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THE FEASIBILITY OF A SUN-CURED ALFALFA HAY PELLETING PLANT in Southeast Central North Dakota

RESEARCH-EXTENSION RURAL DEVELOPMENT PROJECT REPORT

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FOREWORD

This report is one of a series being conducted under a special Research and Extension Rural Development Project at North Dakota State University as authorized by Title V of the Rural Development Act of 1972. The study was initiated and partial funding was provided through an Economic Development Administration Grant (Grant Project Number 05-6-01402).

The authors wish to extend their appreciation to the industry personnel who provided information for this publication, especially Mr. Roy Weigel of Weigel and Stapf Construction, Inc. and Mr. Robert Massengill of the California Pellet Mill Company. The authors gratefully acknowledge the valuable assistance and suggestions received from the Research and Extension personnel in the Agricultural Economics and Animal Science departments and the Cooperative Extension Service.

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THE FEASIBILITY OF A SUN-CURED ALFALFA HAY PELLETING PLANT IN SOUTHEAST CENTRAL NORTH DAKOTA

by

Gary Bedker and Eddie Dunn[1]

INTRODUCTION

The advent of irrigation, coupled with recent variations in commodity prices, will alter the cropping patterns and the level of production of specific crops in the irrigable areas of North Dakota.

Because forage crops respond very favorably to irrigation, increases in production of forages and livestock numbers are expected as irrigation in North Dakota becomes more extensive.

Scope

The factors affecting the feasible operation of a sun-cured alfalfa hay pelleting plant in North Dakota will be analyzed in this study. The scope of this study is limited to State Planning Region VI, a nine-county area in South Central North Dakota, as directed by the Multi-County Concentrated Impact Project and the Research-Extension Rural Development Project, from which funds for conducting the study were provided. The Multi-County and the Rural Development projects specify that the assistance is to be provided within the specified demonstration region (See Figure 1).[2]

This study was initiated in response to a request to the Dickey and LaMoure County extension agents by producers located in the proposed irrigation area within State Planning Region VI (Figure 2). The major emphasis of this investigation will be directed at determining the feasibility of a sun-cured alfalfa hay pelleting plant and the acreage needed to produce the required alfalfa hay supply for the plant. A sun-

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[1]Bedker is a research associate and Dunn is the program coordinator of the Research-Extension Rural Development Project, Agricultural Economics Department, and Extension Agricultural Economics, North Dakota State University, Fargo, North Dakota.

[2]The Multi-County Concentrated Impact Project is a pilot project conducted cooperatively by the Economic Development Administration (EDA), U.S. Department of Commerce and North Dakota State University. The project is administered through the Center for Economic Development at North Dakota State University. The Rural Development Project is a special project being conducted in State Planning Region VI through the research and extension capabilities at North Dakota State University, as authorized under Title V of the Rural Development Act of 1972.

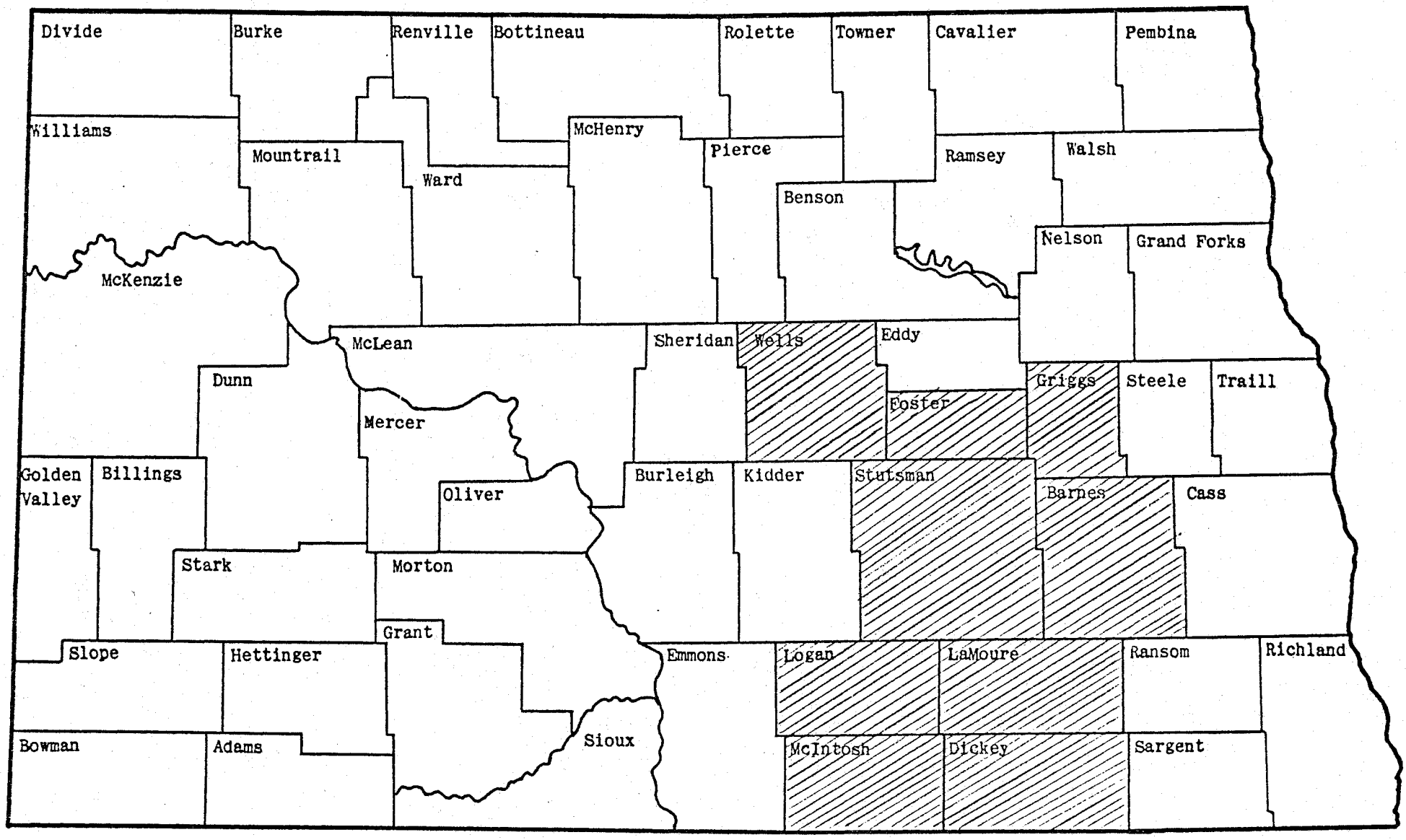
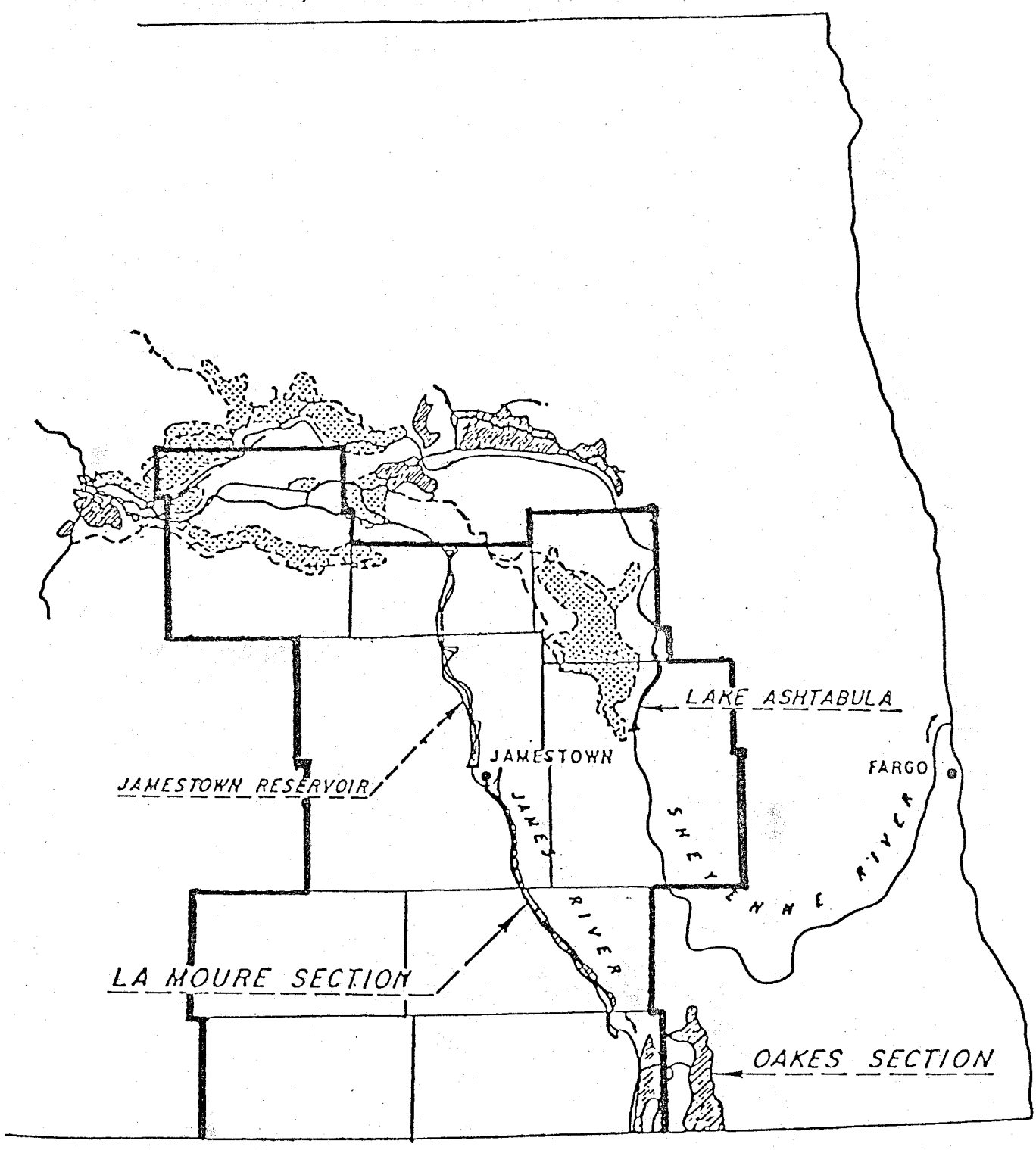


FIGURE 1. COUNTIES INCLUDED IN THE STUDY AREA; NORTH DAKOTA STATE PLANNING REGION VI.

