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Farm To Plant Milk Assembly In Minnesota

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Introduction

GATHERING and transporting (assembling) milk from farms to dairy plants is expensive. Once it was of small relative importance. Today it frequently exceeds the cost of manufacturing milk into finished dairy products. New technology has resulted in fewer but larger processing plants. To obtain the volume, these large plants must gather milk from much larger areas.

This issue of *Minnesota Agricultural Economist* describes how changes in the number of dairy farms and dairy plants have affected farm to plant milk assembly. It also presents the results of a study of milk assembly costs for various truck sizes and route conditions. These findings can help design routes and select equipment for efficient milk assembly. The data can also help determine fair milk-hauling charges.

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Dairy farm changes

Significant changes have occurred in Minnesota the last 5 years, both in the number of farms and the volume of milk shipped in the three classes of milk (table 1). During this 5-year period, there was a major decline in the number of Grade B can producers—from 27,100 in 1968 to 14,200 in 1973 (52 percent). Also, the annual volume of B can milk fell by 51 percent.

Grade B bulk shippers declined from 15,077 in 1968 to 12,800 in 1971. They then increased to 14,435 in 1973. There was an initial decline of 14 percent and then an increase of 10 percent—a net decline of 4 percent. Milk volume shifted about the same amount. In contrast, the number of farms producing Grade A milk increased from 5,200 to 7,950 (53 percent), while the overall volume of Grade A milk rose from 1.73 billion pounds in 1968 to 3.22 billion pounds in 1973—an 86 percent increase.

The trend in Minnesota milk production is clearly from Grade B to Grade A. Another persistent trend is the sharp reduction in the number of Grade B can producers. Overall, there is a continuing decline in the number of milk producers in the state—a 66 percent decline from about 85,000 in 1960 to 28,659 in 1973. These trends are expected to continue.

The impact of these changes is substantial. As the number of can milk producers has declined, the per hundredweight (cwt.) cost of assembling can milk has increased. Milk haulers have had to travel longer distances to collect a load of milk.

Continuous change in the volume of milk in each class and in the number of farms in each group makes milk routes difficult to plan. Reduced milk-hauling efficiency

Table 1. Milk receipts from Minnesota farms and number of farms selling milk by grades in selected years.

	Plant milk receipts			
Year	All classes	Grade A[1]	Grade B-bulk	Grade B-cans
		billion pounds		
1966	9.38	1.73	3.68	3.98
1967	9.57	1.84	3.84	3.89
1968	9.66	2.06	3.93	3.68
1969	9.23	2.24	3.78	3.22
1970	9.23	2.69	3.62	2.93
1971	9.05	2.96	3.49	2.59
1972	9.39	3.40	3.69	2.29
1973	8.95	3.22	3.84	1.89
		Farms selling milk[2]		
		thousands		
1968	47.3	5.2	15.1	27.1
1969	43.1	5.4	14.2	23.6
1970	40.6	6.4	13.7	20.5
1971	38.8	6.7	13.0	19.1
1972	38.7	7.8	13.5	17.5
1973	36.6	8.0	14.4	14.2

[1] A small portion of the Grade A milk was received in cans through 1968.
[2] Farm members are based on mid-year count. Milk receipts data are based on whole year enumeration.

Source: Minnesota Dairy Summary, Minnesota Crop and Livestock Reporting Service, No. 282, July 1973.

and higher unit costs result. Many dairy plants have closed, and others have discontinued receiving milk in cans. Thus, can producers must have their milk hauled even longer distances—and at higher costs. Milk haulers in some marginal dairy areas of the state have discontinued serving widely scattered small-volume can producers.

Dairy plant changes

Changes in the number of dairy plants have also affected assembly patterns and costs. The number of processing and bottling plants in the state has been declining for a long time. Processing plants have declined from about 455 in 1960 to 93 in 1973. This was offset somewhat because many butter plants were converted to milk-receiving stations. These stations increased from about 40 in 1950 to 218 in 1972. Now they, too, are on the decline. From mid-1972 to mid-1973, 36 receiving stations closed. From 1960 to 1973, fluid milk (bottling) plants declined from 227 to 52.

These changes have increased the average distance milk is hauled from farms to plants. Thus the cost of assembling milk is increased; more miles have to be driven between route areas and the plants.

