Agricultural Economics Miscellaneous Report No. 130 October 1990

ECONOMIC FEASIBILITY OF ONION PRODUCTION, MARKETING, AND PROCESSING IN NORTH DAKOTA

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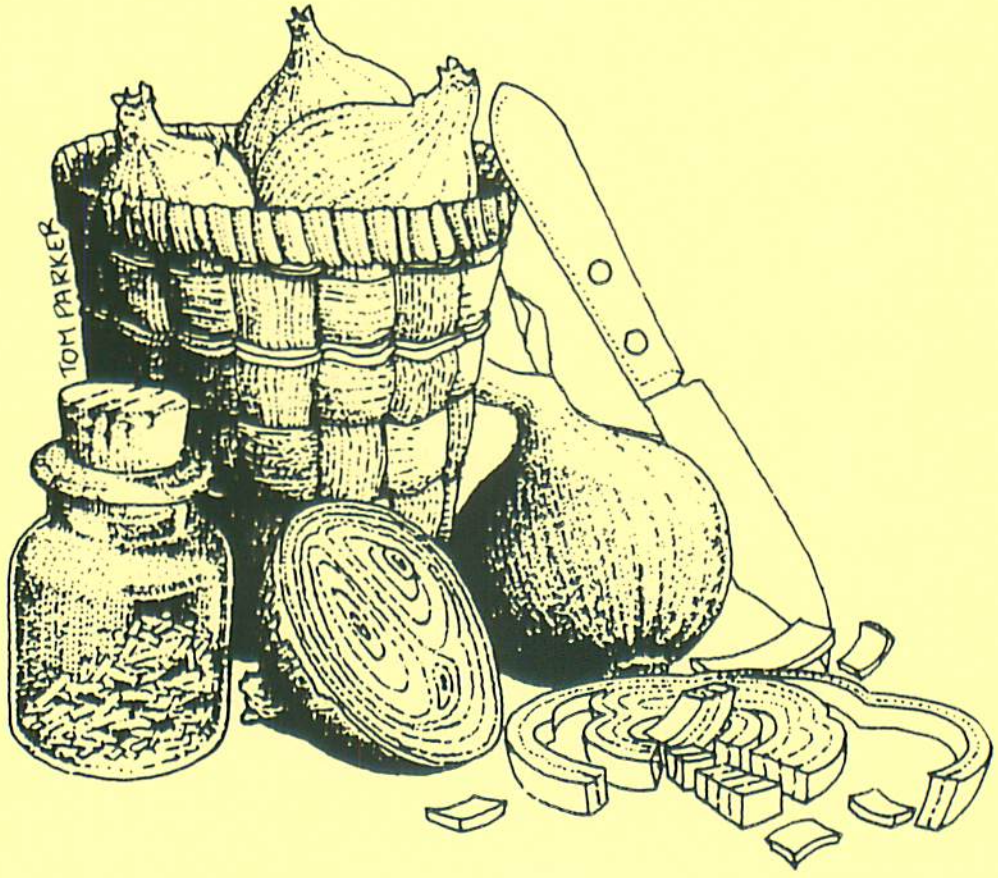

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N.D. Agricultural Products Utilization Commission
USDA-CSRS Project No. 8802822
Rural Development Research in North Dakota

Acknowledgements

The authors are indebted to vegetable growers and numerous businesses and governmental agencies who have provided support and data for this study.

Special recognition is given for financial support provided by Cooperative State Research Service (CSRS) of the U.S. Department of Agriculture, under project number 8802822, the Institute for Business and Industry Development (IBID) at North Dakota State University, the North Dakota Agricultral Products Utilization Commission, and the North Dakota Agricultural Experiment Station.

The authors would like to thank those who provided reviews of this manuscript: Drs. George Flaskerud, Bill Wilson, Professor Tim Petry, Mr. Dale Zetocha, and Ms. Charlene Lucken. Appreciation is given to Marna Unterseher for typing draft copies and the final copy. The authors accept sole responsibility for any omissions or errors.

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Highlights

A yield of 300 masters (50-lb. bag) per acre and a price between $6 and $7 per master would be needed for a commercial-sized onion producer to cover all costs in North Dakota. When transportation costs from North Dakota and competing production areas were compared, North Dakota primarily had transportation advantages in local but not regional markets.

In an earlier study on the "Economic Feasibility of Vegetable Production, Marketing, and Processing in the Red River Valley of North Dakota," Dufner et al. found that both onions and carrots have production and marketing potential in North Dakota.

This paper is a summary of the economic feasibility of onion production marketing, and processing in North Dakota. Case study data from Dufner et al. and an expanded model developed from a study by the Agricultural Economics Department at Michigan State University were used to evaluate the economic feasibility of commercial onion production.

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Introduction

Onions were a significant crop in the Fargo-Moorhead area during the 1940s and 1950s when farmers planted over 1700 acres.[1] The major Fargo-Moorhead onion growers gradually ceased onion production due to price instability and competition from western growers who popularized the mild Spanish onion types. Onions also were raised in the Grand Forks area and farther north. One major onion grower remains in the Fargo-Moorhead area and annually produces about 50 acres. A limited number of farmers in the northern Red River Valley raise smaller amounts.

