.50
4	Cheese trucks	616.00	20	61.60	27.72
3	Tables	100.00	15	10.00	6.00
1	Sanitary pipe washing machine	785.00	15	78.50	47.10
	Office equipment	2,000.00	10	200.00	180.00
	Total	149,479.70			10,947.88

Source: Data obtained from Damrow Brothers' Company, Fond Du Lac, Wisconsin, and Stoelting Brothers' Company, Kiel, Wisconsin, Cheese Plant Equipment Manufacturers.

APPENDIX TABLE IV

MANUFACTURING COSTS IN MARCH, MODEL CHEESE PLANT, OKLAHOMA[a]

Item	Monthly Utility Requirement[b]	Monthly Cost	Cost Per 100 Pounds Milk	Cost Per Pound of Cheese[c]
		(Dollars)		(Cents)
Variable Cost				
Utilities				
Water	258,815 gal.	61.32	.0026	.0274
Steam	534,237 lbs.	-	-	-
Gas	609,729 cu. ft.	147.19	.0064	.0674
Electricity	11,231 KWH	240.64	.0104	.1094
Total Utilities		449.15	.0194	.2042
Supplies				
Rennet, Salt, and Starter		1,345.43	.0581	.6116
Packaging		791.98	.0342	.3600
Cleaning		111.15	.0048	.0505
Office		162.10	.0070	.0737
Laboratory		92.63	.0040	.0421
Total Supplies		2,503.29	.1081	1.1379
Variable Labor		5,491.02	.2371	2.4960
Total Variable Cost		8,443.46	.3646	3.8381
Total Fixed Cost[d]		5,182.38	.2238	2.3558
Storage		132.00	.0057	.0600
Total Manufacturing Cost		13,757.84	.5941	6.2539

[a]Average daily milk intake of 77,191 pounds of milk.

[b]Based on equation 4.4 (water requirements), and 23.07 pounds of steam, 26.33 cu. ft. of gas, and .485 KWH per 100 pounds of milk receipts.

[c]Computations from monthly costs to costs per pound of cheese may not be the same as added totals due to rounding.

[d]Based on annual cost of $62,188.46 as follows: equipment $25,148.46, building $10,080, land $360, operating capital $3,600, miscellaneous expenses $3,000, and fixed labor $20,000.

APPENDIX TABLE V

MANUFACTURING COSTS IN MAY, MODEL CHEESE PLANT, OKLAHOMA[a]

Item	Monthly Utility Requirement[b]	Monthly Cost	Cost Per 100 Pounds Milk	Cost Per Pound of Cheese[c]
		(Dollars)		(Cents)
Variable Cost				
Utilities				
Water	453,256 gal.	90.49	.0020	.0211
Steam	1,032,655 lbs.	-	-	-
Gas	1,178,580 cu. ft.	295.44	.0066	.0695
Electricity	21,709 KWH	384.59	.0086	.0905
Total Utilities		770.52	.0172	.1811
Supplies				
Rennet, Salt, and Starter		2,600.66	.0581	.6116
Packaging		1,530.85	.0342	.3600
Cleaning		214.86	.0048	.0505
Office		313.33	.0070	.0737
Laboratory		179.05	.0040	.0421
Total Supplies		4,838.75	.1081	1.1379
Variable Labor		8,674.83	.1938	2.0400
Total Variable Cost		14,284.10	.3191	3.3590
Total Fixed Cost[d]		5,182.38	.1158	1.2189
Storage		255.14	.0057	.0600
Total Manufacturing Cost		19,721.62	.4406	4.6379

[a]Average daily milk intake of 149,206 pounds.

[b]Based on equation 4.4 (water requirements), and 23.07 pounds of steam, 26.33 cu. ft. of gas, and .485 KWH per 100 pounds of milk receipts.

[c]Computations from monthly costs to costs per pound of cheese may not be the same as added totals due to rounding.

[d]Based on annual cost of $62,188.46 as follows: equipment $25,148.46, building $10,080, land $360, operating capital $3,600, miscellaneous expenses $3,000, and fixed labor $20,000.

APPENDIX TABLE VI

MANUFACTURING COSTS IN JUNE, MODEL CHEESE PLANT, OKLAHOMA[a]

Item	Monthly Utility Requirement[b]	Monthly Cost	Cost Per 100 Pounds Milk	Cost Per Pound of Cheese[c]
		(Dollars)		(Cents)
Variable Cost				
Utilities				
Water	365,628 gal.	77.34	.0022	.0232
Steam	808,033 lbs.	-	-	-
Gas	922,215 cu. ft.	236.43	.0068	.0716
Electricity	16,987 KWH	326.20	.0093	.0979
Total Utilities		639.97	.0183	.1927
Supplies				
Rennet, Salt, and Starter		2,034.97	.0581	.6116
Packaging		1,197.86	.0342	.3600
Cleaning		168.12	.0048	.0505
Office		245.18	.0070	.0737
Laboratory		140.10	.0040	.0421
Total Supplies		3,786.23	.1081	1.1379
Variable Labor		6,857.77	.1958	2.0610
Total Variable Cost		11,285.97	.3222	3.3915
Total Fixed Cost[d]		5,183.76	.1480	1.5579
Storage		199.64	.0057	.0600
Total Manufacturing Cost		16,667.37	.4759	5.0094

[a]Average daily milk intake of 116,751 pounds.