In some cases, the decline in dairy plants should have reduced overlap. When neighboring creameries closed, many producers were absorbed by milk routes of remaining plants. This increased the density of patrons for remaining plants, allowing reduced mileage in assembling loads of milk. However in many cases, patrons of closed plants were not absorbed by adjoining plants. Rather, more remote plants began serving them, resulting in continued overlap of routes and inefficient milk assembly patterns.

Extensive and costly overlapping of routes continues to be a major problem in many dairy areas of the state. In two market studies of four Minnesota dairy counties, in 1963 and 1964, each dairy plant had an average of three competing plants assembling milk in its immediate supply area. In some cases, 6 to 7 plants were assembling milk in the same area.

Milk haulers and managers interviewed in 1973 indicated that an average of 2 to 3 competing plants were picking up milk in their milk supply areas. Some competing plants had as many as three different types of milk trucks: Grade A bulk; Grade B bulk; and Grade B can. Thus, the number of trucks in an area probably averages 6 to 8 and as many as 10 or 12 in some cases. This duplication is very costly; it imposes a heavy burden on milk producers who pay the bill.

In the 1950's, only a few Minnesota dairy plants received more than 200,000 pounds of milk a day. Nearly all the milk was assembled directly from farms located within a 15- to 20-mile radius. Today, major milk processing plants in the state receive 500,000 to as much as 1½ million pounds of milk a day. Plants of this size must receive milk from a much wider area. Currently, about 50 percent of the milk processing plants receive directly from farms comes from outside the old 15- to 20-mile radius. Most processing plants now receive bulk milk from farms up to 45 miles away, and some plants go out 100 miles.

Milk assembly rates

Survey data show that Minnesota milk assembly rates have increased significantly in recent years. This is especially true of can milk. Table 2 shows milk-hauling rates paid in early 1973 by 12,235 Minnesota milk producers shipping milk to 40 different plants. According to this survey, can milk-hauling charges have doubled in the last 5 years, and bulk milk rates have increased about 50 percent.

Milk assembly costs increased even more than these rates indicated. A large proportion of Minnesota dairy plants subsidize their milk assembly. They either pay additional amounts to contract haulers, or it costs more to operate dairy-owned trucks than dairies charge producers. Can milk assembly was usually subsidized 2 to 5 cents per cwt., and some plants were providing subsidies in the 10 to 20 cents range. Bulk milk assembly subsidies averaged from 1 to 2 cents a cwt.[1]

Dairy plant managers indicated that milk-hauling subsidies became necessary when hauling rates could not be raised as rapidly as costs increased. Milk producers strongly resisted increased assembly charges. To keep haulers in business and to avoid interruptions in their milk supplies, dairy plants provided subsidies.

Ownership of farm to plant hauling services

Most milk in Minnesota is assembled from farm to plant by independent haulers. These haulers contract with farmers. Dairies sometimes own their own trucks and provide the hauling service. Dairy plant managers indicate advantages and disadvantages to each method.

The major advantage of dairy-operated hauling is usually the flexibility in adjusting to changing route conditions. Shifts in route structure, i.e. number of producers, volume per stop, plant destination, etc., are changing constantly. If a

Table 2. Milk-hauling rates reported by 40 plants for 12,235 milk producers in Minnesota, June 1973.

Rates	Can milk producers		Bulk milk producers	
(cents per cwt.)	number	percent	number	percent
10-11			37	1
12-13			54	1
14-15			384	4
16-17			829	9
18-19	133	4	5,313	60
20-24	388	12	1,615	18
25-29	1,478	44	644	7
30-34	385	11		
35-39	788	23		
40 and over	187	6		
	3,359	100	8,876	100

dairy provides hauling services, it can efficiently allocate trucks and drivers according to route changes. If, for example, dairy farms are on the decline in a portion of the assembly area, a manager can drop a truck or assign it to an expanding area. However if haulers contract with farmers, adjustments to route changes occur slower because of market processes.

However, contract haulers often have lower truck and labor costs because owners drive or can closely supervise other drivers. Rural roads, problem driveways, winter storms, and other seasonal variations all contribute to the economic importance of reliable drivers. The use of contract haulers also avoids labor union problems. Some dairy associations feel that union work rules are too restrictive for the varied conditions of farm milk assembly and/or union wage rates are too high for rural labor markets. Large dairies are usually unionized in the plants; this carries over to the milk assembly drivers working for the dairies. The use of contract haulers—who usually do not belong to a union—avoids unionization problems with milk assembly, even though workers in the plant may be unionized.