Although local market demand for onions is strong, it is not strong enough to support a substantial expansion in acreage. Regional marketing may be feasible, and the potential appears quite good for onion production and marketing because the product keeps well, can be harvested mechanically, and existing potato storage facilities can be adapted for storage. Production of direct-seeded onions can be accomplished by planting early in the spring, especially with fast-maturing types. Direct seeding of Spanish onions is risky due to their long growing period and the difficulty of curing them under wet harvest conditions. Transplanting greenhouse or southern grown Spanish onions is feasible for small acreages, because producers can enter the market at least one month earlier than with direct seeded onions. Fast maturing winter storage varieties are recommended for large acreages rather than transplants which are too expensive. Weeds, a serious problem for onions, can be controlled chemically.

Small acreages of onions can be hand harvested into burlap sacks and allowed to dry in the field. This is appropriate for large Spanish onions that mechanical harvesters can bruise. Large commercial acreages require specialized equipment, including a rod weeder for uprooting the bulbs, a windrower or an adapted two-row potato digger to gather the bulbs after they are dry, and an onion harvester to lift them into trucks after curing.

Onions (depending on variety) can be stored for up to eight months at 32°F and low humidity. A continual movement of air around and through them is important to keep them dry so they don't sprout.

Onion Production Potential for North Dakota

U.S. onion production has gradually increased over the past 10 years from 35.9 million cwt. in 1978 to 45 million cwt. in 1987 (Figure 1). Increased yields rather than increased acreage caused the additional production. The 1978-82 average yield was 309 cwt. per acre compared to 369 cwt. for the 1983-87 average.

Two factors influence the growing demand for onions, population growth and increased per capita consumption of onions. From 1978 to 1987, U.S. resident population increased from 222 million to 243 million, a 10 percent increase. Per-capita consumption during the same period increased from 13.7 pounds in 1978 to 16.3 pounds in 1987, a 19 percent increase (Table 1).

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[1]Interview with Bud Romkey, onion grower and packager, Moorhead, Minnesota, Spring, 1989.

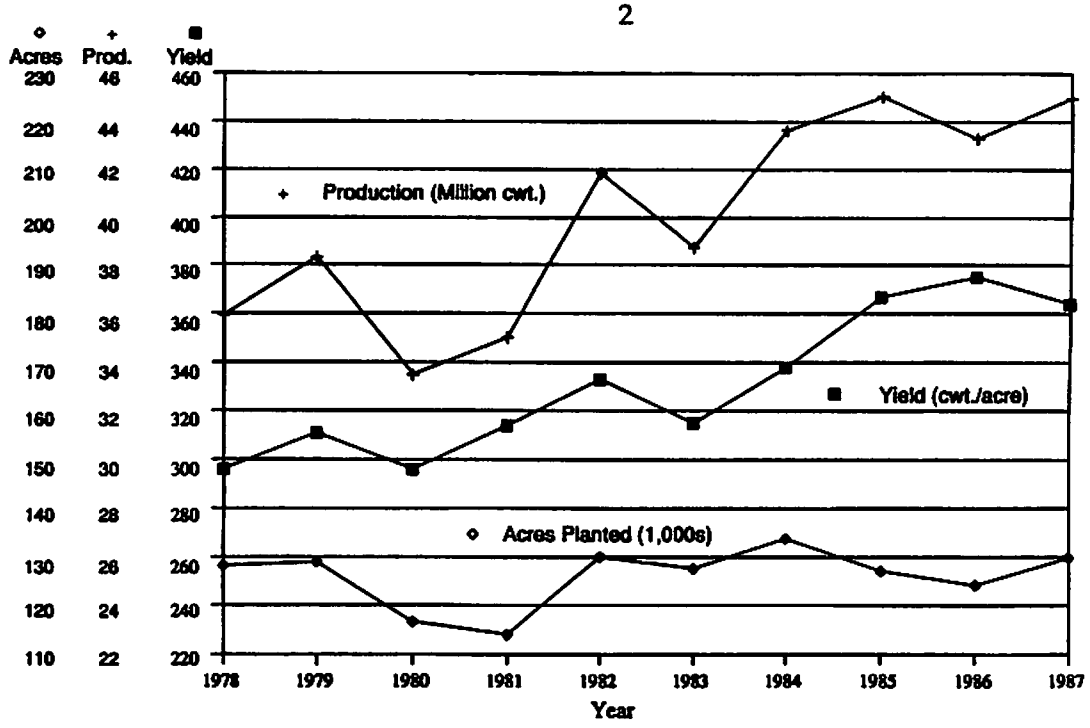

Figure 1. Acreage, Production, and Yield for U.S. Onions, 1978-1987.
SOURCE: USDA, Vegetable Summary, Various Issues.

