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Movement of Milk in the United States and Its Implications to the Spread and Control of Foot-and-Mouth Disease

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1. Introduction

Foot-and-Mouth disease (FMD) is one of the most contagious of all diseases. Cattle affected with FMD shed the virus through numerous pathways including mammary secretions. FMD virus may be present in milk from infected cows a few days before the onset of clinical signs.[1/] Thus milk and milk derivatives from infected cows could present a potential hazard in transmission of the disease not only by direct contact but also through the contamination of persons, containers and vehicles.

Various research investigations have linked FMD outbreaks to infected milk. Milk-borne transmission of FMD was reported in England and other countries. Brooksby cited a case in which milk from infected cows was fed to calves while in transit at Crewe, England. The subsequent movement of these calves led directly or indirectly to 101 new outbreaks of FMD at places 150 to 300 miles from Crewe.[2/] During the 1967-1968 FMD epidemic in Great Britain a number of outbreaks were traced to contaminated skim milk which was fed to pigs. A bulk

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* Research Associate, Department of Agricultural and Applied Economics, University of Minnesota, St. Paul, Minnesota. The author is indebted to Dr. Hunt McCauley and Dr. W. B. Sundquist for their helpful comments and suggestions. This report is part of a collaborative study on the economic impact of FMD in the United States by the Department of Agricultural and Applied Economics and the College of Veterinary Medicine, University of Minnesota, under a contract from APHIS/USDA. However, the opinions and recommendations are those of the author and do not necessarily represent those of APHIS or the University of Minnesota.

1/ Report of the Committee of Inquiry on Foot-and-Mouth Disease, Part Two, Her Majesty's Stationery Office, London, December 1968, pp. 49-51.

2/ Brooksby, J. B., "The Epizootiological Picture in Foot-and-Mouth Disease," Proceedings of the 16th International Veterinary Congress, Madrid, 1959, Vol. 1, pp. 233-245.

tanker carrying contaminated skim milk distributed its load among three pig farms in Worcestershire, England which subsequently became infected with FMD. The disease spread from two of the three farms until 29 more farms in the area became infected.[3/] Hyslop reported that several outbreaks of FMD in Switzerland were attributed to milk products.[4/]

A more recent study by Hugh-Jones[5/] stated that primary movement of milk is less than might have been previously thought. He developed a computer simulation model to mimic the 1967-68 FMD epizootic in Shropshire and Cheshire, England in which the daily spatial distribution of outbreaks was randomized. The pattern of outbreaks was then analyzed to determine what percentage of outbreaks would fulfill an arbitrary set of criteria for the primary movement of milk. The result indicated that a milk truck had to visit seven infected farms before it would have appeared to have transmitted FMD to one other subsequently visited dairy herd.

The dangers associated with the movement of milk during FMD epidemics have been recognized by U.S. animal health officials. The Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture has established a code of practice in handling milk movement during disease outbreaks. The code stipulates that special handling and processing procedures should be applied to milk and milk products produced within quarantine and buffer areas. For example,

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3/ Hedger, R. S. and P. S. Dawson, "Foot-and-Mouth Disease Virus in Milk: An Epidemiological Study," Veterinary Record, Vol. 87, 1970, pp. 186-188, 213.

4/ Hyslop, N. St. G., "The Epizootiology and Epidemiology of Foot-and-Mouth Disease," Advances in Veterinary Science and Comparative Medicine, C. A. Brandly and G. E. Cornelius, Editors, Vol. XIV, New York: Academic Press, 1970, p. 269.

5/ Hugh-Jones, M.E., "A Simulation Spatial Model of the Spread of Foot-and-Mouth Disease Through the Primary Movement of Milk," Journal of Hygiene, Vol. 77, 1976, p. 1.

the regulations state that "with the exception of milk used on the premises of origin, all milk within the quarantine zone must be (1) destroyed by a method that will prevent the spread of FMD (such as dumping in pits and covering) or (2) processed at approved plants using 'approved' procedures known to be effective in destroying Foot-and-Mouth disease virus. The only 'approved' procedures are (1) manufacturing of cheese or sour cream butter or (2) heating to 145 degrees F for 30 minutes."[6/] Because of economic considerations the decision to process or condemn milk may depend largely on the volume of milk involved. If the cost of processing it via approved procedures is not excessive relative to its value the milk will likely be processed.

It is clearly recognized that a major epidemic of FMD in the United States could cause serious disruptions in the dairy industry. The value of U.S. dairy products at the farm level alone was more than $9.4 billion in 1974.[7/] While it is agreed that every effort should be made to control the spread of an FMD epidemic, it is also recognized that efforts should be made also to minimize the economic impact of quarantines and other restrictions on producers, processors and consumers of milk and milk products.

An understanding of milk movement in the U.S. by animal health officials will substantially enhance their disease control measures. In the event of a disease epidemic it would be possible to do the following:

(1) Predict more effectively the general direction of spatial spread of the disease caused by milk movement. For example, if an FMD outbreak has occurred in a dairy herd, it would be possible to trace the movement of infected milk from that herd and make predictions of the most likely locations where such milk or its derivatives might be fed to animals.

6/ APHIS/USDA, "Foot-and-Mouth Disease: Guidelines for Eradication," Emergency Programs, Washington, D.C., 1975, pp. 22-25.

7/ SRS/USDA, Milk: Production, Disposition and Income 1972-74, Washington, D.C., April 1975, p. 3.

(2) Enforce restrictions on milk movement and deploy disease control personnel to areas in which the disease is likely to spread by infected milk. By enforcing controls in which the disease is most likely to spread it will be possible to limit the economic impact of controls by eliminating unnecessary and costly restrictions.

2. Objectives

Given that infected milk may be involved in the spread of FMD and that it may prove to be a serious obstacle to FMD control this study has the following objectives:

(1) Give a global picture of the production and marketing system of fluid and other milk products in the United States. The main pathways of milk movement will be described.

(2) Indicate the major risks of FMD spread associated with the movement of dairy products.

(3) Suggest recommendations for minimizing both the risk of spread and the impact of controls on the dairy industry.

3. Milk Production

Milk is produced in every state of the United States but only a few states produce a large portion of the total milk produced. The numbers of dairy cows and milk production by states are shown in Figure 1 for 1975. Figure 2 shows the number of dairy farms by states for 1969. Wisconsin, California, New York and Minnesota are the four highest producing states. Wisconsin, which has been the leader in milk production, produced about 19 billion pounds of milk in 1975 followed by California which produced close to 11 billion pounds.[8/] More than one-half of the milk produced in 1975 was produced in the eight states touching the Great Lakes.