Some dairy managers worry that contract haulers have too much influence over milk supplies. If competition for milk becomes great, a competing dairy may induce a contract hauler to convince farmers to shift en masse to the competitor. Contract haulers sometimes use this mass defection threat to get concessions or subsidies from the dairies.

A method of obtaining benefits of each system is to have the dairies contract with milk haulers rather than with individual farmers. The problems associated with driver dependability and concern for truck equipment are minimized, and the dairies can design efficient milk-hauling routes and assembly patterns.

[1] The substantial increase in fuel costs as well as lesser increases in labor and truck costs after this survey was taken have caused milk-hauling charges and/or the subsidies to increase.

Milk assembly costs

Milk assembly charges paid by Minnesota farmers vary a great deal. The underlying conditions of milk assembly vary a great deal as well.

The cost per cwt. for assembling milk from farm to plant was estimated for several different route situations common to Minnesota. The milk assembly process was first divided into truck costs and labor costs categories. Truck costs were further divided into depreciation, taxes, insurance, license fees, fuel, tires, repair, and maintenance. Labor costs were further divided into specific tasks such as driving time, pumping time, testing, measuring and rinsing on the farm, truck cleanup, etc. The estimates for these small categories wer obtained through a time study of milk routes and from interviews with haulers and equipment sales personnel.

Greatly different types and sizes of trucks are used to collect milk from farms. Four different hauling units were selected for cost estimation. They were selected because they represent common type and size units used to assemble milk or because they represent developing type or size units. The four units were:

1. Can truck (nominal, up to 120 10-gallon cans);
2. 2,300-gallon bulk truck;
3. 3,250-gallon bulk truck;
4. Two 2,695-gallon twin tank trailers (total 5,350 gallon).

The first three trucks are typical of their class and are found throughout the state. The 2,300-gallon tank is about as large as the state weight limits allow for a single-axle truck. The 3,250-gallon tank is about as large as the state weight limits allow for a tandem-axle truck.

The twin tank trailer unit is a new concept in Minnesota farm-to-plant milk assembly. The unit consists of two single-axle semitank trailers, a truck tractor, and a dolly axle to convert one of the semitrailers into a four-wheel trailer. Between the route area and the plant, the trailer with the dolly axle is pulled behind the first trailer which is coupled to the tractor. Actual milk collection is done one trailer at a time. The driver parks the trailer with the dolly axle at a central point in the route area. He then makes farm stops—loading the first trailer—returns, switches the dolly axle to the loaded trailer, connects the tractor to the empty trailer, and makes more farm stops—loading the second trailer. When both trailers are loaded, he hooks the first loaded trailer—now a four-wheel unit—behind the second trailer and pulls the two tank units to the plant.

Another double-unit hauling system uses a four-wheel tank trailer with a conventional straight bulk truck. The straight truck makes all the farm pickups. The driver parks the trailer at a central point in the route area, collects a load of milk, returns, pumps the milk from the truck to the trailer, and then collects a second load of milk in the truck tank. He then returns to the plant with the loaded trailer behind the loaded truck.

The capacity of these double units can match that of large over-the-road semitank trucks. At the same time, the double units can maneuver in farm yards when they are operated as single units.

Currently, much milk is assembled to processing plants by first assembling it in small trucks to receiving stations. The receiving stations ship the milk to processing plants in large semitrailer trucks. The milk is transferred from small trucks to large trucks to reduce transportation costs from the assembly area to the processing plant. However, double units can achieve the same volume advantages as the large semi tankers. They can also avoid receiving station costs of labor, supplies, capital, and milk losses. In addition, they reduce the overall investment in trucks and tanks.

The average cost of assembling milk with both types of double units was analyzed with respect to route conditions. The resulting costs and cost variations were similar. Therefore, only one of the double units—the twin trailer unit—is reported here.

Bulk milk assembly costs

Farm to plant milk assembly costs are sensitive to several economic variables. Five variables were investigated. They were: (1) truck type and size; (2) an area's density of dairy farms; (3) average volume per farm stop; (4) distance between the route area and the plant; and (5) the wage rate of the drivers. Using values common to Minnesota, each significantly affected the per cwt. cost of assembling milk.

