

MILK PRODUCTION AND DISTRIBUTION
IN LOW-DOSE COUNTIES FOR THE
HANFORD THYROID DISEASE STUDY

Hanford Environmental Dose
Reconstruction Project

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Letter report
for the Technical Steering Panel

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PREFACE

This report describes the production and distribution of milk in three Washington State counties—Ferry, Okanogan, and Stevens—for the years 1945 through 1963. Estimates of the origin of the milk consumed in each of the three counties are provided based on U.S. Census of Agriculture information and interviews with knowledgeable experts. This report is not meant to be a definitive description of milk production and distribution for these counties; it is intended only to meet the immediate need of the Hanford Thyroid Disease Study (HTDS) to identify likely sources of milk for the three-county area. More detailed information on these counties will be developed throughout FY 1992 and compiled in a final report in FY 1993 as part of the Hanford Environmental Dose Reconstruction (HEDR) Project (HEDR Milestone 0603D, Milk Production/Distribution Report, 1944-1991).

The research summarized in this report was conducted by the Social and Economic Sciences Research Center at Washington State University under Work Order No. 3 (095265-A-K1) with Pacific Northwest Laboratory (PNL). The methods used were approved by Battelle staff at PNL after discussions with staff of the HTDS and members of the independent Technical Steering Panel that directs the HEDR Project. The report satisfies HEDR Milestone 0603B, Letter Report on Milk Outside Phase I (Shipler 1991, p. 7.4-7.7).

The findings described in the summary of this report are consistent with the milk research reported in the HEDR Phase I report for the counties closest to the Hanford Site (Beck et al. 1992). The fact that Spokane processors shipped milk to Stevens County is consistent with the general finding that large commercial processing plants bought milk from a variety of producers and shipped it throughout a several-county region. For this reason, it will be particularly important to accurately reconstruct the milk production and distribution system for the Spokane milk shed (production and marketing region) because it supplied milk for many counties throughout northeastern Washington and northern Idaho. This topic will be explored in more detail in FY 1992 and addressed in the final milk report to be completed in FY 1993.

SUMMARY

This report summarizes selected aspects of milk production and distribution for 1945 through 1963 in three "low-dose" counties in Washington State: Ferry, Okanogan, and Stevens. Estimates of the amount of milk produced in each of the three counties are based on U.S. Census of Agriculture milk production data. The milk distribution information is based on in-person interviews with dairy industry experts. The objective of this work was to provide general information to the Hanford Thyroid Disease Study on whether or not the milk consumed by residents of the low-dose counties during 1945 through 1963 came from outside the low-dose area, and if so, which other counties most likely produced the milk. The overall findings for these counties include the following:

Ferry County

- The percentage of milk consumed by Ferry County residents from outside the low-dose area was not determined because no dairy industry experts for that county were found.

Okanogan County

- All the milk consumed by Okanogan County residents (with one minor exception noted below) was produced and distributed within Okanogan County, i.e., milk neither entered nor left the county during the study period.
- A minor exception occurred during fruit harvest and deer hunting seasons when milk entered from plants in Moses Lake and Seattle to handle the temporary influx of people.
- In 1945, the estimated percentage of milk produced by a family-owned cow or two (backyard cows) was 28% of the Okanogan County milk supply. The contribution from backyard cows declined to 12% in 1953 and 11% in 1963.

Stevens County

- About half of the milk consumed by Stevens County residents came from outside the low-dose county area (i.e., outside Ferry, Okanogan, and Stevens Counties). The portion of Stevens County's milk supply originating outside the county increased from 45% in 1945, to 53% in 1953, and to 58% in 1963.

- Several counties in northeastern Washington, northern Idaho, and western Montana supplied milk to Stevens County. Spokane County was frequently cited as the most important source of milk from outside the low-dose area.
- Milk produced by backyard cows accounted for 20% of the Stevens County milk supply in 1945, 10% in 1953, and 10% in 1963.
- Milk was sold or transferred among processors supplying Stevens County. Thus, the potential exists that a portion of the milk supply of Stevens County may include milk from higher-dose areas.

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1.0 INTRODUCTION

In the late 1940s and early 1960s, relatively large amounts of radioactive iodine (iodine-131) were released to the atmosphere as a result of operations on the Hanford Site. Preliminary dose estimates from the HEDR Project indicate that some groups could have received thyroid doses well in excess of 100 rad (PNL 1991). The major exposure pathway of iodine-131 to the general population was through the consumption of fresh liquid milk (Napier 1991). Iodine-131 was released to the air, carried by the wind, and deposited on vegetation. Iodine-131 in feedstuffs eaten by cows entered the milk that the cows produced. When humans drank the milk, the iodine in the milk collected in the thyroid gland.

An epidemiological study, the Hanford Thyroid Disease Study (HTDS), was initiated to determine whether the incidence of thyroid disease is higher than expected as a result of exposure to iodine-131 released from Hanford facilities. The study is being conducted by the Fred Hutchinson Cancer Research Center (FHRC) for the Centers for Disease Control (CDC). The HTDS will compare the incidence of thyroid disease in selected areas in the Pacific Northwest near the Hanford Site with the incidence of thyroid disease in areas where Hanford operations resulted in relatively low doses (called low-dose counties).

FHRC designated Ferry, Okanogan, and Stevens Counties (see Figure 1.1) in northeast and north-central Washington State as low-dose counties for the HTDS. In the context of this report, the term "low-dose" implies only that these counties are similar to the areas affected by atmospheric transport of iodine-131 from Hanford production practices with respect to all characteristics relevant to thyroid disease except for iodine contamination.

The objective of the present study is to provide general information to the HTDS on whether or not the milk consumed by residents of the low-dose counties during the years 1945 through 1963 came from outside the three-county area, and, if so, which counties most likely produced the milk. Figure 1.2 depicts the flow of commercial milk from the farm to the consumer.