Study Area

FIGURE 2. PROPOSED IRRIGATION UNDER THE GARRISON DIVERSION PROJECT WITHIN STATE PLANNING REGION VI, NORTH DAKOTA.



LEGEND

Canal Initial Stage Development
Canal Second Stage Development
Initial Stage Development (250,000 ac.)
Second Stage Development (750,000 ac.)

Source: North Dakota State Water Commission, Bismarck, North Dakota.

cured alfalfa hay pelleting plant was selected for examination primarily because it may be operated the entire year, whereas a plant processing dehydrated pellets is limited to operating primarily during the hay harvesting season.

The information presented in this study is intended to provide a broad overview of the feasibility of a sun-cured alfalfa hay pelleting enterprise. The objectives of the study are:

1. Determine the most desirable location for a sun-cured alfalfa pelleting plant within State Planning Region VI of North Dakota.
2. Determine the minimum alfalfa acreage required to supply the needed quantity of alfalfa hay for an economically sized pelleting plant.
3. Determine if the establishment and operation of a sun-cured alfalfa hay pelleting plant is feasible in State Planning Region VI.

Procedure

Several criteria were used in determining the most desirable geographic area for the location of a sun-cured alfalfa hay pelleting plant. Counties within North Dakota with a high concentration of hay production were identified. Hay production was then compared to cattle numbers within these counties to determine the level of hay utilization in relation to total production within each county. Consideration was also given to the proposed irrigation development areas in identifying the area where alfalfa hay production is expected to increase and to determine the most favorable location for establishing a pelleting plant.

The minimum acreage required to support a selected size sun-cured alfalfa hay pelleting plant was determined. The acreage requirements were based upon the average yields per acre for both irrigated and dryland acreage within the geographic area under consideration.

The plant size selected for analysis was determined from a review of previous research and from the recommendations of industry personnel. A seven-ton-per-hour capacity plant was identified as the smallest plant that would allow major economies of size to be achieved, and is the plant size analyzed for feasibility in this analysis. The quantity of alfalfa hay that will be available for pelleting is unknown, due to changes in cropping patterns as water for irrigation becomes available, so two levels of plant utilization (single shift and double shift) were selected for analyzing the feasibility of the plant.

Research involving several departments at North Dakota State University is being conducted to project the level of alfalfa production within State Planning Region VI due to irrigation development.[3]

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[3]Research is being conducted by the Marketing Irrigation Production Interdisciplinary Research Team, North Dakota State University, Fargo, North Dakota, Donald Anderson, project coordinator.

Potential feasibility of the sun-cured alfalfa hay pelleting plant is determined through break-even analysis. Annual cost figures were based upon 1974 estimated construction, hay, labor, transportation and marketing costs for the plant. Cost estimates were obtained from the limited number of previous studies conducted and from personal interviews with researchers and industry personnel.

During the recent price period (1972-1974), considerable fluctuations have occurred in prices of hay and alfalfa pellets. Because of these fluctuations, break-even prices are computed for alfalfa pellets according to alternative prices paid for alfalfa hay to determine the profitability of marketing sun-cured alfalfa pellets.

THE ALFALFA PELLET MARKET

The processed alfalfa industry including sun-cured and dehydrated alfalfa pellets, has an established national market. The volume of processed alfalfa meal used for feed in the United States is presented in Table 1.

TABLE 1. TONS OF PROCESSED ALFALFA MEAL FED IN THE UNITED STATES, 1966-1974.

Year	Estimated Used for Feed (1,000 tons)
1966	1,599
1967	1,550
1968	1,662
1969	1,545
1970	1,584
1971	1,568
1972	1,799
1973	1,550
1974	1,650

Source: Feed Situation, Economic Research Service, United States Department of Agriculture, Washington, D.C., November, 1974.

Information regarding the sun-cured alfalfa pellet industry is relatively limited when compared to information available for the dehydrated alfalfa pellet industry. The American Dehydrators Association, which includes processors of dehydrated alfalfa pellets, provides production and market information to members. The sun-cured alfalfa industry does not have a similar organization to provide market information to the processors.

Sun-cured alfalfa pellets and dehydrated alfalfa pellets appear to be marketed in much the same way. The majority of the alfalfa pellets processed are sold through jobbers, speculators, brokers, or feed distributors. Ultimately, a large portion of the processed pellets are used in the dairy and cattle feedlot industries.

An increasing quantity of roughage is being consumed by livestock in the United States. The figures in Table 2 indicate a significant increase in roughage-consuming livestock since 1970.

TABLE 2. ANIMAL UNITS OF LIVESTOCK FED ANNUALLY, 1952-1973, 48 STATES.[a]

Year Beginning Oct. 1	Roughage-Consuming Animal Units (1,000 units)
1952	84,483
1953	85,448
1954	85,928
1955	85,158
1956	82,259
1957	80,955
1958	82,549
1959	84,096
1960	84,540
1961	85,990
1962	87,974
1963	89,764
1964	89,815
1965	88,892
1966	88,202
1967	88,122
1968	87,532
1969	87,964
1970	89,875
1971	90,523
1972[b]	92,577
1973[c]	97,084

a. Data not available for Alaska and Hawaii.
b. Preliminary.
c. Based on February 1974 indications.

Source: Livestock-Feed Relationships, National and State, Statistical Bulletin No. 530, Economic Research Service, U.S. Department of Agriculture, Washington, D.C., June, 1974.

Indications are that the amount of roughage fed to beef cattle will increase. The world food shortage and increasing competition for cereal grains is expected to have the effect of encouraging cattlemen to use more forages. Consequently, an expanding market is expected for the alfalfa pellet industry.

Currently, over half (68.3%) of the United States sun-cured alfalfa hay pellets are produced in the western states of Washington and California (Table 3). Iowa, Minnesota, Wisconsin, North Dakota, and South Dakota combined account for approximately 6 percent of the total U.S. production.

TABLE 3. TOTAL AND PERCENT OF U.S. SUN-CURED ALFALFA PELLET PRODUCTION BY STATE GROUPING, 1973 AND 1974.

State Grouping	1973 Production	Percent of Total U.S. Production	1974 Production[a]	Percent of Total U.S. Production
	(1,000 ton)		(1,000 ton)	
Nebraska	49.8	9.0	27.8	8.6
Kansas	35.4	6.4	24.7	7.6
California & Wash.	396.1	71.6	221.0	68.3
Colorado, Utah, Mont. & Idaho	19.6	3.5	17.2	5.3
Iowa, Minnesota, Wis., No. & So. Dakota	31.2	5.6	19.5	6.0
Texas, Oklahoma, New Mex.	6.3	1.1	2.2	.7
Maryland, Pennsylvania, Ohio, & Michigan	15.1	2.7	11.0	3.4
TOTAL	553.5	100.0%[b]	323.4	100.0%[b]

a. Includes production through the month of September 1974.
b. Totals may not add to 100% due to rounding

Source: Feed Market News, Weekly Summary and Statistics, Grain Division, Agricultural Marketing Service, United States Department of Agriculture, Independence, Missouri, 1973-1974.

The dairy and cattle feedlot industries provide the major outlet for sun-cured alfalfa pellets. Through feeding pellets, the labor intensive feedlot and dairy industries are provided with a roughage source which presents relatively low labor requirements compared to feeding bulk hay. The demand for pellets in the dairy and cattle feedlot industries within North Dakota has apparently decreased with the decline in the number of milk cows and cattle on feed (Table 4).

TABLE 4. MILK COWS AND CATTLE ON FEED IN NORTH DAKOTA, 1955-1973.

Year	Milk Cows	Cattle on Feed[a]	% of Cattle on Feed[b]
	(1,000)	(1,000)	
1955	410	76	18
1956	406	110	22
1957	378	103	21
1958	348	98	21
1959	324	114	24
1960	305	121	24
1961	296	140	29
1962	296	100	21
1963	287	115	24
1964	276	128	25
1965	262	136	20
1966	231	118	17
1967	206	101	14
1968	183	80	11
1969	168	72	10
1970[c]	145	63	9
1971	133	45	6
1972	130	52	7
1973	129	47	6

a. Cattle on feed are animals being fattened for slaughter market on grain or other concentrates and are expected to produce a carcass that will grade good or better.

b. The percent of cattle on feed is based upon the number of feeders produced in the previous year compared to the number on feed on January 1.

c. The definition for the number of milk cows changed in 1970 from milk cows and heifers 2 years old and over kept for milk to those that have calved.