Figures 1 and 2 show clearly that the dairy industry is most heavily concentrated in East North Central and the Midatlantic regions of the United States. The other major areas of production are the Pacific and the South Atlantic states. The West Central and Mountain states generally have the lowest concentration of dairy farms.

8/ SRS/USDA, Milk Production, Washington, D.C., February 1976, p. 5.

Connecticut	Delaware	Maryland	Massachusetts	New Hampshire	New Jersey	Rhode Island
55	12.5	140	55	33	47	5.9
613	133.0	1555	601	343	527	63

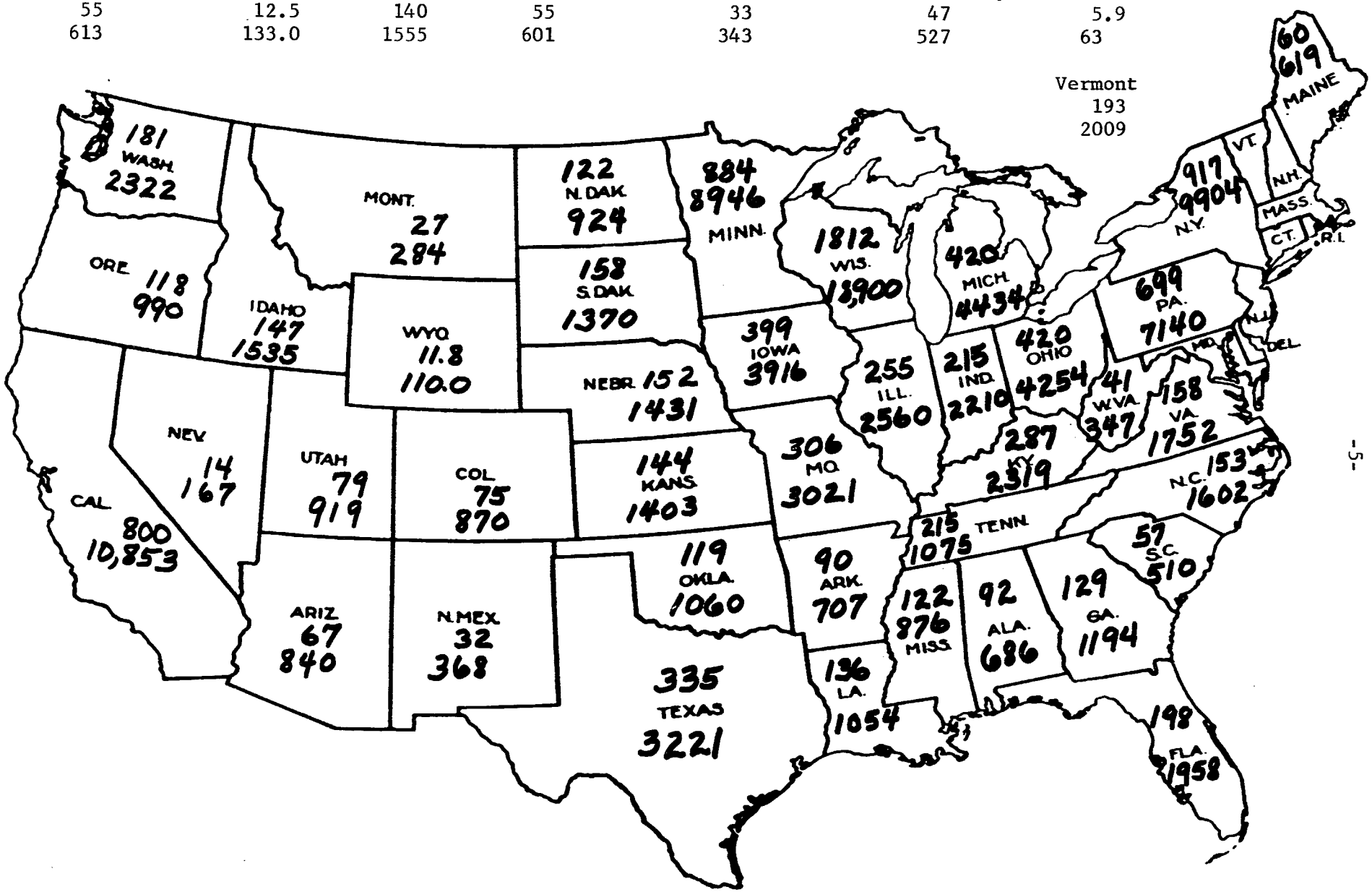

Figure 1. Number of dairy cows (Upper figure in thousands) and millions of pounds of milk (lower figure) by each of the 48 states

Source: SRS, USDA, Milk Production, Washington, D.C., February 1975, pp. 8-9.