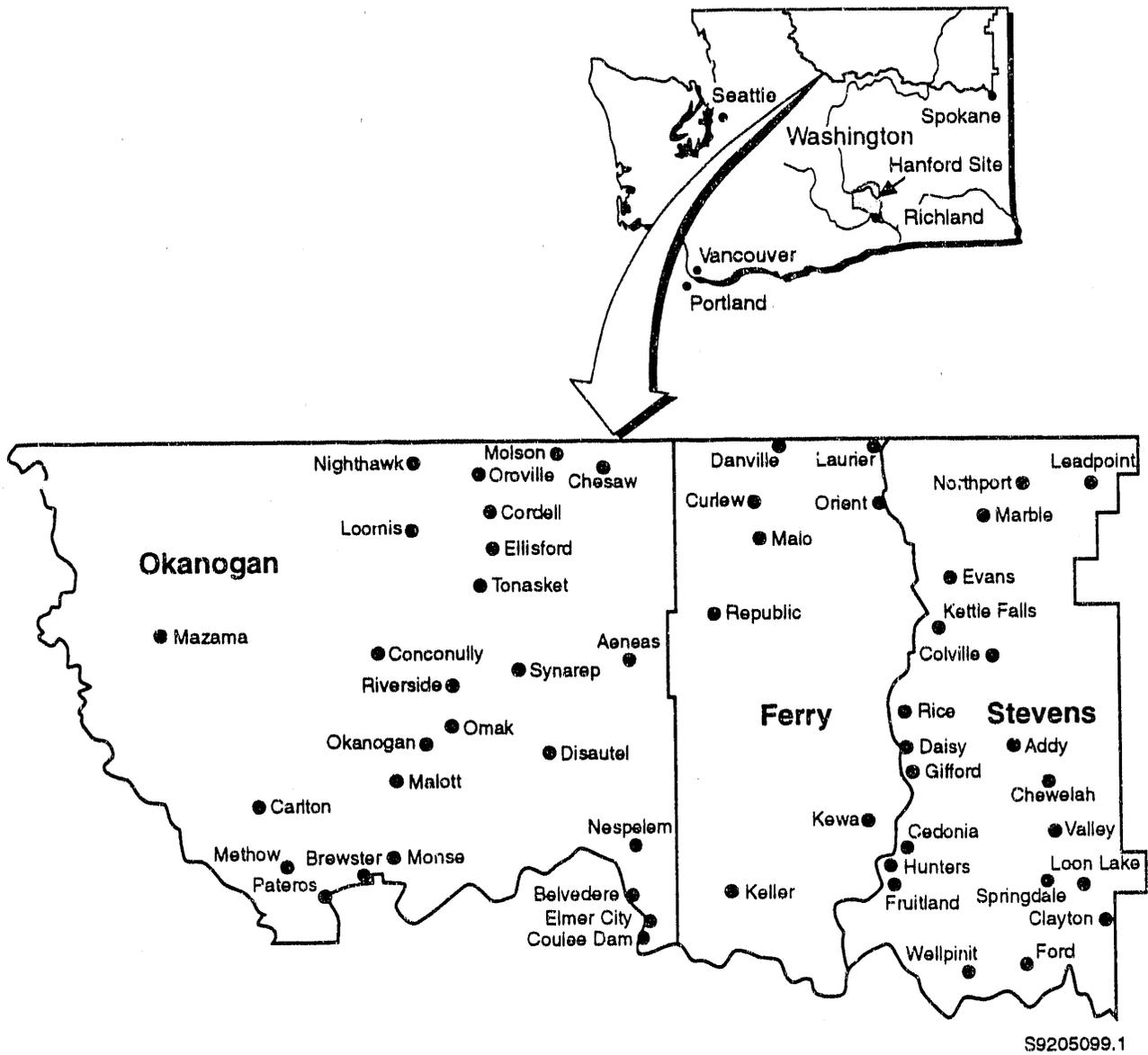
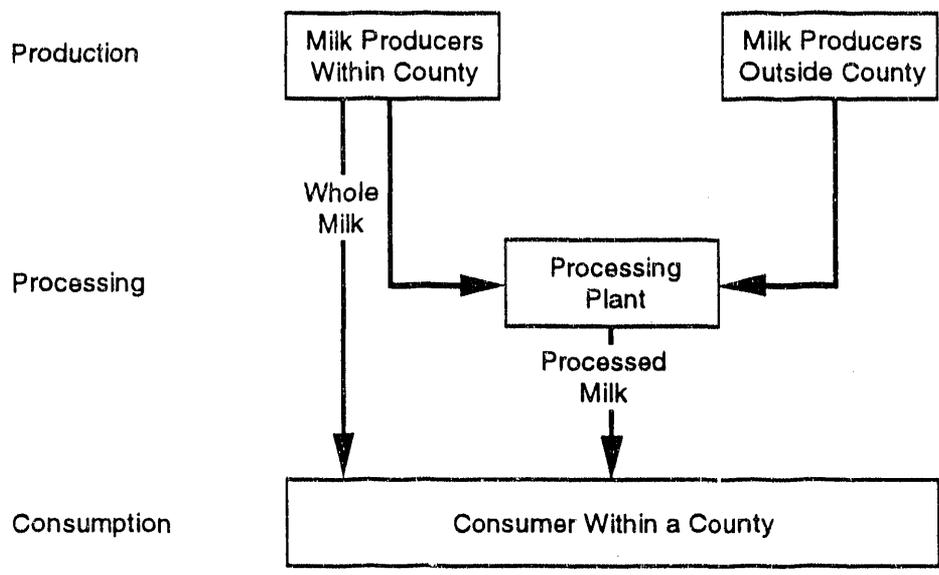


FIGURE 1.1. Study Area for Low-Dose Counties



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FIGURE 1.2. Flow of Commercial Milk from Farm to Consumer

Section 2.0 of this report, Technical Approach, describes the research protocol, data sources, method of analysis, quality assurance, and data quality objectives. The findings are presented and discussed in Section 3.0. For each county, an overview of the milk production segments is provided using U.S. Census of Agriculture data, followed by estimates of the milk supply from within and outside the county. The appendixes contain the interview agenda, raw and derived data upon which this report is based, and summary biographies of interviewees.

2.0 TECHNICAL APPROACH

Section 2.1 describes the interview protocol. Section 2.2 discusses the data analyzed and the method of analysis. A discussion of quality assurance issues, including the achievement of data quality objectives, is found in Section 2.3.

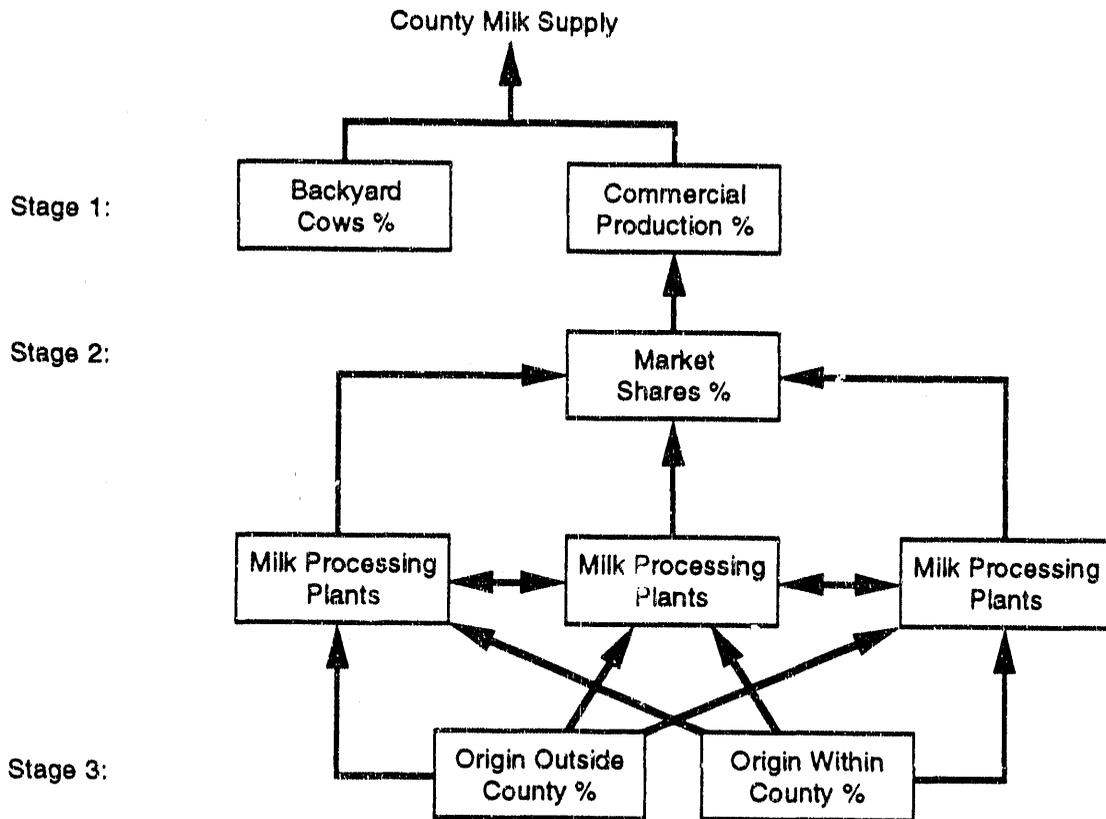
2.1 INTERVIEW PROTOCOL

An in-person interview protocol was designed by the authors to obtain estimates of the percentages of milk consumed from three sources: backyard cows,^(a) local commercial dairy processing plants, and commercial sources outside the counties. Figure 2.1 illustrates the data collection protocol; Appendix A contains the interview agenda. The interview protocol was tested on an individual (Bill Snell) who had participated in the development of milk production and distribution estimates for Phase I of the HEDR Project (Beck et al. 1992).

2.1.1 Selection of Experts

Dairy experts were selected by the "snowball" method. Retired extension livestock specialists, county agricultural agents, and other persons knowledgeable about agriculture in the three counties were contacted by telephone. They were asked to identify persons who were involved in the dairy industries of the three low-dose counties. When located, those persons were screened to determine whether they were willing and able to participate in the study. At the end of the in-person interviews, the experts were asked to identify other dairy industry experts for the low-dose counties, hence the snowball effect.