TABLE 1. U.S. PER-CAPITA CONSUMPTION, ONIONS, 1970-1987

Year	lbs.	Year	lbs.	Year	lbs.
1970	12.4	1976	13.1	1982	15.2
1971	13.1	1977	13.5	1983	15.3
1972	12.6	1978	13.7	1984	16.1
1973	12.5	1979	14.7	1985	16.5
1974	13.9	1980	13.7	1986	17.9
1975	13.3	1981	13.1	1987	16.3

SOURCE: USDA, ERS, Food Consumption, Prices, and Expenditures, 1989.

Seasonal Production

The United States Department of Agriculture classifies onion production into four categories: spring, summer non-storage, summer storage, and summer California. Although onion production has increased over the past 10 years, the market share among USDA categories has remained constant. Spring production accounts for 16 percent, summer non-storage onions for 7.8 percent, summer storage onions for 54 percent, and summer California onions for 22 percent of total production. Comparing 1978-82 averages with 1983-87 averages indicates spring and summer California production have remained constant while summer non-storage onion production has declined and summer storage onion production has increased (Table 2).

TABLE 2. U.S. SEASONAL MARKET SHARE OF ONIONS, 1978-82 and 1983-87

Category	1978-1982	1983-1987
	percent	
Spring	16.27	15.99
Summer - non-storage	8.62	7.76
- storage	52.81	53.98
- California	22.30	22.27

SOURCE: Adapted from Vegetables, Agricultural Statistics Board, USDA, 1978-1987.

Unlike seasonal production groups where market share is constant, individual state's market shares have distinctive trends. California's share of spring onions is growing at the expense of Arizona and Texas. The market share of Texas' grown summer onions also has decreased. Colorado, Idaho, Oregon, and Washington have increased their market share of summer storage onions. The primary loser of market share was New York, and Michigan to a lesser extent. Minnesota, Ohio, Utah, and Wisconsin each decreased slightly in market share (Table 3).

TABLE 3. ONION PRODUCTION AND MARKET SHARE BY SEASON AND STATE, 1978-1987

	Production										Market Share	
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1978-82	1983-87
	(1,000 cwt)										percent	
Spring												
Arizona	738	536	623	512	876	656	805	564	660	585	1.78	1.52
California	1,590	1,904	1,683	2,160	2,805	2,166	2,734	3,510	2,886	3,198	5.49	6.72
Texas	3,345	3,504	3,569	2,700	3,492	3,800	3,348	3,230	3,600	2,750	9.00	7.75
Subtotal	5,673	5,944	5,875	5,372	7,173	6,622	6,887	7,304	7,146	6,533	16.27	15.99
Summer non-storage												
New Jersey	84	115	75	104	90	-	-	-	-	-	.25	.00
New Mexico	1,184	960	1,131	1,242	1,643	1,248	1,365	1,463	1,810	2,106	3.34	3.70
Texas	1,502	1,520	1,764	1,488	1,544	1,643	1,560	943	1,537	799	4.23	3.00
Washington	304	278	257	320	315	492	432	390	429	532	.80	1.05
Subtotal	3,074	2,873	3,227	3,154	3,592	3,383	3,357	2,796	3,776	3,437	8.62	7.76
Summer-storage												
Colorado	2,730	2,535	2,460	2,925	3,255	3,432	4,636	5,355	4,590	4,688	7.53	10.52
Idaho	2,470	2,295	2,453	2,625	2,475	2,475	2,323	3,740	3,710	4,620	6.67	7.82
Michigan	2,448	2,414	1,800	2,446	2,560	2,573	2,933	2,535	1,653	1,900	6.32	5.37
Minnesota	223	125	201	199	168	158	156	194	208	195	.50	.42
New York	4,309	4,818	4,433	3,933	4,550	2,793	3,384	3,960	3,456	3,132	11.94	7.75
Ohio	231	221	165	170	165	193	205	221	169	139	.52	.43
Oregon-Malheur	3,373	3,672	3,434	3,360	3,687	4,242	5,505	5,280	4,505	5,520	9.49	11.61
Oregon-West	814	1,104	1,104	1,100	1,134	1,050	1,280	1,505	1,440	1,512	2.85	3.15
Utah	720	830	656	777	730	570	693	720	469	825	2.01	1.52
Washington	1,178	1,560	1,320	1,480	1,482	1,540	1,935	1,763	1,848	2,300	3.80	4.35
Wisconsin	443	435	348	455	495	552	544	436	378	336	1.18	1.04
Subtotal	18,939	20,009	18,374	19,470	20,701	19,578	23,594	25,709	22,426	25,167	52.81	53.98
California	8,250	9,504	6,000	7,025	10,395	9,179	9,819	9,250	9,953	9,860	22.30	22.27
Total Summer	30,263	32,386	27,601	29,649	34,688	32,140	36,770	37,755	36,155	38,464	83.73	84.01
Total U.S.	35,936	38,330	33,476	35,021	41,861	38,762	43,657	45,059	43,301	44,997	100.00	100.00

SOURCE: USDA, Vegetables, Annual Summaries, 1978-1988

Six states produced over 80 percent of U.S. onions from 1983 to 1987. California 28.99 percent, Oregon 14.76 percent, Texas 10.75 percent, Colorado 10.52 percent, Idaho 7.82 percent, and New York 7.75 percent.