Source: North Dakota Crop and Livestock Statistics, Statistical Reporting Service, United States Department of Agriculture in cooperation with the Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota. May 1966-May 1974.

North Dakota Livestock, County Estimates 1925-1961, Agricultural Statistics No. 7, Statistical Reporting Service, United States Department of Agriculture in cooperation with the Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, January, 1962.

Pelleting also transforms alfalfa into a form which is more economical to transport from areas of surplus hay production to areas where there is a deficit of feed. The opportunity may exist for marketing alfalfa production, in the form of pellets, to states with increasing numbers of dairy and slaughter cattle.

Nebraska, Iowa, Texas, California, Kansas and Colorado are ranked as the six leading states in the number of commercially slaughtered cattle (See Table 5). Wisconsin, New York, Minnesota, California, and Pennsylvania lead the United States in the number of milk cows on farms (Table 6).

TABLE 5. NUMBER OF COMMERCIAL CATTLE SLAUGHTERED BY STATE, 1973.[a]

State[b]	Number of Head (1,000)	State[b]	Number of Head (1,000)
Nebraska	4,307.0	Georgia	280.4
Iowa	4,284.0	Oregon	277.1
Texas	3,471.0	Utah	239.1
California	2,670.0	Montana	188.5
Kansas	2,499.0	Kentucky	187.5
Colorado	2,268.0	North Dakota	172.4
Minnesota	1,242.0	Arkansas	165.5
Illinois	1,234.5	Louisiana	164.0
Wisconsin	1,200.0	Alabama	140.6
Ohio	918.5	New Jersey	138.9
Missouri	820.0	North Carolina	126.7
Pennsylvania	701.0	New England	121.5
Oklahoma	631.5	Virginia	107.3
Michigan	582.0	Delaware & Maryland	88.9
South Dakota	559.0	South Carolina	69.8
Arizona	507.0	West Virginia	51.3
Washington	494.5	Nevada	27.0
Tennessee	455.5	Wyoming	20.3
Idaho	452.0		
Indiana	418.0	48 States	33,626.0
New Mexico	376.5		
Florida	355.5	Hawaii	60.8
Mississippi	308.7		
New York	304.0	United States	33,686.8

a. Includes slaughter in federally inspected and in other slaughter plants, but excludes animals slaughtered on farms.

b. New England includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut; commercial slaughter not estimated in Alaska.

Source: Livestock Slaughter, Annual Summary 1973, Crop Reporting Board, Statistical Reporting Service, United States Department of Agriculture, Washington, D.C., April 1974.

TABLE 6. NUMBER OF MILK COWS ON FARMS, BY STATE, IN FEBRUARY, 1975.[a]

State	Milk Cows on Farms (1,000)	State	Milk Cows on Farms (1,000)
Wisconsin	1,808	Nebraska	155
New York	920	North Carolina	153
Minnesota	883	Idaho	149
California	803	Kansas	145
Pennsylvania	689	Maryland	138
Michigan	418	Lousiana	134
Iowa	404	Georgia	129
Ohio	404	Mississippi	126
Texas	350	North Dakota	122
Missouri	309	Oklahoma	122
Kentucky	291	Alabama	92
Illinois	257	Arkansas	91
Indiana	216	Oregon	91
Tennessee	216	Utah	77
Florida	199	Colorado	75
Vermont	192		
Washington	181	Other 16 States[b]	535
South Dakota	159		
Virginia	159	United States	11,192

a. Includes dry cows. Excludes heifers that have not yet calved.

b. Includes states for which individual monthly estimates are not available.

Source: Milk Production, February 1975, Crop Reporting Board, Statistical Reporting Service, United States Department of Agriculture, Washington, D.C., March, 1975.

Potential markets for pellets shipped from North Dakota are, to a large extent, determined by the distance to the potential market areas and the per-mile freight rate. Transportation cost is a major factor in determining the feasibility of marketing North Dakota sun-cured alfalfa pellets.

A review of previous studies and interviews with industry personnel reveal that the alfalfa pelleting industry is very price competitive and that pelleting firms normally operate on a relatively low profit margin. The price competitiveness of the industry combined with the relative importance of transportation have the influence of largely restricting plants to serving the general areas in which the plants have a comparative locational advantage.

Foreign countries provide a market for a large portion of the United States production of sun-cured alfalfa pellets. In 1974 approximately 44 percent of the total United States production was exported to foreign markets (Table 7).

TABLE 7. TOTAL AND PERCENT OF U.S. SUN-CURED ALFALFA PELLETS EXPORTED IN 1973 AND 1974.

Year	Exported Tons	Percent U.S. Production
1973	187,811	33.9%
1974[a]	143,333	44.3%

a. Export and percentage figures are based on data collected through September 1974 and do not reflect the entire 1974 calendar year.

Source: Feed Market News, Weekly Summary and Statistics, Grain Division Agricultural Marketing Service, United States Department of Agriculture, Independence, Missouri, 1973-1974.

West Coast pelleting firms have exported most of the alfalfa pellets exported from the United States. Transportation costs have tended to minimize competition from the Midwest for foreign markets.

The foreign market for United States sun-cured alfalfa hay pellets has virtually been one country; Japan. Other countries which import limited quantities of sun-cured alfalfa hay pellets include the Philippines, Taiwan, Canada and Mexico. The markets of Japan, Taiwan, Canada, and the Philippines are served almost exclusively from three exporting cities; San Francisco, Los Angeles, and Seattle. San Francisco is the largest outlet for sun-cured alfalfa hay pellets from the United States.

There appears to be no well established market for exported sun-cured alfalfa pellets to Canada. These pellets are normally exported in small quantities and on an infrequent basis. Exports to Canada in 1973 and 1974 have been limited to a few hundred ton which were channeled through the ports at Detroit and Seattle.

Summary of Alfalfa Pellet Market

It appears that the demand for roughage in the foreseeable future will remain relatively strong, with the expected trend of additional forage being fed to slaughter cattle.

The most promising market for sun-cured alfalfa hay pellets produced in a North Dakota based plant appears to be at the domestic level. The potential for competing in any of the domestic markets will depend, to a large extent, upon the cost of transporting the pellets to final demand areas.

THE ALFALFA SUPPLY

The availability of an adequate supply of alfalfa hay is crucial to the efficient operation of a sun-cured alfalfa hay pelleting plant.

Analysis of the availability of alfalfa hay acreage in State Planning Region VI is based upon five-year average county acreage figures (1969-1973) which are presented in Table 8. There appears to be no significant trend in the harvested acreage of alfalfa hay during the years 1969-1973 for individual counties or the region as a whole. This indicates that the alfalfa acreage is a relatively stable enterprise on farms in Region VI.

The production of alfalfa hay, as opposed to acreage, does fluctuate yearly depending upon weather conditions. This is illustrated by the figures in Table 8 and 9 which indicate that the acreage harvested in 1973 increased by approximately 4 percent over 1972, but production was about 36 percent less in 1973 compared to 1972. Therefore, a five year average of alfalfa hay production was used to determine the hay production which normally occurs in the counties.

A comparison of roughage utilization by livestock and the total quantity of alfalfa hay produced was made to determine the annual roughage carry-over, and the amount of alfalfa hay that could potentially be available for pelleting. In the analysis, it is assumed that the roughage produced in each county supplies the roughage requirements for livestock raised within the county. Any surplus roughage production, beyond local livestock feeding requirements, is considered to be potentially available for sale, including utilization by a pelleting plant.

Three roughage deficit counties were identified from this analysis; Barnes, LaMoure, and Wells. The remaining six counties in the region produce roughage, on the average, in excess of the amount required for livestock feeding. Based upon this analysis and a random survey of custom hay haulers, it is estimated that an average of approximately 12,000 tons of alfalfa is exported from the region annually.

Roughage production in Region VI tends to be closely correlated to that amount required to feed livestock in the area (Table 10). It is assumed that hay is generally not produced as a cash crop with the intention of selling the hay to other livestock feeders in the region, or for exporting out of the region.

TABLE 8. ANNUAL ACREAGE HARVESTED IN STATE PLANNING REGION VI BY COUNTY, 1969-1973.

County	1969	1970	1971	1972	1973	5-year Average
Barnes	28,000	29,000	29,000	29,000	33,000	29,600
Dickey	51,000	50,000	51,000	55,000	56,000	52,600
Foster	19,000	20,000	21,000	20,000	22,000	20,400
Griggs	15,000	17,000	19,000	19,000	24,000	18,800
LaMoure	39,000	37,000	37,000	37,000	37,000	37,400
Logan	32,000	36,000	36,000	37,000	41,000	36,400
McIntosh	35,000	39,000	39,000	39,000	39,000	38,200
Stutsman	70,000	72,000	80,000	75,000	73,000	74,000
Wells	14,000	16,000	14,000	14,000	12,000	14,000
REGION VI	303,000	316,000	326,000	325,000	337,000	321,400

Source: North Dakota Crop and Livestock Statistics, Statistical Reporting Service, United States Department of Agriculture in cooperation with the Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota. May 1971-1974.