(a) In this study, "backyard cows" refers to milk produced by a family-owned cow or two, the use of which is intended primarily for the family's own consumption or to supply a neighbor.



S9205073.3

FIGURE 2.1. Process of Obtaining Interview Data

2.1.2 Dairy Industry Experts

Thirteen interviews of individuals intimately involved in the dairy industry of the low-dose counties were conducted in the fall of 1991. Four individuals were interviewed about the dairy industry in Okanogan County. Nine persons with experience in the Stevens County milk industry were interviewed. Only two of the interviewees were unable to completely answer all of the questions; one interviewee did not answer questions about the market shares of Okanogan commercial suppliers and another interviewee was unable to

answer questions about 1953 because he was in the military service in Korea at the time. All interviewees worked in the dairy industry during the time periods investigated. Many of the 13 experts interviewed were initially identified by multiple sources, suggesting that they were indeed experts. The interviewees' dairy industry experience is shown in Appendix D.

2.1.3 Interviews of Dairy Industry Experts

The interview protocol illustrated in Figure 2.1 covered three specific years: 1945 (the end of World War II), 1953 (the end of the Korean War), and 1963 (when President Kennedy was assassinated). These points in time were chosen so that the experts could relate their answers to important historical events. Detecting changes over time was one of the data quality objectives, i.e., representativeness of data (see Section 2.3.1 of this report).

The general premise of the interview and the type of questions to be asked were explained to the potential interviewees on the telephone before the interviews took place. This preliminary step was designed to screen individuals who were willing and able to answer questions, and secondarily, to allow them time to think about the questions and retrieve any relevant documents before the actual interview.

The first stage of the interview involved dividing the county's total milk supply into two component sources: milk from backyard cows and from commercial dairy enterprises. The second stage involved listing all the milk processing plants that supplied milk to the counties of interest. Then interviewees were asked for their best estimates of the market shares of the commercial milk supplied to respective counties. In the last stage, the interviewees were asked to estimate the percentage of milk that each milk processing plant acquired from within and outside the county. For the milk that was acquired outside of the county, they were asked to list those counties. The final question was whether the milk processing plants sold or transferred milk among plants. If milk was sold or transferred among plants, a list of the counties supplying that milk was solicited.

The average age of the interviewees was nearly 74 years (ages ranged from 65 to 84 years). Most of the interviewees' knowledge and experience was

peculiar to one of the low-dose counties. However, a few had knowledge about the dairy industry in more than one of the low-dose counties; those interviewees were queried on the county about which they felt most confident in answering questions.

2.2 DATA ANALYZED

Milk production data (1940 through 1964) from various editions of the U.S. Census of Agriculture were reviewed. These data should be used as a rough indication of the amount of fluid milk produced in the low-dose counties. The dairy industry was not static during the study period. Table 3.1 in Section 3.1 shows that the numbers of farms reporting milk cows and the inventories declined for all three counties during the study period.

The number of milk cows reported for 1944 is actually the number of cows and heifers that were milked any time during 1944. Later censuses relate the number of milk cows on the day preceding the enumeration. Reports of whole milk sold were converted to a common unit of measurement (pounds) for publication.^(a) The date of enumeration needs to be considered when totals for various censuses are compared. The time of year when livestock inventories are enumerated affects the data, in that typically more cows were in milk during the spring months. This study did not attempt to adjust inventories and production to a constant census date. Thus, spring enumerations overestimate inventories and production levels for the year. The census of 1945 was taken as of January 1 while those of 1940 and 1950 were as of April 1. The last three census inventories (1954, 1959, and 1964) were gathered in the fall (during November and December). The statistics presented in the last three censuses represent totals obtained by summing information obtained from farm operators surveyed in November and December.

2.2.1 Analysis of Interview Data

All of the quantitative data were solicited as percentages. The percentage of the total milk supply from backyard cows (B_{ij}) for the i^{th} county

(a) In 1940 whole milk sold was reported in gallons; 1 gallon of whole milk weighs 8.3 pounds.

(i = Okanogan, Stevens) in the jth year (j = 1945, 1953, 1963) was solicited directly in stage one of the interview. The portion of the total milk supply from processed sources (P_{ij}) for the ith county in the jth year was derived as follows:

$$P_{ij} = C_{ij} \times M_{ijk} \times O_{ijk1};$$

where C_{ij} = percentage of the milk supply from commercial dairy enterprises

M_{ijk} = market share of the kth plant in the jth year for the ith county

O_{ijk1} = percent of milk originating from the lth location processed by the kth plant in the jth year for the lth county

i = Okanogan, Stevens

j = 1945, 1953, 1963

k = Darigold, Carnation, Arden Farms, etc.

l = within county, outside county.

2.3 QUALITY ASSURANCE

Milk production and distribution estimates reported herein are historical reconstructions. Reconstruction involves combining both "hard data" from the U.S. Census of Agriculture and "soft data" from personal recollection of the dairy industry experts. The interview task gathered quantitative data (percentages) to reconstruct the production and distribution processes from production at the farm level to supplies available for consumption at the household level. All interviews were recorded and transcribed so that the information could be verified. Written permission to tape record the interviews and a version of the Washington State University Human Subject Release Form were obtained at the start of the interviews.

2.3.1 Data Quality Objectives

The data quality objectives for this work were established in Shipley (1991, p. 7.7). Three attributes of data quality (accuracy, completeness, and representativeness) were evaluated subjectively and quantitatively. Accuracy of milk production and distribution data was required to describe the low-dose

counties' dairy industries in general. The historical data is of sufficient accuracy to describe the overall character for the time periods investigated. The accuracy objective was attained by interviewing the most knowledgeable experts in the dairy industries of the low-dose counties. The accuracy objective (variations up to 20% from the previous HTDS milk model) was the goal of this study. Standard errors were about 10% of the value of the estimates in Stevens County. In Okanogan County, where the number of completed interviews was small, standard errors were from 32% to more than 100% of their respective estimates.

The completeness objective was to contact local experts, focusing on major movements of milk into and out of county-level areas. This objective was hampered by difficulties in identifying and locating experts for Ferry County, where dairying was not an important industry. From 10 to 20 interviews were specified in the work order, 13 were conducted, and 11 were complete.

The representativeness objective was to represent the dairy industries of the low-dose counties from the late 1940s through early 1960s. This was done, as documented in this report.

3.0 RESULTS AND DISCUSSION

This section describes the dairy industries of the three-county, low-dose area in terms of where fluid milk was produced, processed, and distributed from 1945 through 1963. Results are reported for Ferry County in Section 3.1, Okanogan County in Section 3.2, and Stevens County in Section 3.3.

3.1 FERRY COUNTY

Table 3.1 lists the number of farms reporting milk cows, county total milk cow inventories, and the associated percentages relative to the low-dose area totals. Similarly, Table 3.2 lists the number of farms reporting whole milk and cream sales and the associated percentages relative to the low-dose area totals.

3.1.1 Milk Production Data

Ferry County was a sparsely populated county with few farms reporting milk cows and few milk cows on inventory. Farms reporting milk cows on inventory were less than 10% of the three-county total from 1940 through 1954. A sharp decline (more than 75%) in the number of farms with milk cows occurred between 1954 and 1959. The number of farms reporting whole milk sales and cream sales declined over the years examined. Whole milk sales as a percent of the three-county total declined from 1.3 to 0.6% from 1944 through 1964. The pounds of cream sold declined from 1940 through 1964 to about 2.4% of the low-dose area total.

3.1.2 Supply Estimates

The sources of Ferry County's milk supply were not determined because no experts knowledgeable about the dairy industry for that county were identified. Other than anecdotal comments from Mr. Luce and Mr. Janzen (who chose to answer questions about other low-dose counties; see Appendix D), no processing and distribution data were obtained for Ferry County.