Foreign Trade

The U.S. was a net exporter of onions before 1982. In five of the six following years the U.S. was a net importer (Table 4). Exports marginally exceeded imports in 1984, but by 1987 a net trade deficit of 1.75 million cwt existed, approximately 4.3 percent of domestic consumption. Import prices are seasonal and generally are lowest during August and September. Price increases occur monthly and peak in March or April (Figure 2).

TABLE 4. U.S. ONION EXPORTS AND IMPORTS, 1970-1987

Year	Imports	Exports	Net Exports (Imports)	Year	Imports	Exports	Net Exports (Imports)
	1,000 lbs				1,000 lbs		
1970	76,185	147,160	70,975	1979	157,381	156,705	(676)
1971	50,882	137,018	86,136	1980	132,831	256,555	123,724
1972	61,451	128,817	67,366	1981	136,147	420,141	283,994
1973	148,368	186,155	37,787	1982	165,680	140,698	(24,982)
1974	98,293	147,629	49,336	1983	204,929	183,163	(21,766)
1975	81,005	152,473	71,468	1984	267,161	273,890	6,729
1976	78,025	326,580	248,555	1985	263,649	121,607	(142,042)
1977	144,144	189,195	45,051	1986	247,696	164,406	(83,290)
1978	138,698	249,500	110,802	1987	371,159	195,826	(175,333)

SOURCE: USDA, Vegetables and Specialties, November, 1988.

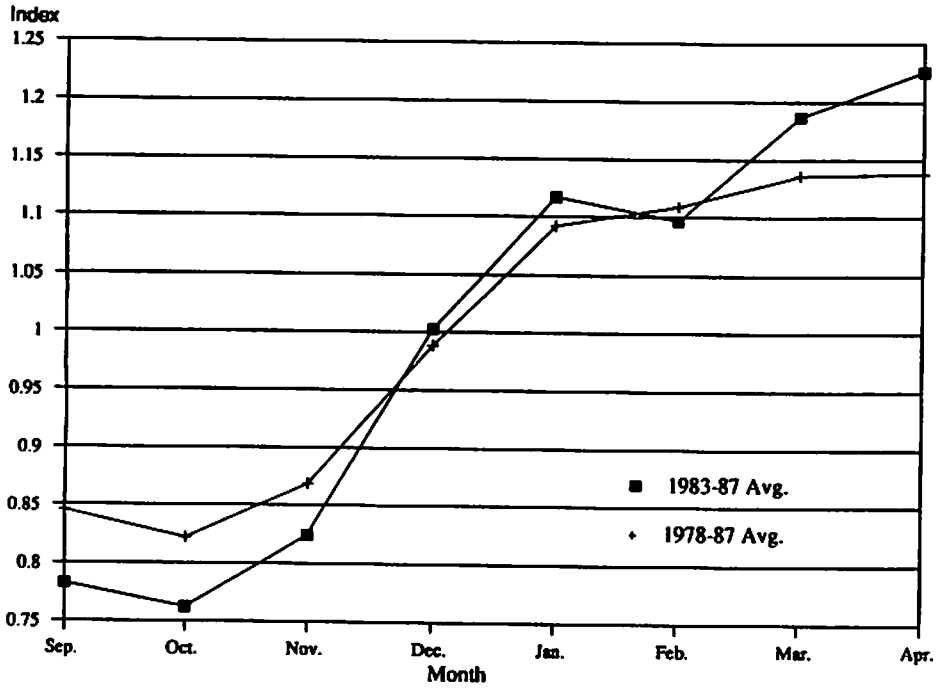

Figure 2. Monthly Price Indices for Idaho-Oregon Onions Using Wholesale Chicago Prices.

SOURCE: USDA, Fresh Fruit and Vegetable Prices, 1978-1988.

TABLE 5. U.S. ONION IMPORTS BY COUNTRY OF ORIGIN, 1986 AND 1987

Country of Origin	1986	1987
	----------metric tons----------	
Latin America	94,081	148,583
Mexico	93,199	138,352
Chile	379	9,344
Other	503	656
Canada	16,754	14,081
Other	3,247	4,328
Total	114,082	166,992

SOURCE: Foreign Agricultural Trade of the United States, 1988.

Seasonal Shipping

Shipping seasons vary in time and length, depending on the production and climate in the producing states. Arizona, California, and Texas typically do not store crops as refrigeration is too expensive. These states generally plan production to supply fresh products when Northern states cannot meet supply requirements.

Arizona generally ships onions during May and June, New Mexico from June to August, Texas from April to August, and California all year round with most onions shipped from May to August. Colorado, Idaho, Michigan, Oregon, and Washington generally begin shipping in August when harvest begins and continue until March or April as onions are removed from storage (Table 6). Eighty percent of the onions were shipped by truck during 1987, and 13.5 percent by rail, of which 3 percent were by piggyback rail.

Seasonal Pricing and Returns to Storage

Chicago wholesale prices were used to determine seasonality of prices and returns to storage. Major terminal market prices were used because they would reflect the overall U.S. market and would not be subject to local supply and demand factors. The USDA only publishes comprehensive wholesale prices for two major markets, New York and Chicago. Chicago was chosen as the most likely major market for North Dakota produce.