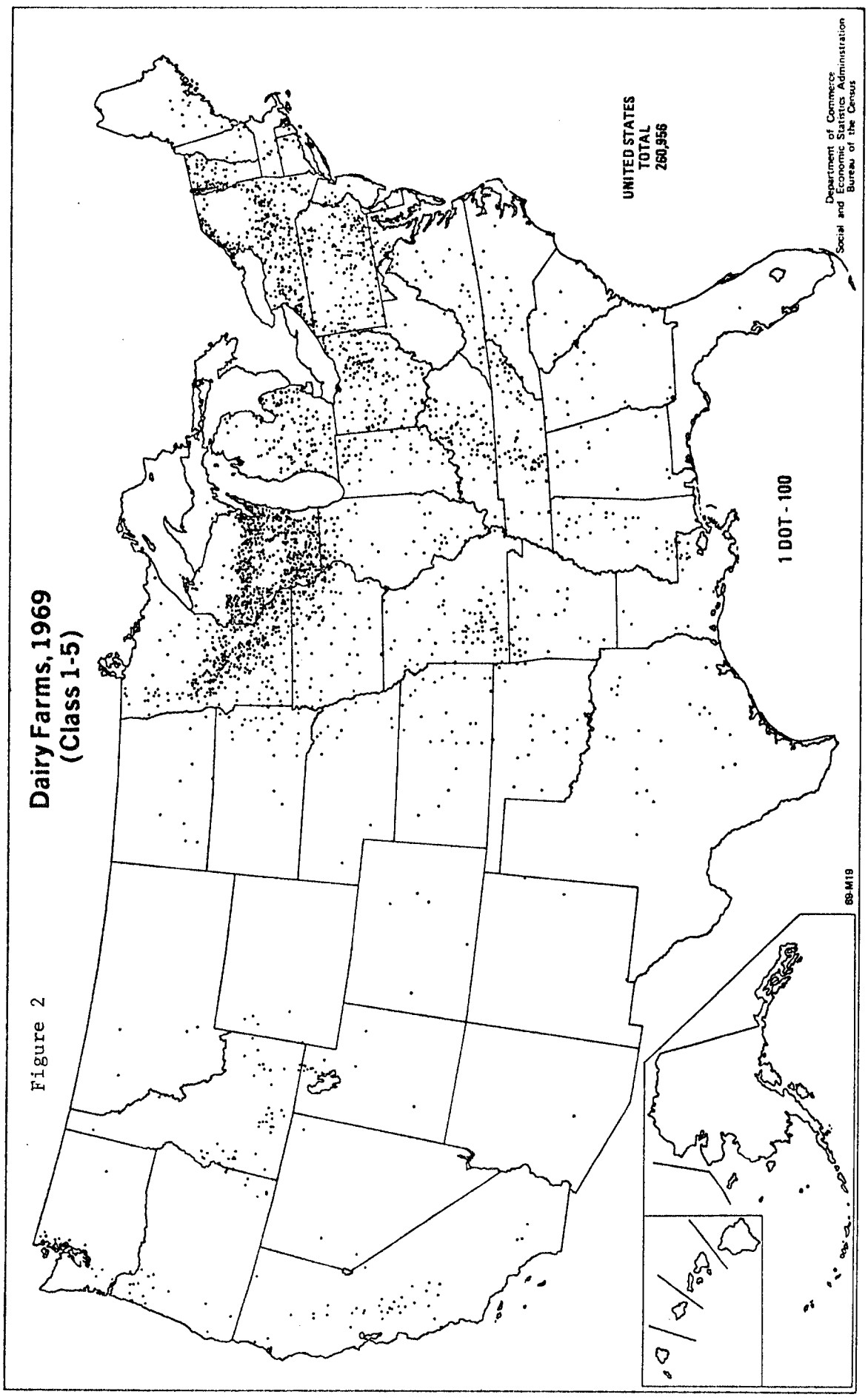
Dairy Farms, 1969
(Class 1-5)
UNITED STATES
TOTAL
260,956
1 DOT - 100
Department of Commerce
Social and Economic Statistics Administration
Bureau of the Census
69-M18

Figure 2

4. Milk Assembly and Movement

The marketing of milk in the United States involves a large number of organizations and agencies. There are three primary stages in the marketing of milk. These are:

(1) The first stage consists of the collection and subsequent movement of milk from farms to assembly and processing plants.

(2) The second stage of milk marketing is the processing, manufacturing and packaging.

(3) The third stage involves the distribution of fluid milk and manufactured products.

Not many years ago the basic assembly of milk was done by trucks picking up milk in cans from the individual farms and delivering it to milk plants. During recent years milk assembly has changed significantly. Many dairy producers have installed large cooling tanks that receive milk directly from milking machines. Milk is then picked up from farms by large bulk tank trucks which pump it directly from the cooling tanks.

Since milk is considered to be a highly perishable product, it must be refrigerated and either consumed within a short period of time or manufactured into dairy products that are less perishable and bulky. Milk is transported from farms to processing plants where it is processed and packaged. The processor or distributor then delivers the milk directly to consumers, retail stores, institutions, etc. The reader is referred to Figure 3 which shows the movement of milk and milk products from the producer to the final consumer.

The development of bulk handling methods expanded the area from which milk may be collected for processing and subsequent distribution. Assembly routes of milk from farms to plants vary from 30 to 300 miles but most plants obtain their supply of milk from within a 45 mile radius.[9/]

[9/] Nolte, G. M. and E. F. Koller, "Economic Analysis of Farm-to-Plant Milk Assembly," Agricultural Experiment Station Bulletin No. 512, University of Minnesota, 1975. p. 10.