TABLE 9. TONS OF ALFALFA HAY PRODUCED IN STATE PLANNING REGION VI, BY COUNTY, 1969-1973

County	1969	1970	1971	1972	1973	5-Year Average
Barnes	44,800	58,000	66,700	60,900	52,800	56,640
Dickey	91,800	80,000	91,800	126,500	50,400	88,100
Foster	26,600	28,000	33,600	34,000	19,800	28,400
Griggs	21,000	27,200	38,000	32,300	36,000	30,900
LaMoure	70,200	62,900	74,000	74,000	48,100	65,840
Logan	54,400	57,600	64,800	55,500	45,100	55,480
McIntosh	70,000	66,300	85,800	74,100	46,800	68,600
Stutsman	108,500	100,800	144,000	120,000	65,700	107,800
Wells	21,000	28,800	26,600	23,800	18,000	23,640
REGION VI	508,300	509,600	625,300	601,100	382,700	525,400

Source: North Dakota Crop and Livestock Statistics, Statistical Reporting Service, United States Department of Agriculture in cooperation with the Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, May 1971-1974.

TABLE 10. AVERAGE ALFALFA AND ROUGHAGE PRODUCTION AND AVERAGE NUMBER OF CATTLE AND SHEEP IN STATE PLANNING REGION VI, BY COUNTY, 1969-1973.

County	Average Alfalfa Production	Average Roughage Production	Average Number of Livestock	
			Cattle	Sheep
	--Tons--	--Tons--	--Head--	--Head--
Barnes	56,640	104,954	51,000	5,219
Dickey	88,100	152,933	63,000	15,536
Foster	28,400	64,550	25,000	6,961
Griggs	30,900	59,976	23,000	5,287
LaMoure	65,840	122,024	55,000	12,466
Logan	55,480	130,233	52,000	4,298
McIntosh	68,600	132,748	51,000	2,144
Stutsman	107,800	200,174	84,000	21,937
Wells	23,640	76,032	38,000	7,641
REGION VI	525,400	1,043,624	442,000	81,489

Source: North Dakota Crop and Livestock Statistics, Statistical Reporting Service, United States Department of Agriculture in cooperation with the Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota. May 1971-1975.

Maintaining an adequate supply of alfalfa for a sun-cured alfalfa pelleting plant would hinge on the competitiveness of alfalfa hay with other crops grown in the region. The presence of a pelleting plant would increase the demand and the price for alfalfa hay. The relative profitability of alfalfa in relation to alternative crops will ultimately influence the supply of alfalfa hay produced in the region.

PLANT LOCATION AND SIZE

A high concentration of hay production is vital to the economic feasibility of operating a sun-cured alfalfa hay pelleting plant. Consideration must be given to the cost of transporting the hay to the plant site. In a previous study,[4] it was suggested that a 50-mile radius is normally the farthest distance from which a plant could economically draw hay for pelleting. Obviously, the closer the alfalfa production is to the plant, the lower the input cost will be for hay when transportation costs are assumed by the plant.

Presently the concentration of alfalfa production is the highest in the four southern-most counties in the Region (Figure 3). Dickey county has the highest concentration, with an average of 81 tons per square mile.

Dickey County appears to have a comparative advantage over other counties within the Region for location of a sun-cured alfalfa pelleting plant because of the high concentration of alfalfa produced in the county and the large year-to-year carry-over of alfalfa. In addition, the irrigation potential resulting from the Garrison Diversion Project in the two southeastern counties of the region, LaMoure and Dickey, is expected to have a considerable positive impact on the concentration of alfalfa production.

The Oakes and LaMoure irrigation districts are scheduled to be the first areas receiving irrigation water from the Garrison Diversion Project. Irrigation water is expected to be available to this area by 1980. The Oakes and LaMoure irrigation districts encompass approximately 59,330 acres in Stutsman, LaMoure, Dickey and Sargent counties. Irrigation of this acreage is expected to result in additional forage production which, in turn, will further improve the potential for a pelleting plant in the southern portion of State Planning Region VI. The community of Oakes lies in the approximate geographic center of the area affected by the two irrigation districts. Therefore, the Oakes community is the location selected for analyzing the feasibility of a sun-cured alfalfa pelleting plant.

The cost analysis presented in this report is based on a pelleting plant operating at two alternative production levels. The production levels considered were 12,600 tons and 25,200 tons of sun-cured alfalfa hay pellets per year.

The plant operating at the 12,600 ton production level per year is based on the operation of the plant eight hours per day, five days per week. This operation level is presumed to be the minimum operating time necessary to economically justify initial construction expenditures.

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[4]Vangsness, Elmer, "Sun-Cured Alfalfa Hay Pelleting Plant", Unpublished paper, Cooperative Extension Service, North Dakota State University, Fargo, North Dakota, November, 1972.

Obtaining the 25,200 ton production level per year is achieved by operating two eight-hour shifts per day, five days per week. Operating the plant for two eight-hour shifts per day allows the per unit costs to be lowered through the spreading of fixed investment costs over a larger number of tons of pellets being produced.

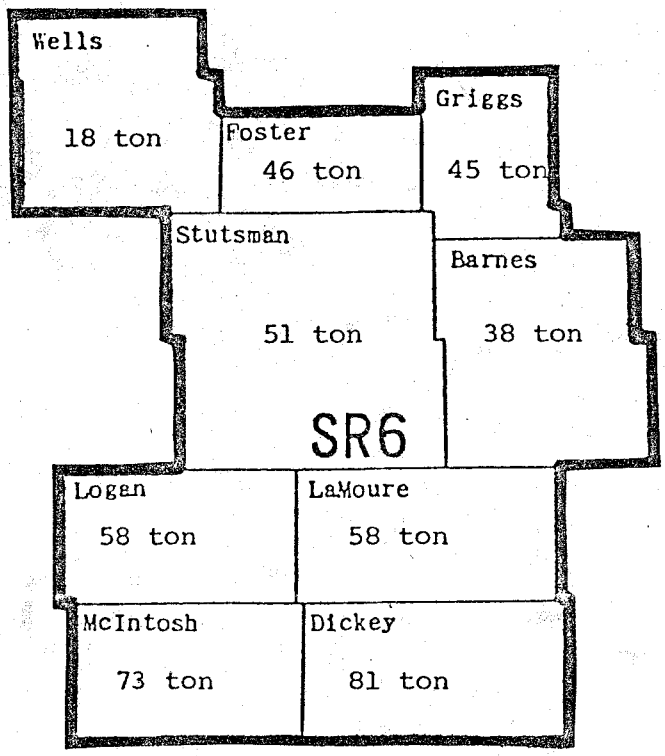
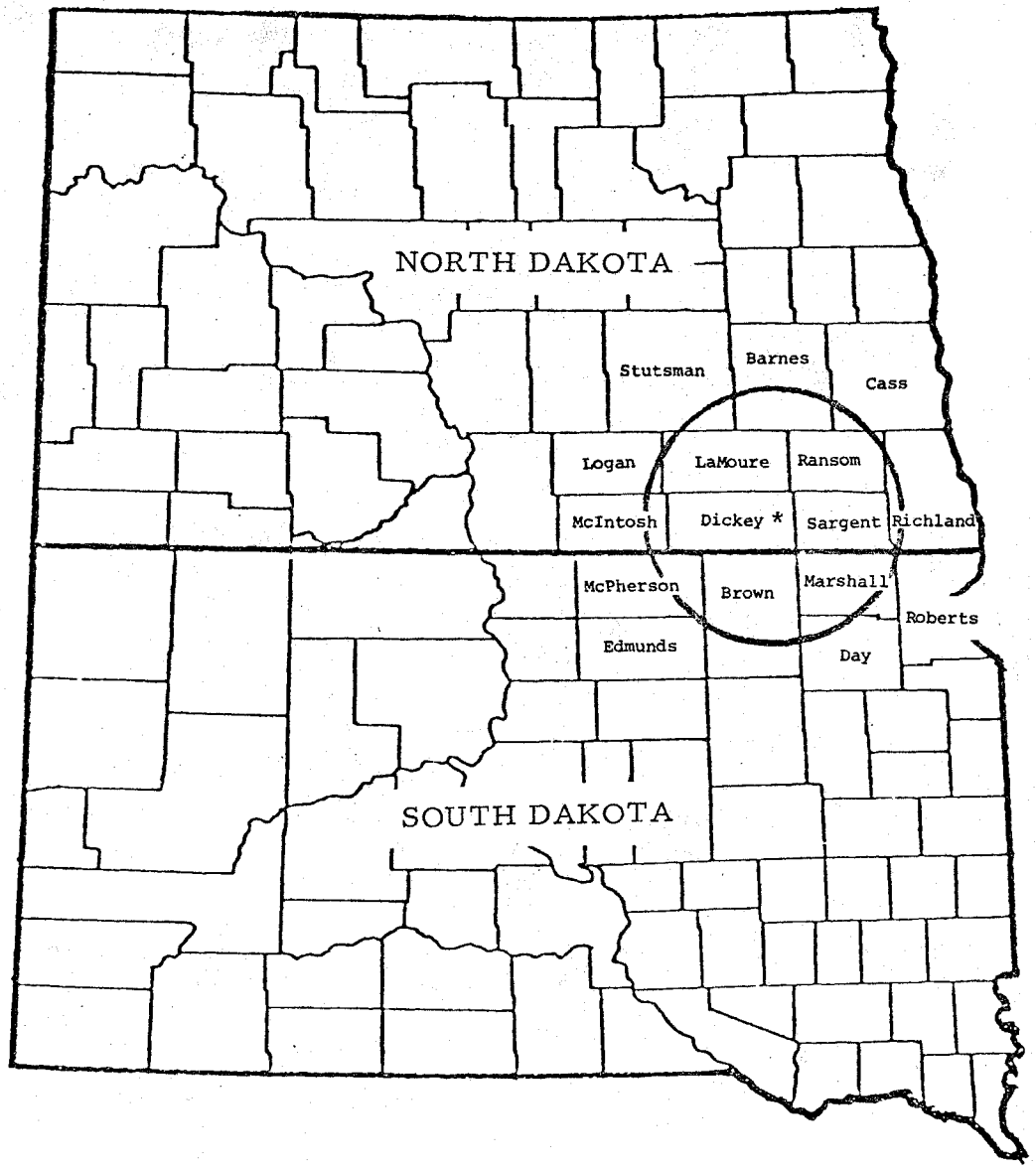


Figure 3. Concentration of Alfalfa Hay Production Expressed as Tons Produced Per Square Mile of Farmland, By County, State Planning Region VI, 1969-1973.