Ben Luce, a dairy inspector covering southeast Washington from 1944 through 1958, and later Chief of the Dairy Division of the Washington State Department of Agriculture, indicated that "Ferry County wasn't a dairy

TABLE 3.1. Farms Reporting and Number of Milk Cows By County and Year^(a)

Ferry County				
Year	Farms Reporting		Milk Cows (head)	
	Number	Percent	Number	Percent
1940	399	9.7	2,131	10.1
1944	365	9.3	1,978	9.7
1949	278	9.1	1,227	8.5
1954	262	9.9	870	6.3
1959	64	5.0	235	2.3
1964	59	6.7	175	2.1

Okanogan County				
Year	Farms Reporting		Milk Cows (head)	
	Number	Percent	Number	Percent
1940	1,638	40.0	6,942	33.0
1944	1,599	40.9	6,033	29.7
1949	1,187	38.8	3,906	27.1
1954	995	37.6	3,235	23.6
1959	465	36.0	1,897	18.5
1964	279	31.6	1,180	14.4

Stevens County				
Year	Farms Reporting		Milk Cows (head)	
	Number	Percent	Number	Percent
1940	2,061	50.3	11,994	56.9
1944	1,941	49.7	12,304	60.6
1949	1,594	52.1	9,265	64.3
1954	1,390	52.5	9,621	70.1
1959	761	59.0	8,142	79.2
1964	544	61.7	6,867	83.5

All Three Counties, Total				
Year	Farms Reporting		Milk Cows (head)	
	Number	Percent	Number	Percent
1940	4,098	100.0	21,067	100.0
1944	3,905	100.0	20,315	100.0
1949	3,059	100.0	14,398	100.0
1954	2,647	100.0	13,726	100.0
1959	1,290	100.0	10,274	100.0
1964	882	100.0	8,222	100.0

(a) Source: U.S. Department of Commerce, Bureau of the Census (1940, 1944, 1949, 1954, 1959, 1964).

TABLE 3.2. Farms Reporting and Pounds of Dairy Products Sold By County and Year^(a)

Ferry County								
Year	Whole Milk Sold				Cream Sold			
	Farms	Percent	Pounds	Percent	Farms	Percent	Pounds	Percent
1940	19	6.4	246,452	2.0	250	9.5	210,142	9.3
1944	15	4.2	260,090	1.3	238	9.8	181,483	9.6
1949	24	5.3	459,619	1.7	175	10.9	101,868	10.5
1954	2	0.5	233,800	0.6	104	9.5	71,842	8.8
1959	5	1.3	288,328	0.5	26	3.8	10,051	2.2
1964	6	1.5	341,734	0.6	17	4.5	7,593	2.7

Okanogan County								
Year	Whole Milk Sold				Cream Sold			
	Farms	Percent	Pounds	Percent	Farms	Percent	Pounds	Percent
1940	85	28.4	1,871,218	15.4	904	34.5	712,269	31.7
1944	135	37.9	3,276,540	16.9	811	33.4	460,325	24.5
1949	142	31.3	4,041,444	15.0	505	31.5	238,818	24.6
1954	90	23.6	7,853,446	18.7	306	27.9	171,938	21.1
1959	88	23.0	7,945,923	13.8	205	29.6	97,712	21.3
1964	35	8.7	5,274,800	9.2	74	19.7	50,433	18.1

Stevens County								
Year	Whole Milk Sold				Cream Sold			
	Farms	Percent	Pounds	Percent	Farms	Percent	Pounds	Percent
1940	195	65.2	10,022,855	82.6	1,464	55.9	1,325,441	59.0
1944	206	57.9	15,850,273	81.8	1,382	56.8	1,239,776	65.9
1949	287	63.4	22,393,587	83.3	925	57.6	629,597	64.9
1954	290	75.9	33,947,096	80.8	688	62.7	569,966	70.0
1959	290	75.7	49,541,012	85.7	461	66.6	351,312	76.5
1964	360	89.8	51,584,221	90.2	284	75.7	220,117	79.1

All Three Counties, Total								
Year	Whole Milk Sold				Cream Sold			
	Farms	Percent	Pounds	Percent	Farms	Percent	Pounds	Percent
1940	299	100.0	12,140,525	100.0	2,618	100.0	2,247,852	100.0
1944	356	100.0	19,386,903	100.0	2,431	100.0	1,881,584	100.0
1949	453	100.0	26,894,650	100.0	1,605	100.0	970,283	100.0
1954	382	100.0	42,034,342	100.0	1,098	100.0	813,746	100.0
1959	383	100.0	57,775,263	100.0	692	100.0	459,075	100.0
1964	401	100.0	57,200,755	100.0	375	100.0	278,143	100.0

(a) Source: U.S. Department of Commerce, Bureau of the Census (1940, 1944, 1949, 1954, 1959, 1964).

[production] county at all." This observation was supported by Harold Janzen, another dairy inspector for the Washington State Department of Agriculture from 1944 through 1973, who knew of only one dairy processing plant (Burbank, located in Republic) that operated in Ferry County.

3.2 OKANOGAN COUNTY

Okanogan County milk production is summarized in Tables 3.1 and 3.2. Estimated supply percentages and standard errors are shown in Table 3.3. The associated standard errors listed in Table 3.3 indicate the variability of the estimates. Sources of the Okanogan County milk supply (by year) are illustrated in Figure 3.1.

3.2.1 Milk Production Data

Okanogan was the most populated of the three low-dose counties. Okanogan County had from 30 to 40% of the total farms reporting milk cows and about 25% of the low-dose area milk cow inventory. Producers in Okanogan County sold proportionately more cream (24%) than whole milk (15%) relative to the low-dose area totals. In 1959, 49% of the Okanogan County farms had only one cow; another 47% of the farms had from two to nine milk cows.

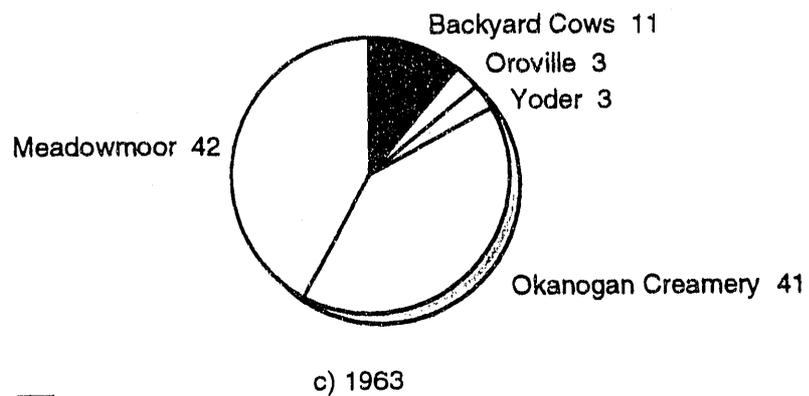
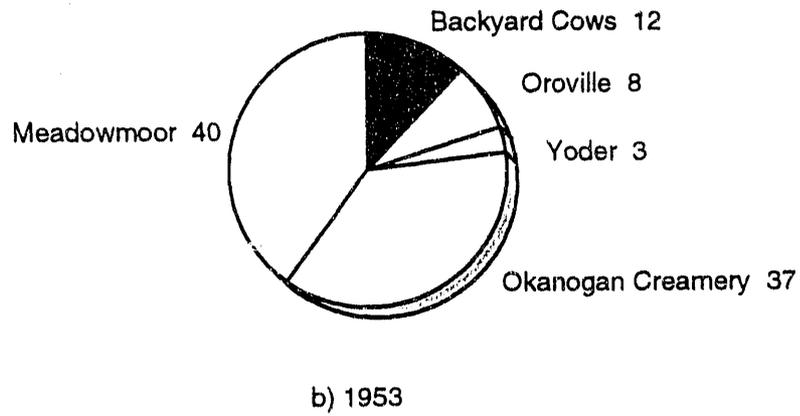
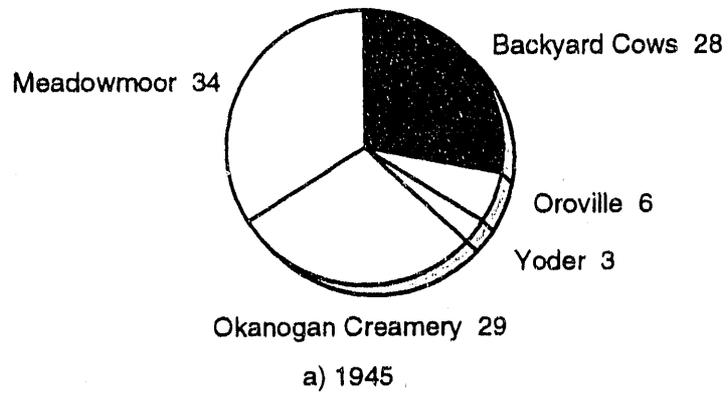
3.2.2 Milk Supply from Backyard Cows