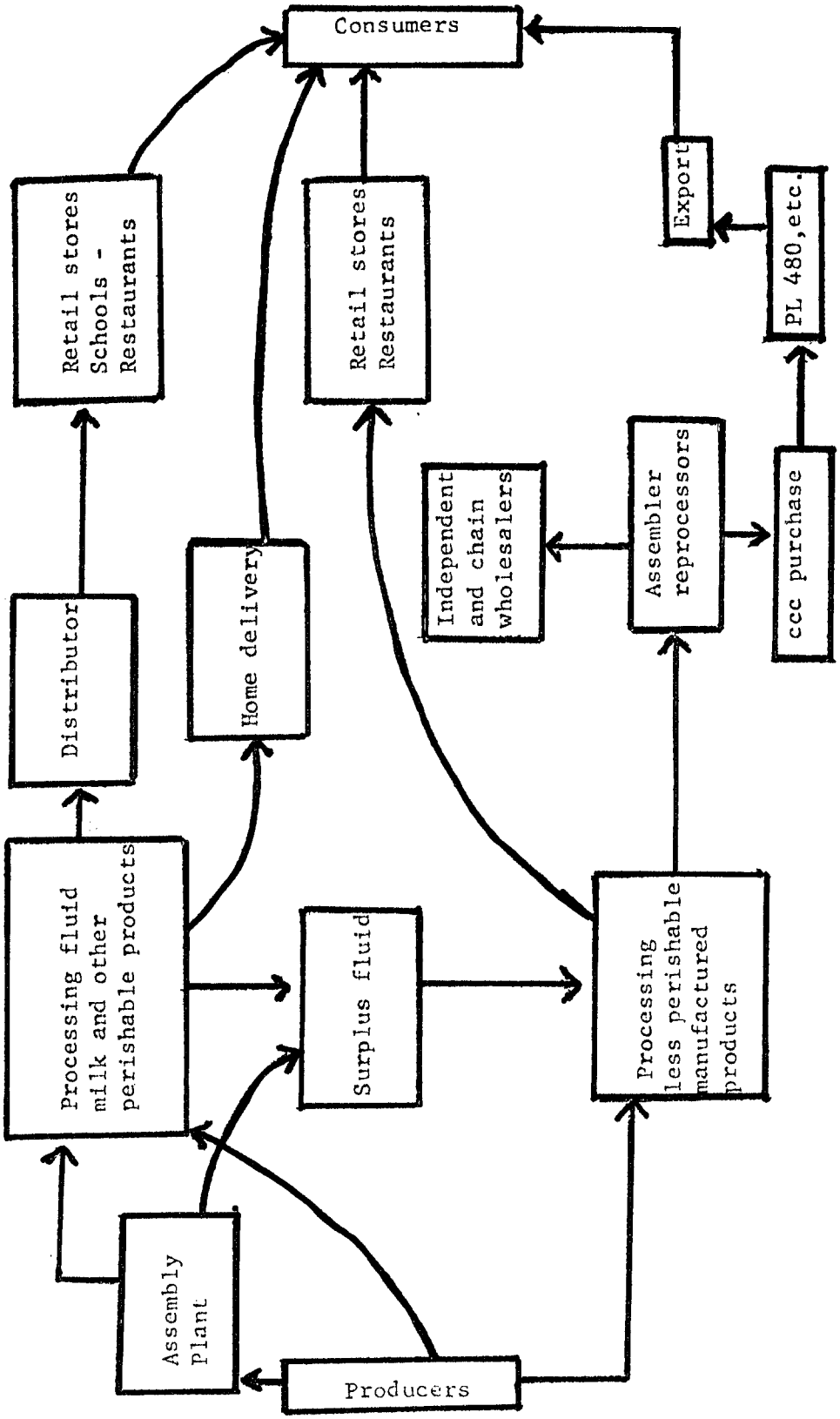

Figure 3. Milk Marketing System in the United States

On the distribution side, improvement in transportation and the development of the paper container have contributed in expanding sale areas for fluid milk. There are examples of packaged milk shipped up to 500 miles. However, most fluid milk is shipped less than 100 miles from processing plants.[10/]

5. Milk Utilization

Usage of milk in the United States varies considerably by regions as shown in Figure 4. In production areas which are removed from large metropolitan centers a large portion of the milk produced goes into manufactured milk products such as butter and cheese. For example, approximately three-fourths of the milk produced in Michigan, Minnesota and Wisconsin is used for manufacturing dairy products. On the other hand only 30 percent of the milk produced in the Northeast is used for manufactured dairy products. Because the population is large in this region the majority of milk produced is used for fluid milk and cream. On a national basis less than 50 percent of all milk is used for fluid consumption. Appendix Table 1 presents milk utilization by states for the year 1974. The table shows that in 1974 about 95.3 percent of all milk produced by U.S. dairy farmers was sold as whole milk to milk dealers and processing plants. Sales of cream by farmers were about half of one percent of total milk produced. The remaining 4.2 percent included 1.4 percent fed to calves, 1.5 percent used for milk, cream and butter on farms, and 1.3 percent sold directly to consumers by producer dealers.

10/ Economic Report on the Dairy Industry, Staff Report to the Federal Trade Commission, Washington, D.C., March 1973, p. 51.

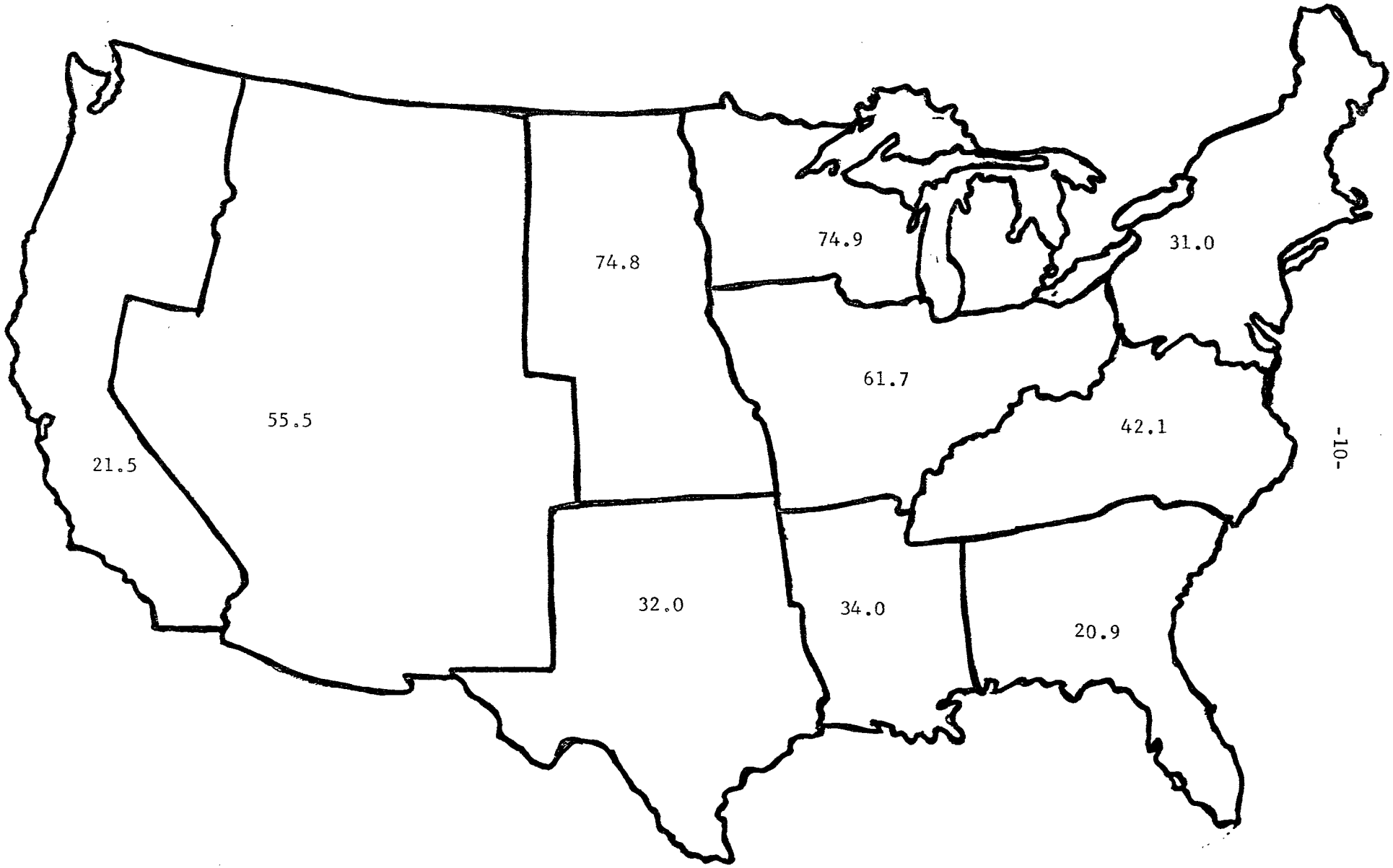

Figure 4. Percentage of the Total Milk Supply in the United States Used for Manufactured Dairy Products by Region.
Source: Schmidt, G. Hand L. D. Van Vleck, Principles of Dairy Science, San Francisco, Cal. W. H. Freeman and Company, 1974, p.35.