ACREAGE REQUIREMENTS

The acreage required to support a plant at a production level of seven tons per hour depends upon the yield of the irrigated and dryland acreage. Because of transportation costs, it is assumed in this study that production will need to take place within approximately 50 miles of the plant site. The counties within a 50-mile radius of a plant located in the Oakes area would include all of Dickey and Sargent counties, the majority of LaMoure and Ransom counties and a major portion of two South Dakota counties; Marshall and Brown (See Figure 4).



*Indicates location of Oakes, North Dakota.

Figure 4. Counties Within a Fifty Mile Radius of Oakes, North Dakota.

Also included within the 50-mile area surrounding Oakes are portions of Stutsman, Barnes, Cass, Logan, McIntosh and Richland counties in North Dakota and Roberts, Day, McPherson and Edmunds counties in South Dakota. Virtually all of the Oakes and LaMoure irrigation districts is included within a 50-mile radius of the city of Oakes.

Alfalfa hay production data for counties which comprise the majority of the area included in the 50-mile radius were obtained for the years 1969-1973, and an average yield per acre for each county was calculated. It is expected that the five-year average yield for each county would reflect a reliable estimate of the alfalfa production expected for each county. The five-year average yield per acre for the counties primarily encompassed within the 50-mile area appear in Table 11. Township alfalfa hay production figures were not available for computation of alfalfa hay yields for the portions of the additional counties included within this area. To arrive at an estimated yield per acre for these portions of land, average yields for the principle counties included within the 50-mile radius were used. The estimated acreage and tons for these counties are included as "all others" in Table 11.

TABLE 11. AVERAGE ALFALFA HAY YIELD, 1973 ALFALFA ACREAGE, AND ESTIMATED LONG-RANGE ALFALFA HAY PRODUCTION BY SELECTED COUNTIES.

County	5-Year Average Yield (Tons)	Estimated 1973 Alfalfa Acreage	Estimated Long-Range Production (Tons)
Dickey	1.67	56,000	93,520
LaMoure	1.76	37,000	65,120
Ransom	1.83	38,000	69,540
Sargent	2.06	29,000	59,740
Brown	1.74	103,000	179,220
Marshall	1.70	36,000	61,200
All Others	1.77	56,988	100,869
TOTAL AREA	1.77	355,988	629,209

Source: North Dakota Crop and Livestock Statistics, Statistical Reporting Service, United States Department of Agriculture in cooperation with the Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, May 1971-1974.

South Dakota Agriculture 1973, Crop and Livestock Reporting Service, South Dakota Department of Agriculture in cooperation with the Statistical Reporting Service, United States Department of Agriculture, May 1974.

Production figures for 1973 do not represent the production intentions of farmers because of the general drought situation which existed in the area during the 1973 crop year. Estimates of the tonnage of alfalfa that would have been produced under normal weather conditions, based upon the number of acres in alfalfa in 1973, are presented in Table 11. An estimated 629,209 tons of alfalfa hay was intended for production (based upon the 1973 alfalfa acreage and five-year average yields) within an area fifty miles around Oakes. A plant producing 12,600 tons of sun-cured alfalfa hay pellets would require approximately 2 percent of the total alfalfa hay production in the area.

It appears that there is a surplus of alfalfa hay presently produced in the area. Based upon the number of livestock and the roughage production and from the survey of hay haulers, it is estimated that there is an excess of approximately 23,000 tons of alfalfa hay produced in the area. A plant operating at a level of 12,600 tons per year would require approximately 60% of the excess alfalfa hay produced annually. This excess hay production is apparently being marketed, so a pelleting plant would face competition from existing markets for alfalfa hay.

The dryland acreage requirements for a plant operating at a 12,600 ton annual operating level is 7,830 acres. The plant operating at the 25,200 ton level would require 15,661 dryland acres. If irrigated acreage were available, an estimated 2,772 acres of irrigated alfalfa would be required to operate the plant at the 12,600 tons per year level. A total of 5,544 irrigated acres would be required to produce 25,200 tons of pellets per year. The dryland requirement is based on an annual hay yield of 1.77 tons per acre harvested. A 5 ton per acre yield is estimated for irrigated acreage.

Irrigation water from the Garrison Diversion Project is expected to reach the counties of Stutsman, LaMoure, Dickey, and Sargent and a small portion of Ransom county in 1980. The potentially irrigable land is estimated to be 2,856 acres for Stutsman County, 9,980 for LaMoure County, 20,195 for Dickey County, and 26,320 acres combined for Sargent and Ransom counties. Assuming that the alfalfa acreage is equally distributed within each of these counties and that no change occurs in the cropping patterns from 1973, a total of 3,710 acres of land now in alfalfa hay production would be affected by the Garrison irrigation project.

Increased production from irrigating these 3,710 acres would result in an increase of 11,787 tons of alfalfa hay. An additional 1,171 dryland acres, or 415 irrigable acres, would be required to increase production sufficiently in the area to supply a plant producing 12,600 tons per year. About 9,000 additional dryland acres or an additional 3,187 irrigable acres would have to be committed, along with the increased production of 11,787 tons due to irrigation, to provide an adequate amount of hay for a plant producing 25,200 tons of pellets per year.

Summary of Acreage Requirements

The acreage requirements for production of an adequate hay supply for a plant producing 12,600 tons of sun-cured alfalfa pellets per year is 7,830 acres or 2.2 percent of the alfalfa acreage harvested in 1973 within the 50-mile radius of Oakes. The irrigated acreage requirements would be 2,772 irrigable acres which is equivalent to 4.7 percent of the 59,330 acres projected to be irrigated in the Oakes and LaMoure irrigation districts. The plant operating at a 25,200 ton annual capacity would require 15,661 dryland acres, or about 4.4 percent of the alfalfa acres harvested in the area in 1973. Production of an adequate hay supply would require 5,544 irrigable acres to be entirely committed to the production of alfalfa hay for the plant.

MARKET PRICES FOR ALFALFA HAY AND PELLETS

During the past few years there has been considerable fluctuation in the prices farmers received for baled alfalfa hay. Prices received for alfalfa, as illustrated in Table 12, have increased from $16.50 in June 1971 to a high of $47.50 per ton in November of 1974. The 1974 price level is not a result of a constant and persistant increase in prices over time, but a result of price increases which began rising sharply during the 1973 crop season. This is reflected by the yearly average prices of alfalfa hay. Alfalfa hay prices rose less than $2.00 per ton from 1971 to 1972, but increased by $6.79 per ton in 1973 and $16.71 per ton in 1974.

Similarly, the wholesale price level of alfalfa pellets has changed dramatically in accordance with the rise in alfalfa hay prices in the 1973 crop year (Table 13). The $24.33 increase in the yearly average price in 1973 compared to an increase of only $1.86 from 1971 to 1972 illustrates the tremendous change in pellet prices which occurred from 1972 through 1973. Figure 5 illustrates the large increase and fluctuation in alfalfa hay and sun-cured alfalfa pellet prices that have occurred since 1972.

The relatively rapid increase in agricultural prices which began in 1973 has magnified the problem of determining the feasibility of a sun-cured alfalfa pelleting plant through the use of long-term price trends or average price levels of alfalfa hay and pellets. Therefore, the cost and returns based upon recent price and cost levels were used rather than historical prices to estimate the potential income from a pelleting plant.

TABLE 12. MIDMONTH BALED ALFALFA HAY PRICES RECEIVED BY FARMERS, NORTH DAKOTA, 1971-1974.

Month	1971	1972	1973	1974
January	18.00	20.50	20.50	37.00
February	19.50	19.50	19.50	41.00
March	18.00	19.50	20.50	46.00
April	18.00	19.50	19.50	46.00
May	17.50	18.50	21.00	46.50
June	16.50	20.00	24.50	42.00
July	17.00	19.50	24.50	39.50
August	17.50	19.00	32.00	41.50
September	17.50	19.00	32.00	41.50
October	18.00	19.00	32.00	42.50
November	18.00	19.00	33.50	47.50
December	18.00	21.00	36.00	45.00
YEARLY AVERAGE	17.79	19.50	26.29	43.00

Source: Agricultural Prices Annual Summary, 1971, 1972, 1973, Agricultural Prices, March 15, 1974 - January 15, 1975, Crop Reporting Board, Statistical Reporting Service, Washington, D.C.