At the end of World War II, backyard cows were estimated to be the source of 19 to 37% of the milk supplied to the county. Gordon Woodrow,

TABLE 3.3. Sources of Milk Supplied to Okanogan and Stevens Counties

Year	Number of Responses	Milk Originating from Backyard Cows		Milk Originating from Commercial Suppliers			
		Estimate, %	S.E., ^(a) %	Within County		Outside County	
				Estimate, %	S.E., %	Estimate, %	S.E., %
<u>Okanogan County</u>							
1945	3	28	9.0	72	9.0	0	N/A
1953	3	12	15.1	88	15.1	0	N/A
1963	3	11	15.3	89	15.3	0	N/A
<u>Stevens County</u>							
1945	9	20	2.0	35	3.1	45	3.2
1953	8	10	1.2	37	3.1	53	3.5
1963	9	10	1.8	32	3.1	58	3.2

(a) S.E. = standard error.



Backyard Cow
 Within Okanogan County

S9204011.4

FIGURE 3.1. Sources of Okanogan County Milk

formerly the agricultural extension agent in Okanogan County, indicated that in 1948 there were only 44 grade A milk shippers in Okanogan County, suggesting the importance of backyard cows to the county milk supply. The importance of backyard cows as a source of Okanogan County milk declined to 13% in 1953 and 1% in 1963.

3.2.3 Commercial Milk Supply Originating Within Okanogan County

Commercial dairy farms in the county are located near Omak, Tonasket, Oroville, and the northern Methow Valley. Okanogan County was self sufficient for whole milk. For the three years investigated, all of the milk supplied to Okanogan County consumers was produced and processed within the county.

Figure 3.1 depicts the sources of the Okanogan County milk supply. Four milk processors located within Okanogan County supplied all the commercial milk to the county. In 1945 these four processors supplied 72% of the total milk supply. In 1953 and 1963, milk from backyard cows was replaced by milk from commercial suppliers, bringing the commercial share to nearly 90% of the total supply. The two major processors, Meadowmoor Dairy and Okanogan Creamery, located in Omak and Okanogan, supplied the majority of the commercial milk in approximately equal market shares. Two Okanogan producer/distributors located in Riverside and Oroville supplied another 9% of the total milk supplied in 1945. The local producer/distributors supplied 11% and 6% in 1953 and 1963, respectively.

3.2.4 Commercial Milk Supply Originating Outside Okanogan County

Walter Ullrich, owner and manager of Okanogan Creamery, indicated that the two major Okanogan County milk processors acquired milk from Linden and Lucerne Dairy in Seattle, Morning Sun Dairy in Moses Lake, and Darigold in Spokane to supplement the local supply during the fall months. This demand-driven situation occurred primarily in the fall during fruit harvest and during deer hunting season because of a temporary influx of nonresident fruit pickers and deer hunters. Other than this minor exception, all of the milk consumed in Okanogan County originated and was processed within the county.

3.2.5 Milk Transfers Among Processors

Although infrequent, transfers and sales among Okanogan County milk plants did occur. But because all the milk consumed in the county was produced and processed locally, transfers among milk processors would not have affected the iodine-131 doses that Okanogan County residents received through milk.

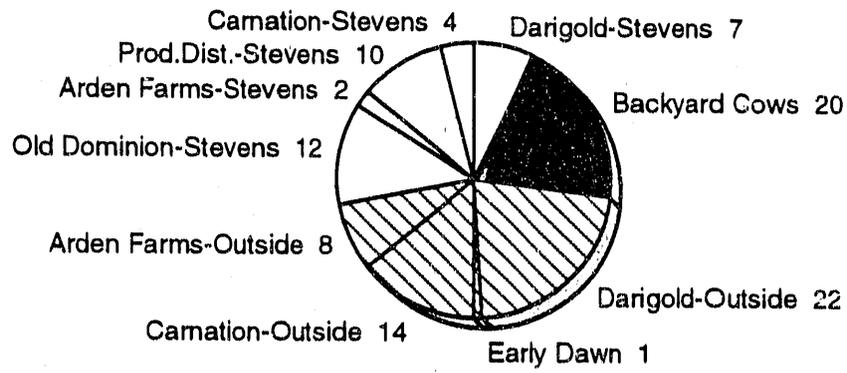
3.3 STEVENS COUNTY

Stevens County milk production is summarized in Tables 3.1 and 3.2. Estimated supply percentages and standard errors are shown in Table 3.3. Estimated supply percentages are less variable for Stevens County than for Okanogan County because three times as many interviews were completed. Sources of the Stevens County milk supply (by year) are graphically illustrated in Figure 3.2.

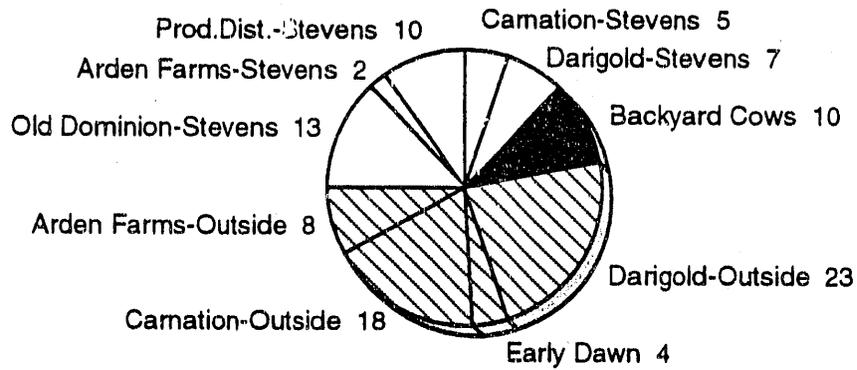
3.3.1 Milk Production Data

Of the three low-dose counties, Stevens County clearly dominated as a dairy production county. Stevens County had the greatest number of farms reporting milk cows; from 1944 through 1964, the milk cow inventory increased from 60.6 to 83.5% of the low-dose area total. Milk producers in Stevens County sold nearly six times as much whole milk and nearly twice as much cream as Ferry and Okanogan Counties combined. Sales of whole milk by Stevens County farms more than tripled from 1944 through 1959, while the sales of cream declined steadily.

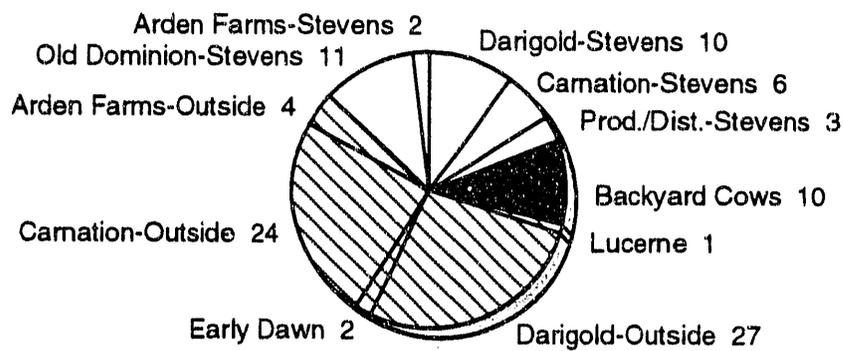
U.S. Census of Agriculture data and the assumed per capita disappearance of milk (USDA 1965) suggest that Stevens County farms produced more whole milk and cream than the county's residents consumed. If one accepts the assumption that Stevens County consumed milk at the same rate as the rest of the United States, there was a net flow of milk out of Stevens County. Presumably, the final retail destinations of that surplus milk would be those counties supplied by the major milk handlers (Darigold, Carnation, and Spokane Milk Producers Association).



a) 1945



b) 1953



c) 1963



S9204011.5

FIGURE 3.2. Sources of Stevens County Milk

3.3.2 Milk Supply from Backyard Cows

In 1945, backyard cows supplied about 20% of the milk consumed in Stevens County. This figure declined to about 10% in 1953 and 1963.