The effect on average cost of any one of these factors depended on the others. For example, the larger the truck capacity, the slower the average cost per cwt. rose as the distances between the route area and the plant increased. However, if the average volume per farm stop was low, which means more stops to obtain a load, a large truck could require more time than is available in a reasonable work day.

Tables 3, 4, and 5 summarize the average costs per cwt. of milk for selected values of the five route

Table 3. Average cost of assembling bulk milk for a 2,300-gallon tank truck for selected farm sizes, farm densities, distances between route area and plant, and wage rates for Minnesota 1973.

Miles between route area and plant			0			10			20			40		
Miles between farm stops			2	4	6	2	4	6	2	4	6	2	4	6
Vol. per farm (lbs.)	Farm stops	Item												
1,500	21	Total miles	42	84	126	82	124	166	122	164	206	202	244	286
		Hours	7.1	8.4	9.8	8.0	9.4	10.8	9.0	10.4	11.8	10.9	12.3	13.7
		Cost per cwt. (¢/cwt.)												
		@ $3. wage	11.7	15.9	20.0	14.7	18.8	22.9	17.5	21.6	25.8	23.3	27.4	31.5
		@ $4. wage	14.0	18.6	23.1	17.2	21.8	26.3	20.4	24.9	29.5	26.8	31.3	35.9
2,400	13	Total miles	26	52	78	66	92	118	106	132	158	186	212	238
		Hours	5.3	6.1	7.0	6.2	7.1	7.9	7.2	8.0	8.9	9.1	10.0	10.8
		Cost per cwt. (¢/cwt.)												
		@ $3. wage	9.1	11.7	14.2	12.0	14.6	17.1	14.9	17.5	20.0	20.7	23.3	25.8
		@ $4. wage	10.8	13.6	16.5	14.0	16.8	19.7	17.2	20.0	22.9	23.6	26.5	29.3

Table 4. Average cost of assembling bulk milk for a 3,250-gallon tank truck for selected farm sizes, farm densities, distances between route area and plant, and wage rates for Minnesota 1973.

Miles between route area and plant			0			10			20			40		
Miles between farm stops			2	4	6	2	4	6	2	4	6	2	4	6
Vol. per farm (cwt.)	Farm stops	Item												
1,500	30	Total miles	60	120	180	100	160	220	140	200	260	220	280	340
		Cost per cwt. (¢/cwt.)	9.7	11.6	13.6	10.6	12.6	14.6	11.6	13.6	15.5	13.5	15.5	18.5
		@ $3 wage												
		@ $4 wage	12.0	17.0	22.0	14.3	19.3	24.3	16.6	21.6	26.5	21.2	26.1	31.1
			14.2	19.6	25.0	16.7	22.1	27.5	19.2	24.6	30.0	24.2	29.6	35.0
2,400	18	Total miles	36	72	108	76	112	148	116	152	188	196	232	268
		Hours	6.9	8.1	9.2	7.8	9.0	10.2	8.8	10.0	11.2	10.7	11.9	13.1
		Cost per cwt. (¢/cwt.)												
		@ $3 wage	9.1	12.2	15.3	11.5	14.6	17.7	13.8	16.9	20.0	18.6	21.7	24.8
		@ $4 wage	10.7	14.0	17.4	13.3	16.6	20.0	15.9	19.2	22.6	21.1	24.5	27.8

Table 5. Average cost of assembling bulk milk for twin 2,675-gallon tank trailers for selected farm sizes, farm densities, distances between route area and plant, and wage rates for Minnesota 1973.