[b]Based on equation 4.4 (water requirements), and 23.07 pounds of steam, 26.33 cu. ft. of gas, and .485 KWH per 100 pounds of milk receipts.

[c]Computations from monthly costs to costs per pound of cheese may not be the same as added totals due to rounding.

[d]Based on annual cost of $62,188.46 as follows: equipment $25,148.46, building $10,080, land $360, operating capital $3,600, miscellansous expenses $3,000, and fixed labor $20,000.

APPENDIX TABLE VII

MANUFACTURING COSTS IN AUGUST, MODEL CHEESE PLANT, OKLAHOMA[a]

Item	Monthly Utility Requirement[b]	Monthly Cost	Cost Per 100 Pounds Milk	Cost Per Pound of Cheese[c]
		(Dollars)		(Cents)
Variable Cost				
Utilities				
Water	278,234	64.24	.0025	.0263
Steam	584,018	-	-	-
Gas	666,545	177.55	.0070	.0737
Electricity	12,278	264.20	.0104	.1095
Total Utilities		505.99	.0200	.2105
Supplies				
Rennet, Salt, and Starter		1,470.80	.0581	.6116
Packaging		865.77	.0342	.3600
Cleaning		121.51	.0048	.0505
Office		177.21	.0070	.0737
Laboratory		101.26	.0040	.0421
Total Supplies		2,736.55	.1081	1.1379
Variable Labor		5,706.90	.2254	2.3730
Total Variable Cost		8,949.44	.3535	3.7214
Total Fixed Cost[d]		5,182.38	.2047	2.1547
Storage		144.30	.0057	.0600
Total Manufacturing Cost		14,276.12	.5639	5.9361

[a]Average daily milk intake of 84,383 pounds.

[b]Based on equation 4.4 (water requirements), and 23.07 pounds of steam, 26.33 cu. ft. of gas, and .485 KWH per 100 pounds of milk receipts.

[c]Computations from monthly costs to costs per pound of cheese may not be the same as added totals due to rounding.

[d]Based on annual cost of $62,188.46 as follows: equipment $25,148.46, building $10,080, land $360, operation capital $3,600, miscellaneous expenses $3,000, and fixed labor $20,000.

APPENDIX TABLE VIII

MANUFACTURING COSTS IN OCTOBER, MODEL CHEESE PLANT, OKLAHOMA[a]

Item	Monthly Utility Requirement[b]	Monthly Cost	Cost Per 100 Pounds Milk	Cost Per Pound of Cheese[c]
		(Dollars)		(Cents)
Variable Cost				
Utilities				
Water	191,435	51.22	.0033	.0347
Steam	361,520	-	-	-
Gas	412,606	119.04	.0076	.0800
Electricity	7,600	187.04	.0119	.1253
Total Utilities		357.30	.0228	.2400
Supplies				
Rennet, Salt, and Starter		910.46	.0581	.6116
Packaging		535.93	.0342	.3600
Cleaning		75.22	.0048	.0505
Office		109.69	.0070	.0757
Laboratory		62.68	.0040	.0421
Total Supplies		1,693.98	.1081	1.1379
Variable Labor		4,542.05	.2898	3.0510
Total Variable Cost		6,592.33	.4207	4.4289
Total Fixed Cost[d]		5,182.38	.3307	3.4811
Storage		89.32	.0057	.0600
Total Manufacturing Cost		11,864.03	.7571	7.9700

[a]Average daily milk intake of 52,235 pounds.

[b]Based on equation 4.4 (water requirements), and 23.07 pounds of steam, 26.33 cu. ft. of gas, and .485 KWH per 100 pounds of milk receipts.

[c]Computations from monthly costs to costs per pound of cheese may not be the same as added totals due to rounding.

[d]Based on annual cost of $62,188.46 as follows: equipment $25,148.46, building $10,080, land $360, operating capital $3,600, miscellaneous expenses $3,000, and fixed labor $20,000.

APPENDIX TABLE IX

BUTTERFAT TEST OF MILK RECEIVED BY HANDLERS, OKLAHOMA METROPOLITAN MARKETING AREA, 1959-1963

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Av.
1959	3.95	3.85	3.76	3.70	3.67	3.68	3.70	3.67	3.69	3.88	3.90	3.87	
1960	3.88	3.82	3.86	3.60	3.61	3.61	3.61	3.61	3.63	3.74	3.85	3.91	
1961	3.868	3.799	3.715	3.660	3.583	3.597	3.600	3.602	3.726	3.809	3.869	3.913	
1962	3.919	3.728	3.695	3.583	3.502	3.577	3.549	3.568	3.705	3.776	3.855	3.859	
1963	3.881	3.769	3.656	3.518	3.513	3.505	3.488	3.524	3.599	3.690	3.824	3.945	
Actual Average	3.90	3.79	3.74	3.61	3.57	3.60	3.59	3.59	3.67	3.78	3.86	3.90	3.72
Average Adjusted to 3.85 pct.[a]	4.04	3.92	3.87	3.74	3.69	3.73	3.72	3.72	3.80	3.91	3.99	4.04	3.85

[a]The average of 3.85 was for the five year period, 1957-1961, for Oklahoma from data obtained from U. S. Department of Agriculture, SRS, and State Board of Agriculture, Oklahoma Agriculture, 1963, p. 130.