3.3.3 Commercial Milk Supply Originating Within Stevens County

The region north and east of Colville was an important dairy production area for the time periods examined; there were also several dairy farms near Chewelah and Addy. Commercial dairy enterprises within the county produced about one-third of the milk consumed by Stevens County residents. Stevens County commercial milk producers maintained that market share over the three years investigated. While the local producer/distributors lost market share, Darigold and Carnation increased their market share of milk produced within Stevens County.

3.3.4 Commercial Milk Supply Originating Outside Stevens County

In 1945, about 45% of the milk consumed in Stevens County was produced outside the county. In 1953, 53% of the supply originated from sources outside Stevens County via the major Spokane milk plants. By 1963, the Spokane milk plants were shipping in about 58% of the Stevens County milk supply. Backyard cow milk production was being replaced by an increasing supply that originated outside of Stevens County.

3.3.5 Counties Supplying Milk to Stevens County

Table 3.4 lists the counties in Washington, Idaho, and Montana that the interviewees cited as supplying milk to Stevens County. Spokane County was most frequently cited as the largest supplier to Stevens County. Howard Esvelt indicated that Ferry County supplied a very small amount of milk in 1953. Dr. Swantz stated that the westside counties of Washington (west of the Cascade Mountains) produced milk for Lucerne brand milk to Safeway grocery stores in Stevens County since 1963. Another interviewee recalled that Arden Farms and Carnation acquired milk from western Montana counties.

TABLE 3.4. Counties Outside Stevens Supplying Commercial Fluid Milk to Stevens County

State	County		
	1945	1953	1963
Washington	Grant Lincoln Pend Oreille Spokane	Ferry Grant Lincoln Pend Oreille Spokane	Grant Lincoln Pend Oreille Spokane Westside Counties
Idaho	Bonner Boundary	Bonner Boundary Kootenai	Benewah Bonner Boundary Kootenai
Montana	Lake Sanders	Sanders	Lake

3.3.6 Milk Transfers Among Processors

Nearly all interviewees agreed that milk was sold or transferred between processors. Noel Robb indicated that "...it was not unusual for milk processors to buy milk from each other even though they were fierce competitors." Bert Porter corroborated the transfers among processors: "If Darigold came up short, then Carnation might supply them with some." The potential impact is that milk from higher dose areas may have entered the milk supply of low-dose areas. Or, in other words, the low-dose counties may have been subject to more iodine-131 exposure than originally thought.

Nevertheless, emergency shortages of milk that required processors to procure milk from other processors were rare in Stevens County. At the end of World War II, transfers of milk from one processor to another were highly impractical because of transportation problems. As time progressed and transportation and refrigeration technology improved, more transferring of milk from one processor to another occurred.

Arden Farms procured milk from Darigold and Spokane Milk Producers Association. Darigold, as the reserve handler of milk,^(a) was known to have supplied Carnation and Arden Farms. As explained by Roy Olson, if Darigold needed milk, they could truck it in from their plant in Ronan, Montana. Likewise, Olson and Steuve recognized the possibility that if the Carnation plant in Spokane was short of milk, they might get milk from the Carnation plant in Sunnyside. Dr. Alex Swantz indicated that the smaller processors, i.e., the ones that didn't manufacture milk or had only a few farmers contracted, were more likely to experience shortages, and would therefore have to buy milk from the larger handlers.

Unlike the demand-driven situation in Okanogan County, when Stevens County suppliers procured milk from other processors it was because of a supply effect. The seasonal nature of milk production creates shortages because quantities demanded are relatively constant throughout the year. Historically, less milk is produced in the fall because there are fewer cows in milk. When this occurred, the plant operators would look to other plants to supply their needs. Dr. Swantz indicated that plants with facilities for manufacturing surplus milk always had surplus milk they could sell.

(a) The reserve handler of milk in the market sells milk to all processors, whether they are cheese plants or bottled milk plants.

4.0 CONCLUSIONS

The objective of this study was to provide background information to the HTDS on the production and distribution of milk in three low-dose counties in Washington State.

Dairying was not an important industry in Ferry County. From 1940 through 1964, Ferry County did not contribute more than 2% of the total whole milk sales in the three-county area. From 1940 through 1964, Stevens County dominated in dairy production among the three counties. Stevens County had more farms with milk cows, more milk cows on inventory, and sold much more whole milk than Ferry and Okanogan Counties.

Milk produced by a family-owned cow or two (backyard cows) was of particular interest to this study because of the short time lag between production and consumption. Milk from backyard cows declined from 1945 through 1953 and remained at approximately that level in 1963 in both Okanogan and Stevens Counties. Backyard cows were the source of about 28% of the milk consumed by Okanogan County residents in 1945, 13% in 1953, and 11% in 1963. Milk produced by backyard cows accounted for about 20% of the total milk supply in Stevens County in 1945, and 10% in 1953 and 1963.

Dairy production in Okanogan County was sufficient to meet its own needs, i.e., milk neither entered nor left the county during the study period. A minor exception occurred during fruit harvest and deer hunting seasons when milk entered from plants in Moses Lake and Seattle to handle the temporary influx of people. In terms of the HTDS, this exception becomes even less important because the milk was for the most part consumed by nonresidents.

The origins and distribution of milk consumed by Stevens County residents were more complicated than for Okanogan County. Between 13 and 17% of the total milk supplied to Stevens County was produced in the county, processed by the four major milk plants in Spokane, and returned to Stevens County for sale. In addition to Stevens County's own milk production, a number of other counties supplied milk through the Spokane milk plants. Percentages depicted in Figure 3.2 approximate the mixture of sources of milk in Stevens County. Over the years studied, milk produced by backyard cows was replaced

by milk that originated outside Stevens County. A tradeoff exists in that milk produced by backyard cows (in a low-dose area but with short time lag from production to consumption) was replaced by milk from commercial sources outside the area (potentially from a higher dose area but with a longer time lag from production to consumption). Essentially the same tradeoff exists when milk was transferred (or sold) from higher dose counties to low-dose counties.

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APPENDIX A

INTERVIEW AGENDA

APPENDIX A

INTERVIEW AGENDA

Low-Dose County Study for the Hanford Thyroid Disease Study
Washington State University, Pacific Northwest Laboratory,
and the Fred Hutchinson Cancer Research Center, cooperating

Interview Agenda

I. *Introduction*

1. Introduce personnel involved in research
2. Purpose of HEDR study
3. Why eliciting specific information
4. How data is to be used
5. Tape recording process and release
6. Human Subject Release form
7. Nonsensitive information
8. Biographical background and dairy industry experience

II. *Data Collection for 1944 (End of World War II)*

- A. Percentages of commercial vs. backyard cow production
- B. List of commercial sources of milk to the county

III. *Data Collection for 1953 (End of Korean War)*

- A. Percentages of commercial vs. backyard cow production
- B. List of commercial sources of milk to the county

IV. *Data Collection for 1963 (Kennedy Assassination)*

- A. Percentages of commercial vs. backyard cow production
- B. List of commercial sources of milk to the county

APPENDIX B

OKANOGAN COUNTY DATA

APPENDIX B

TABLE B.1. Okanogan County Interview Data

Interviewee ^(a)	Year	Milk from	Commercial	Dairy Market Shares, %			
		Backyard Cows	Milk	Meadowmoor	Okanogan	Yoder	Oroville
Janzen	1945	0.3	0.7	0.4	0.33	0.08	0.19
	1953	0.2	0.8	0.4	0.33	0.08	0.19
	1963	0.17	0.83	0.45	0.4	0.07	0.08
Ullrich	1945	0.5	0.5	0.55	0.3	0.05	0.1
	1953	--(b)	--	0.45	0.3	0.1	0.15
	1963	--	--	0.4	0.4	0.06	0.14
Harriman	1945	0.05	0.95	0.5	0.5	0	0
	1953	0.05	0.95	0.5	0.5	0	0
	1963	0.05	0.95	0.5	0.5	0	0
Woodrow	1945	0.9	0.1	--	--	--	--
	1953	0.9	0.1	--	--	--	--
	1963	0.9	0.1	--	--	--	--
Average							
	1945	0.28	0.72	0.48	0.38	0.04	0.10
	1953	0.13	0.88	0.45	0.38	0.06	0.11
	1963	0.11	0.89	0.45	0.43	0.04	0.07
Number of Interviews							
	1945	4	4	3	3	3	3
	1953	3	3	3	3	3	3
	1963	3	3	3	3	3	3
Standard Error							
	1945	0.09	0.09				
	1953	0.15	0.15				
	1963	0.15	0.15				

(a) See Appendix D for biographical information on each interviewee.