TABLE 13. MONTHLY WHOLESALE PRICE PER TON FOR 13% PROTEIN SUN-CURED ALFALFA MEAL AT KANSAS CITY, 1971-1974.[a]

	1971	1972	1973	1974
January	44.90	45.50	64.00	88.00
February	43.90	45.70	70.00	83.50
March	44.65	45.70	67.25	79.00
April	44.97	44.80	60.00	70.20
May	45.20	44.20	60.25	68.00
June	47.00	44.20	60.00	66.50
July	46.00	45.40	63.60	66.25
August	46.00	44.40	71.50	85.67
September	46.00	46.45	76.25	82.20
October	43.43	47.80	86.20	84.00
November	45.50	52.45	88.00	81.00
December	45.50	58.70	88.00	78.50
YEARLY AVERAGE	45.25	47.11	71.44	77.69

Source: Feed Market News, Midwest Review, Grain Division, Consumer and Marketing Service, Agricultural Marketing Service, United States Department of Agriculture, Chicago, Illinois, Vol. 54, Vol. 55, 1971, 1972.

[a]The 1973 and 1974 monthly wholesale prices were calculated from weekly price quotations listed in Feedstuffs, Miller Publishing Company, Minneapolis, Minnesota, Vol. 45 and Vol. 46, 1973, 1974.

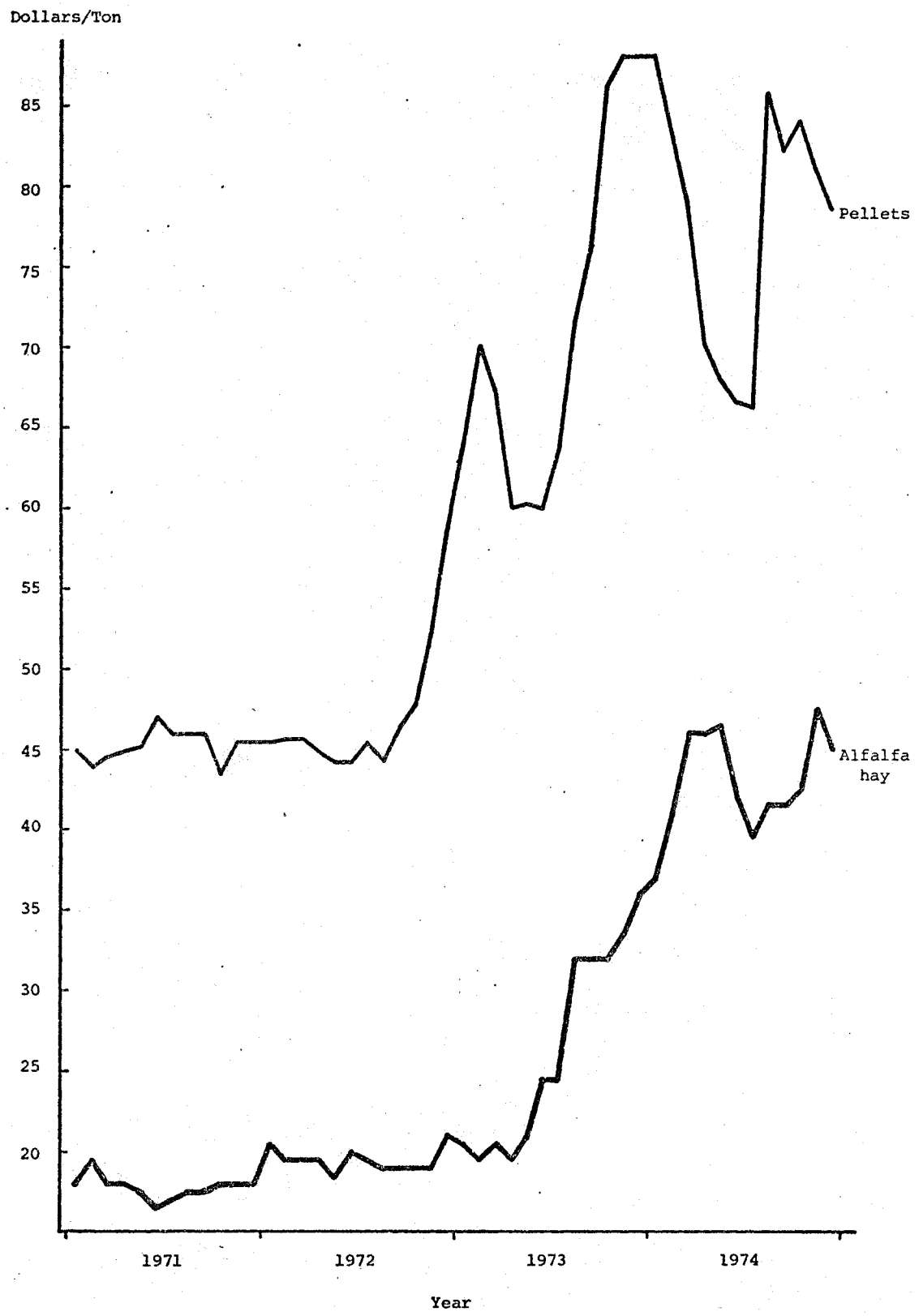


Figure 5. Midmonth Baled Alfalfa Hay Prices Received by North Dakota Farmers and Monthly Wholesale Price Per Ton For 13% Protein Sun-Cured Alfalfa Meal at Kansas City, 1971-1974.

COST OF ESTABLISHING AND OPERATING A SUN-CURED ALFALFA HAY PELLETING PLANT

Costs of establishing and operating a sun-cured alfalfa hay pelleting plant were based on one plant size operating at two alternative production levels. The plant operating at a 12,600 ton production level per year is assumed to operate for 257 days per year, seven hours per day and processes an average of seven tons of sun-cured alfalfa hay pellets per hour. The same size plant operating at a production level of 25,200 tons per year would need to be operated for 14 hours per day, 257 days per year and process about seven tons per hour.

Several additional assumptions were made in providing a basis for establishing the profitability of a sun-cured alfalfa hay processing plant. These assumptions, which apply to the physical and managerial aspects of operating the plant, include the following:

1. Four principal employees would operate the plant during each shift. Each workshift would require three full-time employees under the supervision of the general plant manager.

2. The length of each shift would be eight hours per working day.

3. Maintenance and repair periods consist of one hour per day for the plant if operated with a single workshift, and two hours per day if the plant were to be operated with two workshifts per day.

4. The manager's salary is figured at $1,000 per month and each employee is estimated to receive $600 per month. Both the manager and employees would receive fringe benefits equal to 12 percent of their salary.

5. The principal repayment for equipment is scheduled for 15 years in equal amounts at an annual interest rate of 9.5 percent. Building and facilities are programmed to be paid off in equal installments over a 20-year period.

6. Fuel oil required for the operation of the hay dryer would be approximately 32 gallons per hour. The cost per gallon of No. 2 fuel oil is estimated to be $.35 per gallon.

7. A $7.00 per ton transportation cost to the plant is assumed for delivery of hay from the farm to the plant.

8. Facilities are assumed to be located near, and with access to a railroad line.

9. There is approximately a 10 percent weight loss due to moisture reduction in the processing of alfalfa hay into sun-cured alfalfa hay pellets.

Initial Investment

Cost estimates for the construction of a sun-cured alfalfa hay pelleting plant were secured from a midwest contracting firm, and from a review of previous feasibility studies. Current equipment requirements and costs were obtained from a major pelleting equipment manufacturing representative. The cost of constructing and equipping a pelleting plant capable of processing seven tons of hay per hour is estimated at $505,000. This includes allowances for land and water requirements in addition to the costs of constructing and equipping a modern and efficient plant. A list of equipment and facilities included in the cost estimate is presented in Table 14. The cost estimate includes sales tax, construction, installation and freight charges to Oakes.

Annual Operating Costs

The annual operating costs itemized in Table 15 provide a general overview of the costs associated with producing a ton of sun-cured alfalfa hay pellets. The estimated annual fixed and variable cost for operating a plant at a 12,600 ton production level is $838,246 based upon an alfalfa hay price of $38. The total annual cost for operating at a 25,200 ton production level is $1,593,671.

The fixed cost items include depreciation on equipment and buildings; interest on borrowed capital for initial construction; property tax on land, buildings and equipment; and insurance on buildings and equipment.

The fixed costs comprise a relatively small portion of the total annual costs associated with processing sun-cured alfalfa pellets. Fixed costs represent approximately 8 percent of the total cost of processing a ton of pellets in a plant producing 12,600 tons annually and 4 percent of the total cost for a plant producing 25,200 tons annually.

Variable costs, which vary with the volume of pellets produced, account for over 90 percent of the total cost of processing alfalfa hay into pellets. The largest variable cost item is the hay which constitutes approximately 68 percent of the total variable cost. The cost of delivering alfalfa hay to the plant ($7.70/ton of processed pellets) and the cost of utilities ($5.32/ton) also represent significant expense items. Labor requirements represent approximately 3 percent of the variable costs associated with processing alfalfa pellets. Maintenance and repair costs also account for approximately 3 percent of the variable costs.

The 25,200-ton production level produces pellets at a considerably lower cost per ton than the 12,600-ton level. The cost of producing a ton of pellets is estimated to be approximately $3.28 lower for the higher production level.

It is anticipated that the economies associated with the higher production level would be of vital importance to the feasibility of processing alfalfa hay into sun-cured alfalfa hay pellets.

TABLE 14. ESTIMATED LONG-TERM CAPITAL REQUIREMENTS FOR A SUN-CURED ALFALFA HAY PELLETING PLANT.