Miles between route area and plant			10			20			40			80		
Miles between farm stops			2	4	6	2	4	6	2	4	6	2	4	6
Vol. per farm (cwt.)	Farm stops	Item												
1,500	24	Total miles	68	116	164	88	136	184	128	176	224	208	256	304
		Hours	9.0	10.6	12.2	9.5	11.1	12.7	10.5	12.1	13.6	12.5	14.1	15.6
		Cost per cwt. (¢/cwt.)												
		@ $3 wage	17.1	21.5	25.9	18.5	23.0	27.4	21.5	25.9	30.3	27.3	31.7	36.1
		@ $4 wage	19.6	24.4	29.3	21.2	26.0	30.9	24.4	29.2	34.1	30.7	35.6	40.4
2,400	15	Total miles	50	80	110	70	100	130	110	140	170	190	120	250
		Hours	7.0	8.0	9.0	7.5	8.5	9.5	8.4	9.4	10.4	10.3	11.4	12.4
		Cost per cwt. (¢/cwt.)												
		@ $3 wage	14.2	17.0	19.7	15.7	18.4	21.2	18.6	21.4	24.1	24.4	27.2	30.0
		@ $4 wage	16.2	19.2	22.2	17.8	20.8	23.8	20.9	24.0	27.0	27.3	30.3	33.4

variables for the three types of bulk trucks.

The first column of the tables indicates the average volume of milk picked up per farm stop per day (based on every-other-day pick up). The smaller volume—1,500 pounds—is the amount of milk shipped every other day by an average Minnesota Grade B bulk producer. The larger volume—2,400 pounds—is the milk shipped every other day by an average Minnesota Grade A bulk producer.

The second column indicates the number of farm stops per day. It is based on about 80 percent truck tank capacity. Seasonality of production and shifts in producers generally limit average capacity utilization to this level. The two single-unit trucks were assumed to haul two loads per day—the common practice in Minnesota. The twin trailer unit was assumed to make one trip per day with a load of milk in each trailer.

The results show expected similarities for the three trucks. Average costs go up as miles driven go up, and they go down as average farm stops get larger. Part of the reason that costs go down as farm stops get larger is related to miles driven. Larger stops mean fewer stops to get a load; for a given farm density, it means fewer miles driven between stops. It also means less time spent measuring and sampling milk and rinsing tanks on the farms.

Although costs tend to move in the same direction, the rate at which they move is not the same. Looking first at the two single units: as miles driven in the route area increases, costs go up slower for the 2,300 gallon truck. For a $4 per hour wage, the average cost for a Grade A route with farms 2 miles apart and close to the plant is 10.8 cents per cwt. for the 2,300-gallon truck and 10.7 for the 3,260-gallon truck. If there are 6 miles between stops and other conditions are the same, the average cost for the 2,300-gallon truck is 16.5 cents per cwt., and for the 3,250 gallon truck it is 17.4. If stops are 2 miles apart and the route is 20 miles from the plant and other conditions are the same, the average cost for the 2,300-gallon truck is 17.2 cents per cwt., and for the 3,250 gallon truck, it is 15.9 cents per cwt. When route miles are great, the smaller single-axle truck is less costly to operate. When mileage is great between the route area and the plant, the larger tandem-axle truck is less costly.

The double units become competitive when the routes are between 20 and 40 miles from the plant. For Grade A routes, the distance is closer to 40 miles. For Grade B routes, time becomes a limiting factor at about the 20-mile distance. Even the smaller 2,300-gallon truck would have difficulty making two loads per day unless the farms were close together. For Grade B routes, the double units run into time problems too, unless the farms are located close together. For the Grade A routes, time becomes a problem for the double units at the 80-mile mark. Some double-unit haulers have gotten around this by using a second driver to make the trip to the plant. Several large regional dairies have also talked of providing a shuttle service for the twin trailers. The dairy would send out a tractor and two empty trailers and return with two loaded ones.

The tables reveal many other interesting relationships between costs and milk assembly variables.

Can milk assembly

Can milk assembly costs and problems are considerably different from bulk milk assembly. As shipment of can milk continues to decline, the dairy industry apparently wants to make do with present equipment

Table 6. Average cost of assembling milk in cans from farm to plant for selected numbers of farm stops, farm densities, distance between route area and plant, and wage rates, Minnesota 1973.