(b) -- = No information provided.

TABLE B.2. Okanogan County Derived Data

Interviewee ^(a)	Year	Milk from	
		Backyard Cows	Commercial Milk
Janzen	1945	0.3	0.7
	1953	0.2	0.8
	1963	0.17	0.83
Ullrich	1945	0.5	0.5
	1953	--(b)	--
	1963	--	--
Harriman	1945	0.05	0.95
	1953	0.05	0.95
	1963	0.05	0.95
Woodrow	1945	0.9	0.1
	1953	0.9	0.1
	1963	0.9	0.1
Average			
	1945	0.283	0.717
	1953	0.125	0.875
	1963	0.11	0.89
Number of Interviews			
	1945	4	4
	1953	3	3
	1963	3	3
Standard Error			
	1945	0.090	0.090
	1953	0.151	0.151
	1963	0.153	0.152

(a) See Appendix D for biographical information on each interviewee.

(b) -- = No information provided.

APPENDIX C

STEVENS COUNTY DATA

TABLE C.1. Stevens County Interview Data

Interviewee (a)	Year	Dairy Market Shares													
		Milk from Backyard Cows	Milk from Commercial Sources	Dariquid	Carnation	Arden	Early Dawn	Old Dominion	Curlew	Addy	Beneawah	Hallstone	Colville	Chewelah	Safeway
Stueve	1945	0.1	0.9	0.4	0.4	0.1	0.08	0.01	0.01	0	0	0	0	0	0
	1953	0.05	0.95	0.41	0.41	0.1	0.08	0	0	0	0	0	0	0	0
	1963	0.03	0.97	0.49	0.43	0.06	0.02	0	0	0	0	0	0	0	0
Robb	1945	0.05	0.95	0.15	0.15	0.05	0	0.51	0.02	0.02	0.02	0.05	0	0	0
	1953	0.05	0.95	0.19	0.2	0.05	0	0.5	0.01	0.01	0.01	0.04	0	0	0
	1963	0.02	0.98	0.29	0.29	0	0	0.4	0.01	0.01	0.01	0	0	0	0
Porter	1945	0.05	0.95	0.50	0.30	0.20	0.00	0	0	0	0	0	0	0	0
	1953	0.03	0.97	0.50	0.30	0.20	0.00	0	0	0	0	0	0	0	0
	1963	0.01	0.99	0.60	0.25	0.15	0.00	0	0	0	0	0	0	0	0
Esvelt	1945	0.25	0.75	0.50	0.50	0.50	0.00	0	0	0	0	0	0	0	0
	1953	0.05	0.95	0.35	0.35	0.20	0.25	0	0	0	0	0	0	0	0
	1963	0.02	0.98	0.33	0.25	0.25	0.17	0	0	0	0	0	0	0	0
Olson	1945	0.05	0.95	0.40	0.40	0.05	0.00	0	0	0	0	0	0	0	0
	1953	0.03	0.97	0.55	0.40	0.05	0.00	0	0	0	0	0	0	0	0
	1963	0.03	0.97	0.5	0.47	0	0.03	0	0	0	0	0	0	0	0
Luce	1945	0.1	0.9	0	0	0	0	0.6	0	0	0	0.1	0.3	0	0
	1953	0.1	0.9	0	0	0	0	0.6	0	0	0	0.1	0.3	0	0
	1963	0.1	0.9	0	0	0	0	0.7	0	0	0	0.3	0.3	0	0
Swantz	1945	0.2	0.8	0.6	0.3	0	0	0.05	0	0	0	0	0.05	0	0
	1953	0.15	0.85	0.4	0.35	0.2	0	0.05	0	0	0	0	0	0	0
	1963	0.02	0.98	0.45	0.45	0	0	0	0	0	0	0	0	0	0
Waananen	1945	0.5	0.5	0.1	0.1	0	0	0	0	0	0	0.6	0.2	0.1	0
	1953	0.35	0.65	0.2	0.2	0	0	0	0	0	0	0.45	0.15	0	0
	1963	0.2	0.8	0.5	0.5	0	0	0	0	0	0	0	0	0	0
Ehlers	1945	0.5	0.5	0.4	0.25	0.25	0.05	0	0	0	0	0.05	0	0	0
	1953	--(b)	--	--	--	--	--	--	--	--	--	--	--	--	--
	1963	0.5	0.5	0.5	0.25	0.15	0.05	0	0	0	0	0.05	0	0	0
		Average													
1945	0.200	0.800	0.356	0.211	0.128	0.014	0.030	0.001	0.006	0.002	0.002	0.089	0.061	0.000	
1953	0.101	0.899	0.325	0.258	0.100	0.041	0.144	0.000	0.000	0.001	0.001	0.074	0.056	0.000	
1963	0.103	0.897	0.407	0.321	0.068	0.030	0.122	0.000	0.000	0.001	0.001	0.006	0.033	0.011	
		Number of Interviews													
1945	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
1953	8	8	8	8	8	8	8	8	8	8	8	8	8	8	
1963	9	9	9	9	9	9	9	9	9	9	9	9	9	9	
		Standard Error													
1945	0.020	0.020	0.024	0.017	0.018	0.003	0.027	0.000	0.002	0.001	0.001	0.022	0.012	0.000	
1953	0.014	0.014	0.023	0.017	0.011	0.011	0.032	0.000	0.000	0.000	0.000	0.020	0.014	0.000	
1963	0.018	0.018	0.020	0.018	0.010	0.006	0.028	0.000	0.000	0.000	0.000	0.002	0.011	0.004	

(a) See Appendix D for biographical information on each interviewee.
 (b) Mr. Ehlers was in the military service in 1953 and thus did not provide information on the dairy industry at that time.

TABLE C.2. Stevens County Derived Data

Interviewee Name (a)	Year	Milk from Backyard Cows	Commercial Milk	
			Within County	Outside County
Stueve	1945	0.1	0.217	0.683
	1953	0.05	0.188	0.762
	1963	0.03	0.168	0.802
Robb	1945	0.05	0.665	0.285
	1953	0.05	0.624	0.326
	1963	0.02	0.563	0.417
Porter	1945	0.05	0.428	0.523
	1953	0.03	0.407	0.563
	1963	0.01	0.507	0.483
Esvelt	1945	0.25	0.075	0.675
	1953	0.05	0.093	0.857
	1963	0.02	0.085	0.895
Olson	1945	0.05	0.080	0.870
	1953	0.03	0.131	0.839
	1963	0.03	0.123	0.847
Luce	1945	0.1	0.9	0
	1953	0.1	0.9	0
	1963	0.1	0.9	0
Swantz	1945	0.2	0.224	0.576
	1953	0.15	0.204	0.646
	1963	0.02	0.220	0.760
Waananen	1945	0.5	0.413	0.088
	1953	0.35	0.442	0.208
	1963	0.2	0.12	0.68
Ehlers	1945	0.5	0.133	0.366
	1953	--(b)	--	--
	1963	0.5	0.134	0.366
Average				
	1945	0.2	0.348	0.452
	1953	0.101	0.374	0.525
	1963	0.10333	0.313	0.582
Minimum				
	1945	0.05	0.075	0
	1953	0.03	0.926	0
	1963	0.01	0.085	0
Maximum				
	1945	0.5	0.9	0.870
	1953	0.35	0.9	0.857
	1963	0.5	0.9	0.895
Number of Interviews				
	1945	9	9	9
	1953	8	8	8
	1963	9	9	9
Standard Error				
	1945	0.020	0.031	0.032
	1953	0.012	0.031	0.035
	1963	0.018	0.031	0.032

(a) See Appendix D for biographical information on each interviewee.