Analysis was limited to a September through March time period because the primary market season for summer storage onions most likely would be produced in North Dakota. Consequently, prices are generally not reported from April to August for

TABLE 6. ONION SHIPMENTS BY STATE, ORIGINS, AND MONTHS, 1987

Origin		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		1,000 cwt												
Onions, Dry - Rail														
Arizona		-	-	-	-	11	-	-	-	-	-	-	-	11
Calif Cent		-	-	-	-	8	50	1	1	-	1	-	1	62
Calif Cent	Expt	-	-	-	-	1	-	-	-	-	-	-	-	1
Calif South	Expt	-	-	-	-	5	1	-	-	-	-	-	-	6
Colorado		-	-	-	-	-	-	-	2	-	-	2	3	7
Idaho		296	143	90	2	-	-	2	37	199	243	208	276	1,496
Oregon		288	189	141	9	-	-	-	45	177	231	178	210	1,468
Texas		-	-	-	5	15	-	-	-	-	-	-	-	20
Utah		-	-	-	-	-	-	-	-	3	3	2	3	11
Washington		2	1	-	-	-	-	-	-	14	9	-	1	27
Total		586	333	231	16	40	51	3	85	393	487	390	494	3,109
Onions, Dry - Piggyback														
Arizona		-	-	-	-	55	12	-	-	-	-	-	-	67
Calif Cent		-	-	-	-	14	166	230	36	9	15	2	2	474
Calif South		-	2	-	-	-	-	-	-	-	-	-	4	6
Calif Imp Vly		-	-	-	8	124	10	-	-	-	-	-	-	142
Colorado		-	-	-	-	-	-	-	6	20	2	2	-	30
Idaho		15	13	14	-	-	-	-	8	13	7	5	9	84
New Mexico		-	-	-	-	-	4	-	-	-	-	-	-	4
Oregon		13	14	36	2	-	-	1	9	13	7	3	7	105
Texas		-	-	-	5	7	-	-	-	-	-	-	-	12
Utah		2	-	-	-	-	-	-	-	-	-	-	-	2
Washington		10	7	4	-	-	2	9	-	1	1	-	1	35
Total		40	36	54	15	200	194	240	59	56	32	12	23	961
Onions, Dry - Available Truck														
Arizona		-	-	-	-	285	163	4	-	-	-	-	-	452
Calif Cent		82	30	46	-	182	891	990	458	133	100	67	52	3,031
Calif Cent	Expt	-	-	-	-	-	4	4	2	-	1	1	-	12
Calif South		85	54	84	29	-	13	30	37	38	65	79	56	570
Calif Imp Vly		-	-	-	187	817	54	-	-	-	-	-	-	1,058
Colorado		348	192	16	-	-	-	58	492	631	591	513	434	3,275
Florida		-	-	-	8	1	-	-	-	-	-	-	-	9
Georgia		-	-	-	28	279	62	-	-	-	-	-	-	369
Idaho		126	121	132	38	-	-	-	92	185	234	179	223	1,330
Idaho	Expt	-	-	-	-	-	-	-	-	-	16	6	-	22
Michigan		192	126	105	-	-	-	-	105	150	145	151	186	1,160
New Mexico		-	-	-	-	3	691	527	337	94	-	-	-	1,652
New York		367	290	343	140	-	-	3	179	367	317	315	296	2,617
New York	Expt	1	-	-	-	-	-	-	-	-	-	-	-	1
Oregon		396	400	424	55	-	9	41	271	394	409	321	417	3,137
Oregon	Expt	17	13	21	3	-	6	2	19	41	59	101	191	473
Texas		-	-	78	1257	1231	320	440	207	-	-	-	-	3,533
Utah		86	24	-	-	-	-	-	4	115	177	137	99	642
Washington		208	214	126	14	-	164	301	152	226	193	186	167	1,951
Washington	Expt	31	27	17	2	-	8	18	18	36	45	102	79	383
Total		1,939	1,491	1,392	1,761	2,798	2,385	2,418	2,373	2,410	2,352	2,158	2,200	25,677
U.S. TOTAL		2,565	1,860	1,677	1,792	3,038	2,630	2,661	2,517	2,859	2,871	2,560	2,717	29,747

SOURCE: USDA, Fresh Fruit and Vegetable Shipments, 1988.

summer storage onions as not enough produce is shipped to establish a price series. Also, the market is generally supplied with spring season production from southern states. The price series used were Idaho-Oregon Yellow Spanish Jumbo onions and Michigan Yellow Medium onions (Tables 7 and 8) for Idaho-Oregon spanish onions. Prices varied from year to year, ranging from $3.84 for 50 pounds in February 1977 to $18.50 in March, 1983.

Five-year (1983-1987) and 10-year (1978-1987) indices of monthly onion prices are presented in Figures 2 and 3. Both indices indicate traditional price behavior where prices are lowest during harvest and increase thereafter. Higher prices reward the producer for the additional costs of storing the commodity. Both classes exhibit the same behavior. Prices actually are higher at the beginning of harvest and drop and rise throughout the season.