6. Marketing Orders

Milk is one of the most regulated commodities in the United States. Since the 1930's Federal Milk Marketing Orders were established for the purpose of maintaining orderly production and marketing of dairy products. Unlike livestock movement the movement of dairy products in this country is closely regulated and monitored. Therefore, it is much easier to trace milk movement during a disease situation than to trace animal movements.

As of January 1974 there were 61 marketing areas under Federal Orders (Figure 5). These orders may cover a part of a state, an entire state or parts of several states. For example, the San Antonio Marketing Order includes only a single county. Others such as the Boston Regional Order, cover parts of several states. A marketing order covers all milk marketed within an area even though some of the milk may be produced somewhere else.

In addition to the Federal Marketing Orders, 20 states have established their own milk control agencies. Appendix Table 2 below provides a list of these states and shows the percentage of milk which is regulated by state agencies.

Deliveries of milk to Federal Marketing Orders came from 48 states in 1974. During the same year the 61 Federal Order Markets were receiving milk from producers in 2180 counties of the 3108 counties in the 48 contiguous states. The supply areas for individual markets in many cases covered several states - usually the state or states in which the market was located plus neighboring states. In 1974 the percentage of markets receiving milk from five or more states was 35 percent with 8 percent of the markets receiving milk from eight or more states. Appendix Table 3 lists the Federal Milk Marketing areas and shows the annual volume of milk delivered to each market from each state and the percentage that each state represents of the total volume of milk delivered to each market.

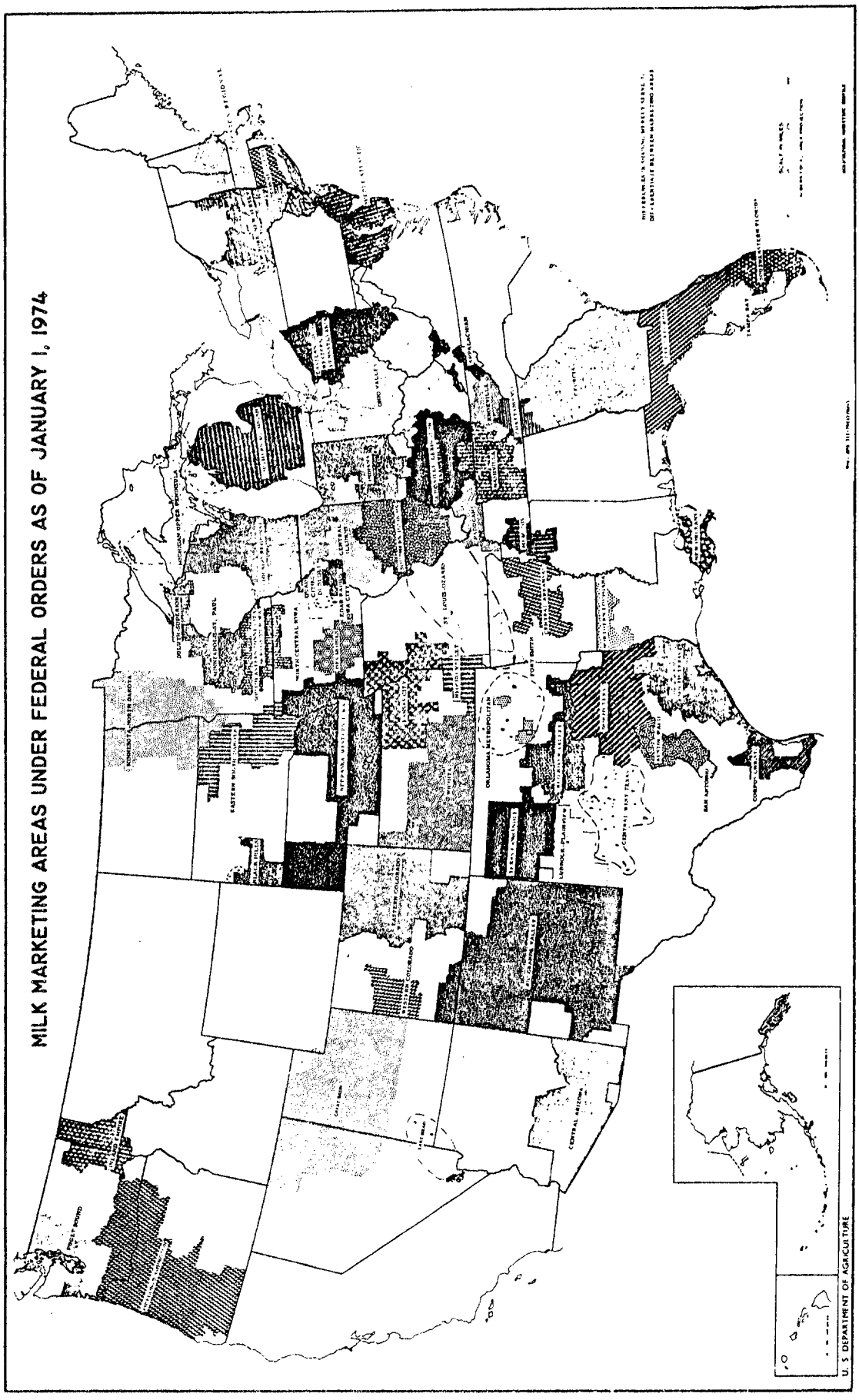
MILK MARKETING AREAS UNDER FEDERAL ORDERS AS OF JANUARY 1, 1974
U. S. DEPARTMENT OF AGRICULTURE

Figure 5

7. Methods by Which Milk May Spread FMD

The following are the major ways by which milk and its movement might be involved in the spread of disease.[11/]

A. Primary Movement of Milk

1. Spillage or leakage of infected milk from containers during transportation.
2. Cross contamination: This may occur when a truck loaded with infected milk and empty milk cans delivers the empty cans to other dairy farms.
3. Particular hazards associated with bulk tank collection: The bulk tank method requires that the milk truck enters the farm yard to collect milk. This increases the chances of disease spread because of the possibility of contact between the truck, the driver and the milking herd. In addition, it is very possible that some milk remaining in the connecting pipe from the previous collection might be spilled during the connecting operations unless the pipe was thoroughly washed.
4. Contamination of the milk truck, the driver or other equipment carried on the truck by infected milk carried on the truck or associated with a visit to an infected premise.