(b) Mr. Ehlers was in the military service in 1953 and thus did not provide information on the dairy industry at that time.

APPENDIX D

BIOGRAPHICAL SUMMARIES OF INTERVIEWEES

APPENDIX D

BIOGRAPHICAL SUMMARIES OF INTERVIEWEES

Mel Ehlers	D.2
Howard Esvelt	D.2
Stan Harriman	D.2
Harold Janzen	D.2
Bender Luce	D.2
Roy Olson	D.3
Lewis Porter	D.3
Noel N. Robb	D.3
Bill Snell (test interview only)	D.3
Donald A. Stueve	D.3
Dr. Alexander Swantz	D.4
Walter Ullrich	D.4
Dr. Martin Waananen	D.4
Gordon Woodrow	D.5

Mei Ehlers was interviewed on October 18, 1991, at his home in Pullman, Washington. Now 63, Mr. Ehlers grew up and worked for 20 years on the family dairy farm. He worked as a fieldman for Carnation before returning to graduate studies in animal sciences. He was unable to answer questions about 1953 because he was in the military service then. The interview ended prematurely so that Mr. Ehlers could take medication.

Howard Esvelt was interviewed on September 28, 1991, at his home in Colville, Washington. Now 80, Mr. Esvelt's dairy experience spans 73 years, most of which was in the production segments. He worked on the family dairy in Daisy, Washington, and in partnership with his father for 23 years. He was involved in organizing, and served as a board member of, Spokane Milk Producers Association. He was knowledgeable about the dairy industry in eastern Washington and chose to answer question about Stevens County.

Stan Harriman was interviewed on October 13, 1991, at his place of employment in Peshastin, Washington. Mr. Harriman is 66 years old and resides in Peshastin. He has 40 years of experience in all phases of the operation of the Meadowmoor Dairy in Omak, Washington. As manager of one of the major dairies in Okanogan County, he has first-hand knowledge of the dairy industry in that county.

Harold Janzen was interviewed on October 6, 1991, at his home in Seattle Washington. Now 70, Mr. Janzen was very knowledgeable about the dairy industry in most of Washington State. Mr. Janzen has 56 years of experience in all phases of the dairy industry. From 1943, his dairy experience was in the Northern Great Plains (Minnesota, South Dakota, and Montana). He arrived in Washington in 1944 and was superintendent of Cascade Milk in Yakima for 2 years. The next 29 years of his experience was as a dairy inspector stationed in Vancouver, Washington, and as a field supervisor (in charge of central and eastern Washington) stationed in Yakima for the Washington State Department of Agriculture. He was knowledgeable about the dairy industry in the three control counties. He chose to answer questions about Okanogan County.

Bender "Ben" Luce was interviewed on October 7, 1991, at his home in Olympia, Washington. Mr. Luce is 78 years old. All of his 55 years of dairy

experience was in the Pacific Northwest. His first 10 years involved producing, distributing, and manufacturing milk in Moscow, Idaho. He worked at the Benewah and Jersey Creameries for 8 years before hiring on with the Washington State Department of Agriculture as a state dairy inspector (14 years) and chief of the dairy division (19 years). After his retirement, he also served as a milk sanitarian and ice cream manager at the Washington State Fair. Mr. Luce chose to answer questions about the Stevens County dairy industry.

Roy Olson was interviewed on September 29, 1991, at his home in Spokane, Washington. Mr. Olson is 81 years old. From his 43 years of professional experience in the dairy industry, he is very knowledgeable and was easily able to answer questions about the dairy industry in Stevens County. After graduating from Washington State University in Dairy Science/Bacteriology, Mr. Olson worked for Inland Empire Dairy in Spokane (2 years) and Carnation in Oakland, California. The rest of his career was with the Washington State Public Health Department and the City of Spokane Health Department.

Lewis "Bert" Porter was interviewed on September 28, 1991, on his dairy farm in Deer Park, Washington. Now 63, Mr. Porter has 39 years of experience in producing cream and whole milk in Four Lakes, Washington. He later served on the board of directors of the Inland Empire Dairy (later named Darigold) for 15 years. He answered questions about the dairy industry in Stevens County.

Noel N. Robb was interviewed on September 24, 1991, at his home in Spokane, Washington. Mr. Robb is 74 years old. The first 25 years of his experience was in Kansas, Oklahoma, and Texas. He arrived in Spokane in 1949 and worked in milk supply and receiving and as a production manager for Carnation. Through his 28 years with Carnation, Mr. Robb is very knowledgeable about the dairy industry in Stevens County. Since his retirement from Carnation, he appraises land and acts as a real estate consultant.

Bill Snell was interviewed on August 21, 1991, at his home in Sunnyside, Washington. Mr. Snell previously supplied information to the HEDR Project and he was interviewed to test the interview protocol. His responses are not included in the current report.

Donald A. Stueve was interviewed on September 24, 1991, at the Darigold milk plant in Spokane, Washington. Now 65, Mr. Stueve resides in Spokane and is a field representative with Darigold. Starting out with Darigold (formerly Inland Empire) in Sandpoint, Idaho, Mr. Stueve has 48 years of experience with Darigold. He is extremely knowledgeable about all facets of the dairy industry in eastern Washington and northern Idaho. He chose to answer questions about Stevens County.

Dr. Alexander "Alex" Swantz was interviewed on October 8, 1991, at his home in Asotin, Washington. Now 62, nearly all of his experience is in the dairy industry, even during active service in the U.S. Navy during World War II. Early in his career he was involved in the production segment. Dr. Swantz's resume details several high-ranking positions in dairy and commodity marketing research and administration. Of greatest interest to this study was that from 1956 to 1961, he was the Federal Milk Marketing Order Administrator for the Inland Empire area. Dr. Swantz had retrieved written records, which he referred to during the interview. He was extremely knowledgeable about all facets of the United States and Pacific Northwest dairy industries, and opted to answer questions about Stevens County.

Walter Ullrich was interviewed on October 12, 1991, at his home in Oroville, Washington. Mr. Ullrich is 70 years old. He is extremely knowledgeable and easily recalled information about the dairy industry in Okanogan County during the time periods studied. With the exception of his time in the military service, all of his 40 years of experience in the dairy industry was in Okanogan County. Mr. Ullrich began as a laborer at the creamery. He later assumed management responsibilities (for 10 years) of the family-owned-and-operated Okanogan Creamery, one of the two major milk suppliers to Okanogan County. In his last 11 years of professional experience, he was general manager of the merged Okanogan Creamery-Meadowmoor Dairy.

Dr. Martin Waananen was interviewed on October 24, 1991, at his home in Pullman, Washington. Dr. Waananen is 65 years old. For 25 years, he was involved in dairying and undergraduate studies in the Upper Peninsula of Michigan, then graduate studies at the University of Illinois. Dr. Waananen held a faculty position at the University of Arizona before joining the faculty at Washington State University (WSU) in 1954, where his research

focused on dairy marketing. Through his 34-year tenure at WSU, he was knowledgeable about dairy marketing in much of Washington and chose to answer questions about the dairy industry in Stevens County.

Gordon "Woody" Woodrow was interviewed on October 5, 1991, at the Cedars Inn in Okanogan, Washington. Mr. Woodrow is 76 years old and resides in Okanogan. He grew up on a cattle ranch near Cheyenne-Wells, Kansas. Mr. Woodrow had dairy production experience insofar as the ranch maintained 25 to 35 milk cows. After World War II he served as the county agent of Okanogan County for 31 years (1948 to 1979). Though he was unable to answer questions about specific percentages, several of his observations about the dairy industry in Okanogan County are included in the report.

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