Prices generally increase throughout the year. Idaho-Oregon onion prices have historically had a higher probability of increasing. Prices from 1978 to 1987 increased eight of 10 years for both three-month and five-month storage periods. Michigan prices increased only four years when storing three months and six years when storing five months. From 1983 to 1987, storage had a positive return every year for Idaho-Oregon onions and four years for Michigan onions. Production in 1984 increased significantly over the previous year, 43.7 versus 38.8 million cwt. and may have prevented prices from rising. Average increases in price from 1978 to 1987 for three and five month storage periods were $1.62 and $2.44, respectively, per 50-pound sack of Idaho-Oregon onions. Price increases were greater during the 1983-1987 period, averaging $2.83 and $3.87 for three and five month storage periods, respectively (Table 9). Prices were similar for Michigan onions but had not increased to the extent of Idaho-Oregon onions. Price increases averaged $.42 and $1.78 for three and five month storage periods from 1983 to 1987, less than half of those for Idaho-Oregon (Table 10).

TABLE 7. WHOLESALE-CHICAGO PRICES FOR U.S. NO. 1 IDAHO-OREGON YELLOW SPANISH JUMBO ONIONS, 1977-1987

Year	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
	$/50 lb. sack							
1977	4.60	4.76	4.95	4.76	4.60	3.84	7.38	8.00
1978	5.38	5.64	6.50	9.00	10.80	12.63	10.00	8.50
1979	5.65	5.35	5.35	5.15	4.69	4.53	4.35	4.67
1980	8.20	7.43	8.06	10.32	10.94	11.00	17.25	15.50
1981	8.25	9.09	11.25	11.05	14.13	14.19	8.60	6.95
1982	7.69	6.97	5.70	4.88	4.88	5.35	6.15	7.75
1983	6.66	7.16	8.50	13.13	13.85	14.00	18.50	15.38
1984	7.33	7.30	7.75	9.75	8.92	7.94	7.68	10.03
1985	6.00	5.47	5.72	6.60	6.75	6.13	5.95	5.97
1986	6.93	7.31	7.63	8.40	11.00	11.93	14.30	15.75
1987	6.72	6.00	6.60	7.03	9.75	9.90	9.19	9.38

SOURCE: USDA, Fresh Fruit and Vegetable Prices, 1978-1988.

TABLE 8. DRY ONION PRICES FOR MICHIGAN YELLOW MEDIUM ONIONS, WHOLESALE-CHICAGO, 1977-1987

Year	Sept	Oct	Nov	Dec	Jan	Feb	Mar
	$/50 lb. sack						
1977	4.25	4.20	3.70	4.14	3.95	3.59	3.81
1978	4.80	4.28	3.84	3.57	3.87	4.00	4.00
1979	5.16	4.12	3.75	3.45	3.28	3.01	2.85
1980	8.20	7.43	8.06	7.06	8.31	9.44	11.35
1981	6.95	6.28	6.25	6.21	6.59	7.25	6.90
1982	5.41	4.50	4.30	3.98	3.86	4.25	4.93
1983	7.38	7.70	7.50	8.00	8.70	9.66	11.63
1984	7.06	5.93	5.10	5.25	4.89	4.56	4.34
1985	5.38	3.88	4.06	4.30	5.56	5.85	4.95
1986	6.80	6.75	6.85	7.25	8.43	10.00	11.94
1987	6.88	6.50	7.00	7.00	9.06	9.95	9.19

SOURCE: USDA, Fresh Fruit and Vegetable Prices, 1978-1988.