B. Secondary Movement of Milk

1. Movement of by-products. There is a possibility of disease spread when raw milk is sent to processing plants, since the by-products, such as skim milk and whey, may end up as animal feed. This possibility represents the greatest threat for spread of FMD long distances from the original source. In 1961 half of the cheese

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11/ Dawson, P. S., "The Involvement of Milk in the Spread of Foot-and-Mouth Disease: An Epidemiological Study," The Veterinary Record, October 31, 1970, pp. 543-548.

factories in Wisconsin returned whey free to farmers for livestock feed.[12/]

2. Producer-retailer activities. In 1974 about 1.3 percent of milk was sold directly to consumers by producer dealers. The possibility of contact with susceptible livestock is considerable because many consumers of this milk live in rural areas and animals may be infected through household wastes.

3. Pasteurized milk movements. The dangers associated with pasteurized milk depend on the efficacy of current pasteurization techniques on on the inactivation of the virus. Normal pasteurization may be inadequate to destroy FMD virus completely. A recent study reported that FMD virus survived in whole milk after heating at 72 degrees C for 15 seconds and also after heating milk at 80 degrees for the same period. The study reported also that FMD virus was detected in milk samples which were pasteurized and evaporated at 65 degrees C to 50 percent of their original volume.[13/]

4. Rejected milk movement. If used for animal feeding, rejected milk may be involved in the spread of FMD.

C. Indirect Methods of FMD Transmission

The spread of FMD may be accomplished indirectly by:

1. Infection of stock by accidental contamination of dairy personnel having access to susceptible animals.

2. Contamination of equipment and vehicles which may be used on other farms.

12/ An Economic Analysis of Whey Utilization and Disposal in Wisconsin, Ag. Econ. 44, Department of Agricultural Economics, College of Agriculture, University of Wisconsin, Madison, Wisconsin, July 1965, p. 14.

13/ Callis, J.J., et al, "Survival of Foot-and-Mouth Disease Virus in Milk and Milk Products," XIV Conference of the O.I.E. Commission on Foot-and-Mouth Disease, Paris, March 11-14, 1975, pp. 4-5.

3. Contamination of disposal systems which may cause the infection of nearby premises.

8. Implications and Recommendations

It is clear that milk movement is a major potential hazard in the control of FMD but it is a hazard which can be controlled by the employment of appropriate control measures. Prior to any control measures, disease control personnel will need to have accurate data pertaining to milk movement by different categories. Such data will not be hard to collect since milk movement in the United States is closely monitored, particularly the milk marketed under marketing orders (see section on marketing orders).

Once data is collected on the movement of milk in the affected areas, steps should be taken to control the spread of disease via milk. The reader is referred to the official APHIS manual which lists the steps that should be taken during an epidemic in order to control FMD spread through milk movement.[14/]

Milk is produced and marketed in every part of the United States. Thus many individuals, agencies and organizations are involved in the complex system of production, processing and distribution of dairy products. Restricting milk movement to limit the spread of disease will have minimum adverse effect on the dairy industry if only a small disease epidemic is involved. However, if a large and prolonged epidemic is involved the restrictions and controls will be felt throughout the industry. The pattern of milk marketing will be substantially changed as a result of restrictions on milk movement. For example, Table 3 shows that in 1974 San Antonio, Texas received more than 25 percent of its fluid milk from Kansas. An epidemic of FMD in Kansas will thus deprive San Antonio of 25 percent of its milk supply for the duration of the outbreak or until an alternative source of milk supply is found. It can be readily seen that milk shortages and high prices may result from FMD epidemics.

14/ See footnote 5.

In order to minimize the economic impact of restrictions and at the same time limit the spread of FMD through milk movement we recommend the following steps:

1. Disease control personnel should seek maximum cooperation from producers, processors and distributors of dairy products.
2. Periodic milk movement data should be collected during an outbreak to assess any possible involvement of milk in the spread of FMD.
3. On the basis of milk movement data it is recommended that anticipatory diagnosis should be conducted on farms considered to be most likely to get the disease. By diagnosis of FMD in milk from cows before clinical signs appear we can substantially limit the extent of an outbreak and subsequently minimize the economic losses. As indicated before research evidence in Great Britain showed that in spite of constant vigilance and early reporting of FMD, the virus was found to be present in fresh milk from farms prior to the disease being either confirmed or even suspected of being there. It is this milk which may present a real hazard in the control of FMD.
4. Support should be given to more research on the spread of FMD by feeding infected milk and milk products in order to determine the technical dimensions of this problem.
5. Finally, it is recommended that research should be continued in order to find a safe method to process infected milk, since disposal of infected milk during a large epidemic may result in drastic and adverse effects on the dairy industry and consumers of dairy products.

APPENDIX

Table 1. Milk Utilization by States, 1974

State	Milk Used on Farms Where Produced			Milk Marketed by Farms			
				Sold to Plants and Dealers		Sold	
	Fed to Calves	Used for Milk, Cream and Butter	Total	As Whole Milk	As Farm Separated Cream	Directly to Consumers	Total
	-Million Pounds-						
Ala.	7	27	34	655		21	676
Ariz.	5	1	6	750		54	804
Ark.	7	35	42	655		12	667
Calif.	84	17	101	10,110	1	389	10,500
Colo.	19	18	37	780	13	36	829
Conn.	6	6	12	580		21	601
Del.	1	2	3	128		1	129
Fla.	7	14	21	1,860		21	1,881
Ga.	5	23	28	1,160		6	1,166
Idaho	36	20	56	1,480	4	15	1,499
Ill.	26	27	53	2,530	7	6	2,543
Ind.	15	23	38	2,220	8	9	2,237
Iowa	75	79	154	3,660	120	13	3,793
Kansas	22	26	48	1,325	15	15	1,355
Ky.	32	133	165	2,190		15	2,205
La.	4	27	31	1,015		13	1,028
Maine	6	7	13	590		12	602
Md.	11	16	27	1,455		8	1,463