Equipment:*	
Grinding (twin tub grinder, fan, collector conveyor, drum or rotary dryer and burner, dryer fan and collector, hammermill, negative pnuematic system with air locks)	$ 95,000
Pelleting (pellet mill hopper, pellet mill, pellet cooler, collector, fan, screener with fines spouting, cold pellet leg, pellet conveyors with connectors, carloading legs, spouting)	130,625
Boiler with pump and condensate system	10,625
Miscellaneous	5,000
TOTAL	$241,250
Buildings:	
Pole Building with concrete pit and attached shed (40' x 40')	19,375
Office and Boiler Building (40' x 60')	55,000
Pellet Storage Building (50' x 200')	62,500
Electrical wiring	40,000
Plumbing and heating	15,000
Truck scale (60 ton)	32,500
Land 20 acres @ $300 per acre	6,000
Well and Sewer	12,125
Engineering and Drafting	21,250
TOTAL	$263,750
TOTAL BUILDING AND EQUIPMENT COSTS	$505,000

*Cost estimates do not include yard hay handling equipment such as front end loaders and trucks.

TABLE 15. ANNUAL OPERATING COST FOR A SUN-CURED ALFALFA HAY PELLETING PLANT OPERATING AT 12,600 AND 25,200 TON PRODUCTION LEVELS, BASED ON AN ALFALFA HAY PRICE OF $38.00 PER TON.

Item	12,600 Ton		25,200 Ton	
	Total Cost	Cost Per Ton	Total Cost	Cost Per Ton
Fixed Cost				
Principal Payment	$29,625	$2.35	$29,625	$1.18
Interest	23,988	1.90	23,988	.95
Taxes	4,837	.38	4,837	.19
Insurance	4,778	.38	4,778	.19
TOTAL	$63,228	$5.01	$63,228	$2.51
Variable Cost				
Salary (Managerial)	$13,440	$1.07	$13,440	$ .53
Labor	24,192	1.92	48,384	1.92
Utilities:				
Fuel Oil	20,149	1.60	40,298	1.60
Gas & Oil	3,600	.29	7,200	.29
Electricity	43,200	3.43	86,400	3.43
Maintenance & repairs	22,050	1.75	44,100	1.75
Telephone	1,800	.14	1,800	.07
Accounting & legal	3,600	.28	3,600	.14
Advertising	600	.05	600	.02
Marketing fees	12,600	1.00	25,200	1.00
Alfalfa Hay*	526,680	41.80	1,053,360	41.80
Delivery Costs*	97,020	7.70	194,040	7.70
Interest on operating capital	6,087	.48	12,021	.48
TOTAL	$775,018	$61.51	$1,530,443	$60.73
TOTAL COSTS	$838,246	$66.52	$1,593,671	$63.24

*Costs were based upon the purchase and delivery of hay at 10 percent more than the assumed production levels to compensate for loss in weight from moisture reduction in processing.

MARKETING NORTH DAKOTA SUN-CURED ALFALFA HAY PELLETS

This section will focus on the marketing of sun-cured alfalfa pellets which could be produced by a pelleting plant in the general area of Oakes, North Dakota. Specifically, this analysis will measure the ability of the pelleting plant to compete in selected markets within the United States. The markets chosen for this analysis were selected from those markets for which published weekly price quotations are available for sun-cured alfalfa hay pellets of both 13% and 15% protein content. Alfalfa pellets with 15% protein content appear to be most common in North Dakota. Additional markets exist that do not publish price quotations but which may provide attractive market outlets for pellets processed in South Central North Dakota. The analytical approach will consider the transportation costs associated with selling pellets in various markets and the amount of profit which may be expected if a plant located at Oakes were to compete in the selected markets.

The yearly average prices of baled alfalfa hay in North Dakota and the yearly break-even prices of the assumed plant, operated at the 12,600 and 25,200-ton production levels for 1973 and 1974, are presented in Table 16. The plant operating at the 25,200-ton production level is estimated to have a break-even price of $3.28 lower than at the 12,600-ton level. The break-even price for the plant was calculated using the approximate yearly average price for baled alfalfa hay for each corresponding year. The 1973 and 1974 break-even prices include 1974 construction and production cost figures. (A comparison of break-even prices at alternative alfalfa hay prices is included in Appendix A).

TABLE 16. YEARLY AVERAGE PRICE FOR BALED ALFALFA HAY RECEIVED BY FARMERS, AND COMPUTED BREAK-EVEN PRICES OF A PELLETING PLANT OPERATING AT 12,600 AND 25,200 TON PRODUCTION LEVELS, OAKES, NORTH DAKOTA, 1973-1974.

Year	Baled Alfalfa Hay Price	Break-Even Price (12,600 ton)	Break-Even Price (25,200 ton)
1973	$26.29	$53.58	$50.30
1974	$43.00	$72.02	$68.74

To illustrate the effect that transportation costs have on the feasibility of marketing pellets in any particular market, break-even prices at 6 selected market locations are calculated; Atlanta, Boston, Chicago, Fort Worth, Kansas City, and Los Angeles. Figure 6 illustrates the geographic location of these selected markets.

TABLE 17. BREAK-EVEN PRICES AND PROFIT MARGINS PER TON OF PELLETS FOR PLANTS OPERATING AT PRODUCTION LEVELS OF 12,600 AND 25,200 TON PER YEAR, AND SUN-CURED ALFALFA HAY PELLET MARKET PRICES AT SELECTED MARKETS FOR 1973 AND 1974.

Market	Ave. Market Price For Alfalfa Pellets		Plant Production Levels					
			12,600 ton			25,200 ton		
	13% Protein	15% Protein	B.E. Price	13% Protein Profit Margin	15% Protein Profit Margin	B.E. Price	13% Protein Profit Margin	15% Protein Profit Margin
1973								
Atlanta	85.93	93.96	78.58	7.35	15.38	75.30	10.63	18.66
Boston	90.20	98.79	84.68	5.52	14.11	81.40	8.80	17.39
Chicago	66.28	68.72	67.68	-1.40	1.04	64.40	1.88	4.32
Fort Worth	83.98	83.92	75.98	8.00	7.94	72.70	11.28	11.22
Kansas City	71.44	71.70	65.48	5.96	6.22	62.20	9.24	9.50
Los Angeles	N/A	68.92	85.08	N/A	-16.16	81.80	N/A	-12.88
1974								
Atlanta	99.10	105.33	102.42	-3.32	2.91	99.14	-0.04	6.19
Boston	96.96	98.21	109.72	-12.76	-11.51	106.44	-9.48	-8.23
Chicago	74.02	76.10	89.12	-15.10	-13.02	85.84	-11.82	-9.74
Fort Worth	90.36	90.36	99.32	-8.96	-8.96	96.04	-5.68	-5.68
Kansas City	77.69	77.92	86.42	-8.73	-8.50	83.14	-5.45	-5.22
Los Angeles	N/A	88.27	110.32	N/A	-22.05	107.04	N/A	-18.77

The figures in Table 17 illustrate the average market prices of sun-cured alfalfa hay pellets at the selected markets for the years 1973 and 1974. In addition, the expected profit margins are indicated for a plant near Oakes producing 12,600 and 25,200 tons annually if pellets were sold in the selected markets in the corresponding year.

The break-even prices for the proposed plant at Oakes were calculated based upon the yearly average price for baled alfalfa hay for 1973 and 1974 and include the transportation cost of the pellets to the selected market. The freight rates presented in Table 18 were used in the computation of break-even prices in the corresponding year at the selected markets.

It is apparent from the figures in Table 17 that a firm operating under the assumed cost conditions would have had the greatest profit potential in the selected market of Atlanta, Georgia. The transportation cost of moving pellets westward appears to limit the ability of a plant in South Central North Dakota to compete in west coast markets.

The profit margins presented in Table 17 for the year 1973 may be somewhat misleading. The reason is that during the fourth quarter of 1973 excess profits may have been realized by pelleting plant owners because of the rapid increase in the price for pellets in relation to alfalfa hay (See Figure 7). Industry representatives expect that profit margins will return to the levels of the 1971-1972 period, in which relatively low profit margins existed. Even with profit margins returning to a more competitive level, the greater profit potential of selling in Atlanta versus Los Angeles is apparent.

Comparing the 1974 average market price to the calculated break-even prices for 1974 in Table 17 reveals that the profit margins for producing and marketing 15% protein pellets ranged from +$2.91 per ton at Atlanta to -$22.05 at Los Angeles for a plant processing 12,600 tons annually. By comparison, the plant processing 25,200 tons reflects a more favorable profit situation, with estimated profits per ton ranging from +$6.19 to -$18.77 in Atlanta and Los Angeles respectively.

The economies associated with the plant processing 25,200 tons versus the processing of 12,600 tons are relatively large. The figures in Table 17 suggest that the profit margin per ton realized by the higher production level is significantly higher than what can be attained by the plant processing at the smaller volume.

A pelleting plant at Oakes could compete in any market in which the price at the selected market is greater than the Oakes break-even price plus transportation costs to the market. Transportation costs and market selection, therefore, are important in determining how effective the manager of a pelleting plant will be in competing in the pellet market industry.

Figure 6. Location of Oakes, North Dakota and Selected U.S. Markets.

TABLE 18. RAIL FREIGHT RATES FROM OAKES, NORTH DAKOTA TO SELECTED MARKETS FOR SUN-CURED ALFALFA HAY PELLETS, 1973 AND 1974.