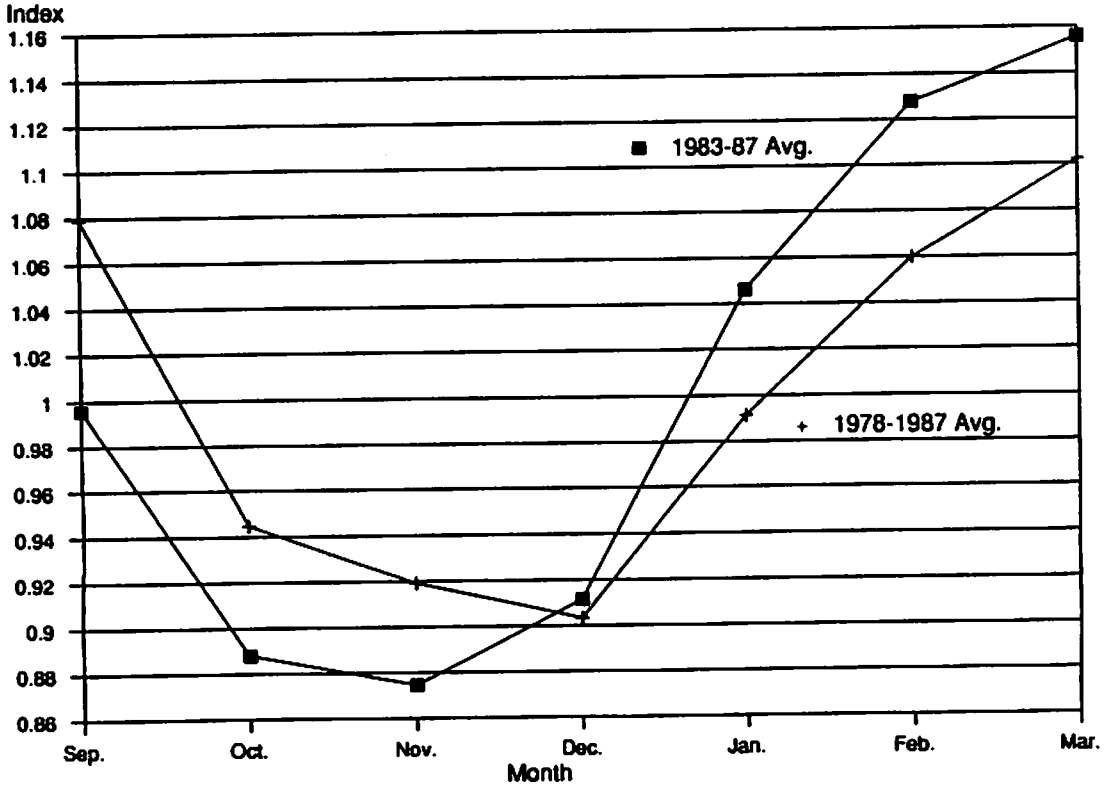

Figure 3. Monthly Price Indices for Michigan Onions Using Wholesale Chicago Prices.

SOURCE: USDA, Fresh Fruit and Vegetable Prices, 1978-1988.

TABLE 9. RETURN TO STORAGE FOR IDAHO-OREGON YELLOW SPANISH ONIONS (3 AND 5 MONTH PRICE CHANGES), 1978-1987

Year	Months		Year	Months	
	Three[a]	Five[b]		Three[a]	Five[b]
	----$/50 lb. sack----			----$/50 lb. sack----	
1978	4.40	5.81	1983	6.58	9.34
1979	-.58	-1.06	1984	2.02	.50
1980	2.82	6.31	1985	.94	.31
1981	3.92	2.73	1986	2.58	6.00
1982	-2.45	-1.58	1987	2.03	3.19
1978-87 average	2.23	3.15	1983-87 average	2.83	3.87

[a]Dec.-Jan. average minus Sept.-Oct. average.
[b]Feb.-Mar. average minus Sept.-Oct. average.

SOURCE: Adapted from Table 7.

TABLE 10. RETURN TO STORAGE FOR MICHIGAN YELLOW MEDIUM ONIONS (3 AND 5 MONTH PRICE CHANGES), 1977-1987

Year	Months		Year	Months	
	Three[a]	Five[b]		Three[a]	Five[b]
	----$/50 lb. sack----			----$/50 lb. sack----	
1978	-.82	0.54	1983	.81	3.11
1979	-1.28	-1.71	1984	-1.43	-2.05
1980	-.13	2.5	1985	.30	.77
1981	-.22	.46	1986	1.07	4.20
1982	-1.04	-.37	1987	1.07	4.20
1978-87 average	-.14	.93	1983-87 average	.42	1.78

[a]Dec.-Jan. average minus Sept.-Oct. average.
[b]Feb.-Mar. average minus Sept.-Oct. average.

SOURCE: Adapted from Table 8.

Market Competitiveness

The market competitiveness of North Dakota depends upon its ability to deliver products to a market at equal or less cost than other suppliers, assuming acceptable quality standards are maintained. Production and shipping costs are the major components in determining final cost.

Published data are not available on production costs for major producing regions in the United States. However, North Dakota's advantage (disadvantage) in shipping cost can be estimated. For the market where North Dakota has a shipping cost advantage, the state can be a competitive supplier providing the differential in production costs does not exceed the shipping cost advantage.

Since primary production of storage onions is located in the West, the potential market for North Dakota production would be markets east or southeast of North Dakota. These would include Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, South Dakota, and North Dakota. Although many of these states also produce onions, they still remain net importers, including North and South Dakota. The exception is Michigan, which is a net exporter of onions. This eight state region is a net importer based on historical production and population estimates. The eight state region accounts for 19.52 percent of U.S. population but only 7.26 percent of U.S. onion production (Table 11). Assuming regional consumption is similar to U.S. consumption, the eight state region produces only 38 percent of what it consumes. In reality this may overstate market potential. Southern states supply the eight states, during late spring and summer, when regional produce is not available. However, since North Dakota is in a deficit region and has a transportation advantage over Western producing states, it could become a market supplier.

Transportation costs were estimated for six markets to determine North Dakota's transportation advantage (disadvantage) relative to other supply points. The markets selected to represent local, regional, and national markets were Fargo, Minneapolis, Sioux Falls, Chicago, New York, and Atlanta. Competing supply regions were Colorado, Oregon-

TABLE 11. REGIONAL MARKET SHARES FOR PRODUCTION OF ONIONS AND POPULATION, 1988

State	U.S. Population	U.S. Onion Production
	----------%----------	
Illinois	4.76	–
Indiana	2.27	–
Michigan	3.78	5.37
Minnesota	1.74	.42
North Dakota	.28	–
South Dakota	.29	–
Ohio	4.43	.43
Wisconsin	1.97	1.04
Total	19.52	7.26

SOURCE: U.S. Census 1980 and Table 3.