Table 1. Continued, Page 2

State	Milk Used on Farms Where Produced			Milk Marketed by Farms			
				Sold to Plants and Dealers			
	Fed to Calves	Used for Milk, Cream and Butter	Total	As Whole Milk	As Farm Separated Cream	Sold Directly to Consumers	Total
	-Million Pounds-						
Mass.	5	7	12	550		32	582
Mich.	47	31	78	4,470	30	10	4,510
Minn.	159	122	281	9,070	24	7	9,101
Miss.	4	33	37	865		5	870
Mo.	35	75	110	2,860	18	20	2,898
Mont.	9	16	25	248	16	5	269
Nebr.	28	30	58	1,295	116	8	1,419
Nev.	3	2	5	161	.3	.7	162
N.H.	4	5	9	316		8	324
N.J.	5	6	11	520		20	540
N.Mex.	3	7	10	308		20	328
N.Y.	142	90	232	9,505		85	9,590
N.C.	18	152	170	1,345		19	1,364
N.D.	28	26	54	910	86	5	1,001
Ohio	60	56	116	4,060	1	18	4,079
Okla.	20	29	49	1,055	17	16	1,088
Oreg.	24	9	33	920	4	47	971
Pa.	40	95	135	6,500	15	241	6,836
R.I.		1	1	61		1	62
S.C.	6	15	21	473		9	482
S.D.	24	30	54	1,385	74	5	1,464

Table 1. Continued, Page 3

State	Milk Used on Farms Where Produced			Milk Marketed by Farms			
				Sold to Plants and Dealers		Sold	
	Fed to Calves	Used for Milk, Cream and Butter	Total	As Whole Milk	As Farm Separated Cream	Directly to Consumers	Total
	-Million Pounds-						
Tenn.	50	60	110	1,770		12	1,782
Tex.	34	59	93	3,270		15	3,285
Utah	8	15	23	860		39	899
Vt.	30	17	47	1,895		8	1,903
Va.	18	39	57	1,630	6	6	1,642
Wash.	7	27	34	289	2	8	299
Wis.	374	176	550	17,799		17	17,812
Wyo.	4	5	9	110	2	2	114
U.S.	1,595	1,753	3,348	109,963	583	1,522	112,068
W.Va.	37	16	53	2,090	4	165	2,259

Source: Milk, Production, Disposition and Income, SRS, USDA, Washington, D.C., April 1975, pp. 8-9.

Table 2. States With Milk Control Programs and Percentage of Milk Regulated

State	Percentage of Milk Under Regulation[a/]
Alabama[b/]	97
California[b/]	89
Hawaii	85
Louisiana	100
Maine[b/]	90
Massachusetts	100
Mississippi	60
Montana[b/]	88
Nevada	100
New Jersey	100
New York	93
North Carolina[b/]	100
North Dakota	100
Oregon	95
Pennsylvania	95
South Carolina[b/]	100
South Dakota	98
Vermont	90
Virginia[b/]	80
Wyoming[b/]	100

[a/] These percentages were submitted by the respective states. In some cases, only a portion of the state is directly under state control since other areas have Federal Orders.

[b/] As of January 1974, these states did not have Federal Milk Marketing Orders (see Figure 5).

Source: Adapted from Richard C. Foley, et al, Dairy Cattle: Principles, Practices, Problems, Profits, Lea and Febiger, Philadelphia, 1972.

Table 3. Sources of Milk for Milk Marketing Areas Under Federal Orders: Producer Deliveries, By Marketing Area and State, 1974

Market and State	State as Percentage of Market
	- -Percent- -
APPALACHIAN (510,805)*	100.00
Va.	41.06
Tenn.	30.35
Ky.	22.66
N.C.	4.14
W.Va.	1.79
AUSTIN-WACO (139,472)	100.00
Tex-(Okla)	100.00
BLACK HILLS (62,464)	100.00
S.D.-(Wyo)	100.00
BOSTON REGIONAL (3,320,322)	100.00
Vt.	47.83
N.Y.	20.92
Mass.	10.75
N.H.	8.43
Maine	7.84
Conn.	2.43
R.I.	1.80
CEDAR RAPIDS-IOWA CITY (131,468)	100.00
Iowa	100.00
CENTRAL ARIZONA (775,572)	100.00
Ariz.	92.28
Calif.	7.21
(Tex)-(N.M.)	.51
CENTRAL ARKANSAS-FT. SMITH (353,410)	100.00
Ark.	96.94
Mo-(Okla)	1.95
Tex.	1.11
CENTRAL ILLINOIS (171,119)	100.00
Ill.	70.73
Iowa	18.02
Minn-(Wis)	11.25
CENTRAL WEST TEXAS (160,428)	100.00
Tex.	90.12
N.M.	9.88
CHATTANOOGA (365,873)	100.00
Tenn.	97.07
Ga.	2.93
CHICAGO REGIONAL (8,141,960)	100.00
Wis.	91.66
Ill.	8.02
Iowa	.21
Minn-(Mich)	.11
CONNECTICUT (1,354,399)	100.00
Conn.	36.88
N.Y.	38.40
Mass.	12.18
Vt.	11.67
N.H. (R.I.)	.87
CORPUS CHRISTI (185,355)	100.00
Tex.	100.00
DES MOINES (618,162)	100.00
Iowa	74.96
Minn.	20.63
Wis.	4.41
DULUTH-SUPERIOR (142,788)	100.00
Minn.	56.50
Wis.	43.50
EASTERN COLORADO (838,154)	100.00
Colo.	75.33
Idaho	8.09
Utah	6.90
Nebr.	3.78
Kans.	2.14
S.D.	1.24
Wyo.	1.06
Minn-(Iowa)	.96
(Oreg)-(N.D.)	.50