Destination	Rate Per Hundredweight* 1973	1974
Atlanta	$1.25	$1.52
Boston	1.55½	1.88½
Chicago	0.70½	0.85½
Fort Worth	1.12	1.36½
Kansas	0.59½	0.72
Los Angeles	1.57½	1.91½

*The rail rate is based upon a minimum of 80,000 pounds per shipment except Los Angeles where the rail rate is based upon a minimum of 110,000 pounds per shipment.

Source: Burlington Northern Freight Office via telephone, May 23, 1975.

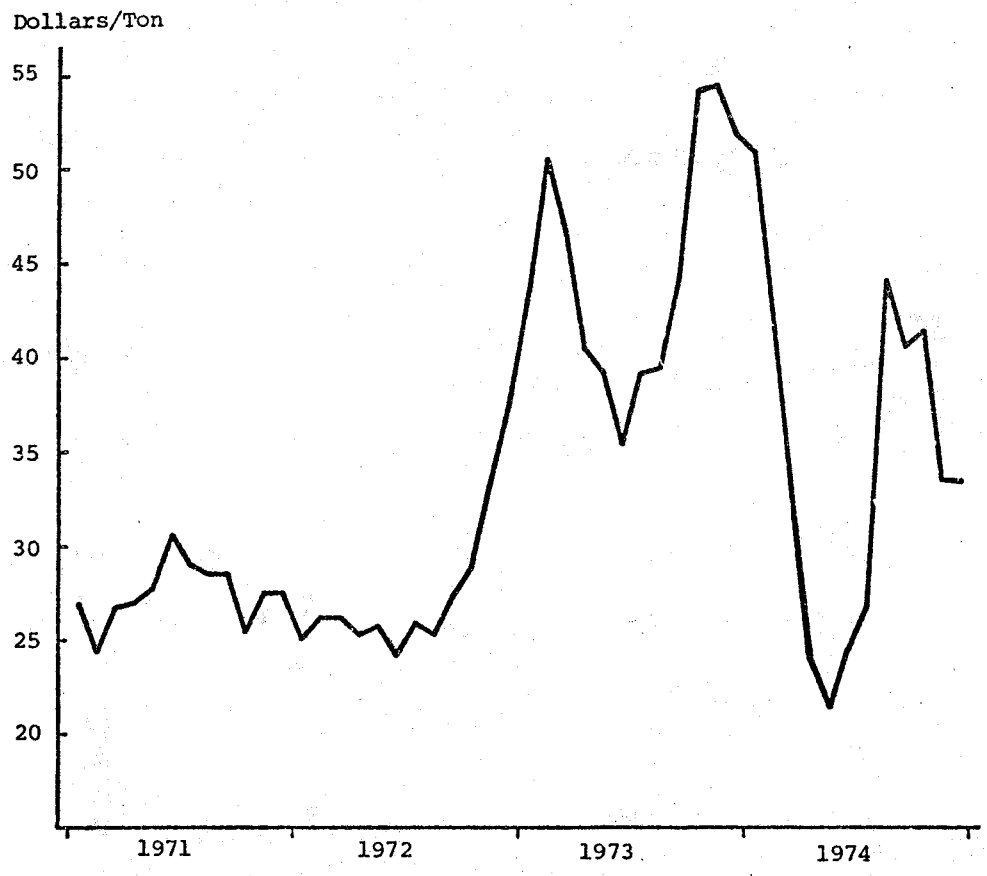


Figure 7. Price Margin Between Midmonth Baled Alfalfa Hay Prices Received by North Dakota Farmers and the Monthly Wholesale Price Per Ton For 13% Protein Sun-Cured Alfalfa Meal at Kansas City, 1971-1974.

SUMMARY AND CONCLUSIONS

Summary

Forage crops respond very favorably to irrigation and therefore, an increase in production of forages and livestock numbers are expected as irrigation in North Dakota becomes more extensive.

A high concentration of hay production is vital to the economic feasibility of operating a sun-cured alfalfa hay pelleting plant. Maintaining an adequate supply of alfalfa for a sun-cured alfalfa pelleting plant would depend upon the economic competitiveness of alfalfa hay compared to other crops grown in the general area in which a plant is located. The presence of a pelleting plant would increase the demand for alfalfa hay in the area.

Dickey County appears to have an advantage over other counties in State Planning Region VI, a nine-county area in Southeast Central North Dakota, for the location of a sun-cured alfalfa pelleting plant because of the high concentration of alfalfa produced in the county. In addition, the irrigation potential resulting from the Garrison Diversion Project in the two southeastern counties of the region, LaMoure and Dickey, is expected to have a considerable positive impact on the concentration of alfalfa production.

The dryland acreage requirements for production of an adequate hay supply for a seven-ton-per-hour plant producing 12,600 tons of sun-cured alfalfa pellets per year is 7,830 acres or 2.2 percent of the alfalfa acreage harvested in 1973 within a 50-mile radius of Oakes, North Dakota. The irrigated acreage requirements would be 2,772 acres which is equivalent to 4.7 percent of the 59,330 acres projected to be irrigated in the Oakes and LaMoure irrigation districts.

A seven-ton-per-hour plant operating two work shifts and producing 25,200 ton annually would require 15,661 dryland acres, or about 4.4 percent of the alfalfa acres harvested in the area in 1973. Production of an adequate hay supply would require 5,544 irrigable acres to be entirely committed to the production of alfalfa hay for the plant.

Increased production from irrigating the 3,710 acres of irrigable land presently seeded to alfalfa, which would be directly affected by the Oakes and LaMoure irrigation districts, would result in an increase of 11,787 tons of alfalfa hay. An additional 1,171 dryland acres, or 415 irrigable acres, would be required, along with the 11,787 tons due to irrigation, to operate a seven-ton-per-hour plant producing 12,600 tons per year.

About 9,000 additional dryland acres or an additional 3,187 irrigable acres would have to be committed, along with the increased production from irrigation, to provide an adequate amount of hay for a plant producing 25,200 tons of pellets per year.

Relatively low profit margins appear to be characteristic of the alfalfa hay pelleting industry. The cost of alfalfa hay is the highest cost item to the plant. The relative importance of alfalfa hay as the major cost item in combination with substantial fluctuations in alfalfa hay prices, add considerable uncertainty to predicting the feasible operation of a pelleting plant. With the advent of irrigation, alfalfa production is expected to increase in Region VI. This increased production will substantially decrease the uncertainty associated with obtaining an adequate hay supply, barring significant increases in cattle numbers.

The estimated profit margins in 1974 for marketing 15% protein pellets to markets in which pellet price quotations are available, ranged from +$2.91 per ton at Atlanta, Georgia to -$22.05 at Los Angeles for a plant located in South Central North Dakota processing 12,600 tons for the year. By comparison, the plant processing 25,200 tons reflects a more favorable profit situation, with estimated profits per ton ranging from +$6.19 to -$18.77 in Atlanta and Los Angeles respectively. Markets exist that do not publish price quotations but which may provide attractive market outlets for pellets processed in South Central North Dakota.

The price competitiveness of the industry combined with the relative importance of transportation have the influence of largely restricting plants to serving the general areas in which the plants have a comparative locational advantage. The generally lower west coast price for pellets and the higher transportation cost of moving pellets westward appears to limit the ability of a plant in South Central North Dakota in competing in west coast markets.

Foreign countries provide a market for a large portion of the United States production of sun-cured alfalfa pellets. West coast pelleting firms export most of the alfalfa pellets that are exported from the United States.

Conclusions

It is concluded from this study that an average of 60 percent of the quantity of alfalfa hay presently available within a 50-mile radius of Oakes, North Dakota, beyond that presently being utilized by livestock, would be required to support an alfalfa pelleting plant processing 12,600 tons per year. Obtaining this relatively large percentage of the surplus alfalfa hay, combined with the sizeable yearly fluctuation in production causes the feasibility of a plant to be questionable under present hay supply and demand conditions.

Production of alfalfa resulting from irrigation from the Garrison Diversion Project is expected to increase forage production sufficiently, along with the normal carry-over of alfalfa hay, to supply hay for a

seven-ton-per-hour plant at a production level of 12,600 ton per year. It is also possible that irrigation would sufficiently increase the alfalfa acreage in the region to provide the additional hay supply needed to support the seven-ton-per-hour plant at a production level of 25,200 tons per year.

The economies associated with the pelleting plant processing 25,200 tons per year are substantial and enhance the feasibility of processing alfalfa hay into sun-cured alfalfa pellets in North Dakota.

APPENDIX

SUN-CURED ALFALFA PELLET BREAK-EVEN PRICES

Alfalfa hay prices along with sun-cured alfalfa hay pellet prices have changed dramatically in recent months, making it difficult to estimate break-even prices based upon historic price data. Appendix Table 1 includes the break-even price for sun-cured alfalfa hay pellets at alternative alfalfa hay prices. The break-even prices were computed for the two plant production levels considered in the study. The break-even prices indicate the prices necessary to cover the fixed and variable costs associated with the production of sun-cured alfalfa hay pellets.

APPENDIX TABLE 1. BREAK-EVEN PRICE PER TON OF SUN-CURED ALFALFA HAY PELLETS BASED ON ALTERNATIVE HAY PRICES AND ALTERNATIVE PRODUCTION LEVELS.

Hay Price Per Ton	Plant Production Level	
	12,600 ton	25,200 ton
	dollars per ton	
$20	$46.57	$43.29
$25	52.11	48.83
$30	57.65	54.37
$35	63.20	59.92
$40	68.74	65.46
$45	74.28	71.00
$50	79.83	76.55
$55	85.37	82.09

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