Miles between route area and plant			0				20			
Miles between farm stops			2	4	6	8	2	4	6	8
Number of farm stops	Volume hauled (cwt.)	Item								
15	58.5	Total miles								
		Hours	30	60	90	120	110	140	170	200
		Cost per cwt: (¢/cwt)	2.8	3.6	4.6	5.5	4.7	5.6	6.5	7.4
		@ $3 wage								
		@ $4 wage	28.7	41.2	53.6	66.1	52.5	65.0	77.5	89.9
			33.6	47.7	61.9	76.0	60.7	74.8	89.0	103.1
20	78.0	Total miles	40	80	120	160	120	160	200	240
		Hours	3.5	4.7	5.9	7.1	5.4	6.6	7.8	9.0
		Cost per cwt: (¢/cwt.)								
		@ $3 wage	26.3	38.7	51.2	63.6	44.1	56.6	69.0	81.5
		@ $4 wage	30.9	45.0	59.2	73.3	51.2	65.3	79.5	93.7
25	97.5	Total miles	50	100	150	200	130	180	230	280
		Hours	4.2	5.7	7.2	8.7	6.1	7.6	9.2	10.6
		Cost per cwt: (¢/cwt.)								
		@ $3 wage	24.8	37.2	49.7	62.2	39.1	51.5	64.0	76.5
		@ $4 wage	29.2	43.4	57.5	71.7	45.5	59.7	73.8	88.0
30	117.0	Total miles	60	120	180	240	140	200	260	300
		Hours	4.9	6.7	8.5	10.3	6.8	8.6	10.4	12.2
		Cost per cwt: (¢/cwt.)								
		@ $3 wage	23.8	36.3	48.7	61.2	35.7	48.2	60.6	73.1
		@ $4 wage	28.2	42.3	56.5	70.1	41.7	55.9	70.0	84.2

because bulk handling will soon replace cans.

Table 6 summarizes the miles driven, hours worked, and the average cost of assembling can milk for several different farm densities, route distances from the plant, and number of farm stops. This table differs from the three tables for bulk trucks. The number of stops vary but not the volume per stop; thus as the number of stops varies, the utilization of truck capacity varies. This is important as can milk declines.

For values in table 6, the average can milk producer was assumed to ship 390 pounds of milk per day. This is slightly above the state average for can producers. It was also assumed that each truck hauled two loads of milk per day.

Two important general conclusions can be drawn. First, the cost of assembling can milk is significantly higher than for assembling bulk milk. The survey in early 1973 indicated charges to farmers were generally higher for cans. This cost study bears out those results.

Second, much upward pressure exists in the cost of assembling can milk. The decline in farms shipping can milk and the closing of nearby plants mean can trucks must drive many miles for partial loads. For example, assume initially that a can truck is making 30 farm stops 2 miles apart; the stops are adjacent to the plant; and the driver's wage is $4 per hour. Then assume that 10 farmers on this route shift to bulk milk or quit dairying, leaving farm stops 4 miles apart. Assume further that the receiving plant consolidates with one 20 miles away. The cost of assembling milk would go from 29.9 cents per cwt. to 72.0 cents per cwt.—about a 140 percent increase.

Higher assembly rates encourage more can shippers to shift to bulk or leave dairying, putting even more upward pressure on can milk assembly rates. Farmers with small herds find themselves in an economic squeeze. The cost of having their can milk assembled significantly reduces the onfarm price of milk. However, converting to bulk is very costly for these small producers.

Conclusions and Implications

The trends discussed in this issue of *Minnesota Agricultural Economist* have generally caused assembly costs to rise. The cost data bear this out. Farms located further apart and further from plants have larger assembly costs. Countering some of this cost rise has been some farms' larger volume of milk. This is especially noticeable for Grade A producers.

The wide variations in route conditions and resulting per cwt. costs suggests the importance of including allowances for route conditions in pricing farmers' hauling services. Inclusion of these variables will result in charges to farmers and returns to haulers that are more equitable to both groups.

The overlap in assembly routes—caused by the need for three different milk assembly routes—implies that assembly costs could be reduced by shifting to one grade of milk—Grade A. The increase in effective farm density would reduce route mileage. For many producers, the assembly cost savings could amount to $200 or more annually.

The use of twin tank milk assembly trucks will expand. The use of double unit trucks reduces the need for milk receiving stations. This means a significant reduction in the number of these plants in the next 5 years.

The shift to double units reduces the need for receiving stations for bulk trucks. However, can assembly does not have a similar economic alternative for long distances. This will result in the shift of most—and frequently all—the cost burden of operating receiving stations to can milk. This will put even more upward pressure on can milk assembly costs. The next 5 years probably will see the abandonment of not only many receiving stations, but also many can assembly routes. Can shippers will have to convert to bulk or stop dairying. Many of them, especially the small producers, will drop out because of economic necessity.

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