Source: U. S. Department of Agriculture, Market Administrator, Market Administrators Bulletin for the Oklahoma Metropolitan Marketing Area, Federal Order No. 106, Tulsa, Oklahoma.

APPENDIX TABLE X

GOVERNMENT PRICE SUPPORT LEVEL FOR MANUFACTURING MILK, 1959-1963

Year	Support Price (Dollars per cwt.)	
1959	3.06	
1960	3.06	Price effective April 1 through September 16, 1960
	3.22	Price effective September 17, 1960 through March 9, 1961
	3.40	Price effective March 10, 1962
1961	3.40	
1962	3.11	
1963	3.14	

Source: U. S. Department of Agriculture, ERS, Dairy Statistics Through 1960, Statistical Bulletin No. 303 (Washington, 1962); and Supplement for 1962.

APPENDIX TABLE XI

PRICES RECEIVED BY OKLAHOMA FARMERS FOR MILK SOLD WHOLESALE FOR MANUFACTURING, ADJUSTED TO THE 1963 PRICE SUPPORT LEVEL, 1959-1963 (DOLLARS PER CWT)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1959	3.68	3.58	3.53	3.43	3.28	3.28	3.28	3.33	3.38	3.63	3.68	3.63
1960	3.63	3.58	3.58	3.28	3.28	3.28	3.28	3.28	3.35	3.47	3.52	3.47
1961	3.42	3.37	3.24	3.04	2.99	3.04	3.04	3.04	3.19	3.29	3.34	3.24
1962	3.29	3.24	3.04	3.13	3.13	3.13	3.13	3.18	3.28	3.43	3.48	3.43
1963	3.43	3.48	3.28	3.20	3.15	3.15	3.20	3.25	3.35	3.55	3.65	3.75
Average	3.49	3.45	3.33	3.22	3.17	3.18	3.19	3.22	3.31	3.47	3.53	3.50

Source: G. P. Collins and W. G. Hill, Prices Received by Oklahoma Farmers 1910-1957 and Supplements, Oklahoma Agricultural Experiment Station Processed Series P-297 (Stillwater, 1958).

APPENDIX TABLE XII

PRICES RECEIVED BY OKLAHOMA FARMERS FOR BUTTERFAT, 1959-1963 (CENTS PER POUND)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1959	51	52	52	52	52	52	52	52	53	55	56	55
1960	54	54	53	53	52	52	52	53	54	55	55	55
1961	55	55	54	54	54	53	53	53	54	54	54	55
1962	54	54	54	52	52	52	52	52	53	53	53	53
1963	53	53	53	52	52	52	52	53	54	54	53	53
	267	268	266	263	262	261	261	263	268	271	271	271
Average	53.4	53.6	53.2	52.6	52.4	52.2	52.2	52.6	53.6	54.2	54.2	54.2

Source: G. P. Collins and W. G. Hill, <u>Prices Received by Oklahoma Farmers 1910-1957</u> and <u>Supplements</u>, Oklahoma Agricultural Experiment Station, Processed Series P-297 (Stillwater, 1958).

APPENDIX TABLE XIII

WEIGHTED AVERAGE PRICE PER POUND OF SALES FOR CHEESE, AMERICAN CHEDDARS, WISCONSIN CHEESE EXCHANGE, 1960-1963

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1960	34.8	34.8	34.8	32.4	32.0	32.0	32.0	33.1	36.6	37.8	37.8	37.8
1961	36.8	33.9	34.7	34.6	34.3	34.2	34.4	34.8	35.0	35.2	35.2	35.2
1962	35.2	35.2	34.8	33.2	33.1	33.0	33.0	33.0	33.3	34.0	34.5	34.5
1963	34.6	34.3	33.8	33.8	33.8	34.0	34.1	34.2	34.3	34.5	35.0	35.1
	141.4	138.2	138.1	134.0	133.2	133.2	133.5	135.1	139.2	141.5	142.5	142.6
Average	35.4	34.6	34.5	33.5	33.3	33.3	33.4	33.8	34.8	35.4	35.6	35.7
Okla. Pri.	37.4	36.6	36.5	35.5	35.3	35.3	35.4	35.8	36.8	37.4	37.6	37.7

Source: U. S. Department of Agriculture, AMS, <u>Dairy and Poultry Statistics</u>, Annual Summaries (Washington).

VITA

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