Table 3. Continued, Page 2

Market and State	State as Percentage of Market
	- -Percent- -
EASTERN OHIO-WESTERN PENNSYLVANIA (3,289,560)	100.00
Ohio	53.68
Pa.	37.46
N.Y.	4.02
W.Va.	2.81
Md.	1.23
Ind.	.45
Wis.	.26
Mich.	.09
EASTERN SOUTH DAKOTA (279,119)	100.00
S.D.	74.87
Minn.	18.89
Iowa-(N.D.)	6.24
GEORGIA (1,340,412)	100.00
Ga.	83.03
Ala-Ky	6.25
Tenn.	4.48
S.C.	3.16
N.C.	3.08
GREAT BASIN (578,376)	100.00
Utah	85.88
Idaho	11.18
Wyo.	2.11
Nev.	.61
(Colo)-(Oreg)	.22
INDIANA (2,010,103)	100.00
Ind.	57.58
Wis.	20.97
Ill.	7.68
Iowa	4.93
Mich.	4.47
Ohio-(Ky)	4.37
INLAND EMPIRE (253,502)	100.00
Wash.	82.61
Idaho	14.93
Mont.	2.46
KANSAS CITY (1,083,525)	100.00
Kans.	43.90
Mo.	35.68
Minn.	17.42
Nebr.	2.32
Iowa	.68
KNOXVILLE (145,551)	100.00
Tenn.	100.00
LAKE MEAD (128,856)	100.00
Nev.	55.72
Utah	44.28
LOUISVILLE-LEX.-EVANS (1,127,058)	100.00
Ky.	75.40
Ind.	23.15
Ill.	1.21
Tenn.	.24
LUBBOCK-PLAINVIEW (73,837)	100.00
Tex.	78.87
N.M.	17.60
Okla.	3.53
MEMPHIS (348,989)	100.00
Tenn.	37.82
Miss.	34.68
Ark.	16.02
Ky.	7.02
Iowa	2.33
Mo.	.88
Wis.	.82
(Okla)-(Tex)-(Kans)-(Minn)	.43
MICHIGAN UPPER PENINSULA (103,532)	100.00
Mich.	88.78
Wis.	11.22

Table 3. Continued, Page 3

Market and State	State as Percentage of Market
	- -Percent- -
MIDDLE ATLANTIC (4,650,459)	100.00
Pa.	48.04
Md.	29.81
Va.	12.38
N.Y.-N.J.	5.32
Del.	2.48
W.Va.	1.97
MINNEAPOLIS-ST. PAUL (2,833,118)	100.00
Minn.	54.98
Wis.	45.02
MINNESOTA-NORTH DAKOTA (814,398)	100.00
Minn.	78.15
N.D.	20.28
S.D.	1.57
NASHVILLE (533,135)	100.00
Tenn.	75.79
Ky-(Ala)	24.21
NEBRASKA-WESTERN IOWA (1,044,613)	100.00
Nebr.	54.91
Iowa	21.38
Minn.	12.27
S.D.	8.65
Kans-(Wyo)-(Colo)	2.79
NEOSHO VALLEY (5,586)	100.00
Kans.	54.40
(Mo)-(Nebr)	45.60
NEW ORLEANS (587,344)	100.00
La.	72.81
Miss.	27.19
NEW YORK-NEW JERSEY (9,462,251)	100.00
N.Y.	72.51
Pa.	24.22
N.J.	3.14
Md.	.10
(Vt)-(W.Va.)	.03
NORTH CENTRAL IOWA (115,117)	100.00
Iowa	93.80
Minn-(Ill)	6.20
NORTH TEXAS (1,628,899)	100.00
Tex.	84.40
Kans.	8.11
Okla.	6.77
N.M.	.66
(Ark)-(Nebr)	.06
NORTHERN LOUISIANA (241,885)	100.00
La.	90.88
Tex.	4.78
Miss.	4.34
OHIO VALLEY (2,905,923)	100.00
Ohio	64.68
Ind.	12.26
Ky.	10.29
Mich.	7.26
W.Va.	3.71
Wis.	1.21
Va.-(Iowa)	.59
OKLAHOMA METROPOLITAN (792,439)	100.00
Okla.	75.37
Kans.	13.55
Tex.	5.06
Mo.	3.49
Ark.	1.53
Nebr-(N.M.)	1.00
OREGON-WASHINGTON (1,193,207)	100.00
Oreg.	61.65
Wash.	33.93
Idaho	3.85
Calif.	.57
PADUCAH (117,144)	100.00
Ky.	67.46
Tenn.	20.36
Mo.	8.43
Ill.	3.75

Table 3. Continued, Page 4

Market and State	State as Percentage of Market
	- -Percent- -
PUGET SOUND (1,499,172)	100.00
Wash.	100.00
QUAD CITIES-DUBUQUE (412,284)	100.00
Iowa	81.32
Ill.	12.26
Wis.	3.43
Minn.	2.99
RED RIVER VALLEY (139,913)	100.00
Okla.	84.88
Tex.	15.12
RIO GRANDE VALLEY (372,670)	100.00
N.M.	66.85
Tex.	18.13
Ariz.	7.91
Colo.	6.26
(Okla)-(Utah)-(Kans)	.85
ST. LOUIS-OZARKS (1,691,251)	100.00
Mo.	63.91
Ill.	30.49
Iowa	2.47
Ark.	1.33
Wis.	.95
Minn.	.30
Okla.	.55
SAN ANTONIO (335,685)	100.00
Tex.	73.51
Kans.	25.35
Okla-(N.M.)	1.14
SOUTH TEXAS (1,019,045)	100.00
Tex.	89.31
Mo.	8.05
Okla.	1.93
Nebr.	.47
(La)-(Kans)-(Ark)-(N.M.)	.24
SOUTHEASTERN FLORIDA (731,254)	100.00
Fla.	98.23
Ga.	1.77
S.E. MINN.-N. IOWA (434,767)	100.00
Minn.	93.96
Wis.	3.59
Iowa	2.45
SOUTHERN ILLINOIS (1,019,681)	100.00
Ill.	40.00
Wis.	34.16
Minn.	14.96
Iowa	6.31
Mo.	3.87
Ind.	.70
SOUTHERN MICHIGAN (3,727,997)	100.00
Mich.	96.18
Wis.	3.03
Ind.	.62
Ohio	.17
TAMPA BAY (451,552)	100.00
Fla-(Ga)	100.00
TEXAS PANHANDLE (91,028)	100.00
Okla.	55.45
Tex.	32.44
N.M.-(Kans)	12.11
UPPER FLORIDA (638,059)	100.00
Fla.	97.06
Ga.	2.94
WESTERN COLORADO (48,567)	100.00
Colo.	100.00
WICHITA (242,150)	100.00
Kans.	94.68
Nebr.	5.32

*Numbers in parentheses represent total producer deliveries in thousand pounds of milk.

Source: Sources of milk for Federal Order Markets by State and County Agricultural Marketing Service, U.S. Department of Agriculture, AMS-565, Washington, D.C., 1976, pp. 10-11.