Idaho-Washington, Michigan, and Grand Forks, representing the Red River Valley of North Dakota. Transportation cost advantages (disadvantages) were estimated for the Red River Valley (Tables 12 and 13).

The Red River Valley has a transportation advantage over the Pacific Northwest in all markets, ranging from $1.75 per 50 pounds to Minneapolis to $1.33 to Atlanta. The Red River Valley also has a cost advantage over Colorado in all markets. Michigan has a cost advantage in supplying the Atlanta, New York, and Chicago markets.

TABLE 12. ESTIMATED TRANSPORTATION COSTS FOR ONIONS FROM SELECTED ORIGINS TO SELECTED MARKETS, UNITED STATES*, 1989

Market Destinations	Origin			
	Grand Forks	Denver	Pacific Northwest	Michigan
	$/50 lb.			
Fargo	.23	1.35	2.09	1.41
Minneapolis	.57	1.42	2.32	1.07
Chicago	1.15	1.53	2.72	.51
New York	2.28	2.63	3.85	1.17
Atlanta	2.09	2.10	3.42	1.29
Sioux Falls	.58	1.09	2.25	1.30

*Rates estimated by following formula: Rate/50 lb. unit = (100 + 1.25 * miles)/880 units.
SOURCE: Based on tariffs derived from industry sources.

TABLE 13. RED RIVER VALLEY'S ESTIMATED TRANSPORTATION COST ADVANTAGE (DISADVANTAGE) IN SUPPLYING SELECTED MARKETS, UNITED STATES, 1989

Market Destinations	Origins		
	Denver	Pacific Northwest	Michigan
	$/50 lb.		
Fargo	1.12	1.86	1.18
Minneapolis	.85	1.75	.50
Chicago	.38	1.57	(.64)
New York	.35	1.57	(1.11)
Atlanta	.01	1.33	(.80)
Sioux Falls	.51	1.67	.72

SOURCE: Adapted from Table 12.

Onions are also shipped by rail from the Northwest. A comparison of rail and truck costs for the Northwest indicated rail reduced costs by approximately $.40 to $.80 per 50 pounds. This cost reduction reduces the Red River Valley transportation advantages. Rail also incurs additional costs including longer delivery times, potentially higher inventory costs, and greater handling costs. Non-cost considerations include less control over shipping once shipment occurs, potential car scheduling problems, and more restrictive planning horizons.

Case Study

Transplant onions, winter storage onions, and greentop onions will be discussed along with production and cost data for each type of onion crop. The problems and benefits of each type of onion will also be presented.

Transplant Onions

Spanish onion transplants from Georgia were air freighted to Minneapolis and hauled by pickup truck to North Dakota in 1988. The plants were transplanted using a four row transplanter that required six workers, one worker for each row, a tractor driver, and a worker to monitor planting depth.

Onion plants were set 5 1/2 to 6 inches apart in 20-inch rows, for a total of about 50,000 plants per acre. A tractor planting speed of 1/4th to 1/5th mile per hour was required so workers had sufficient time to feed the transplanter. Water from tanks mounted on the tractor was applied as the plants were transplanted. Drought conditions required two or three more waterings so transplants could set roots. The transplanted crop was grown organically with no chemical fertilizers, herbicides, or insecticides. Inoculants were used on onion roots to ensure abundant bacterial life in the soil. Liquid fish emulsion was applied with water for nitrogen.

Planting began in late May and continued through the third week of June, despite the drought. A transplant catch of around 90 percent was obtained with irrigation. The onion transplants were cultivated and hand weeded twice. The seedlings developed large bulbs, most of which were hand harvested into burlap sacks in September.

Harvest began when about 75 percent of the tops had weakened and fallen over. Workers with knives or scissors pulled the entire plant, and cut the bulbs from the tops, allowing the bulbs to fall into pails or baskets before being dumped into burlap sacks and left to dry in the field for up to one week. When the onion leaves rustled in the bags, they were air stacked on rows of pallets in a warehouse allowing ventilation to penetrate the sides and center of each pallet. Fans were used to circulate air around the onions to accelerate the evaporation. The onions were hand graded into five sizes and marketed in 50 pound mesh bags. Packout percentages are shown in Figure 4.

The variable cost of growing transplant onions in 1988 was $4.81 per 50 pound master, which is about equal to an FOB price of commercial onions grown in Western states (Table 14). The transplants alone cost nearly $2 per master. Variable harvest and packaging costs were $3.90 per master, which was double most commercial rates.

Despite high growing costs, which consisted primarily of seedling purchase and transplanting, the transplant onion operation was profitable (Tables 14 and 15). This was largely because fixed costs were low ($1.70 per master). The onions were shipped early and required only temporary indoor storage.

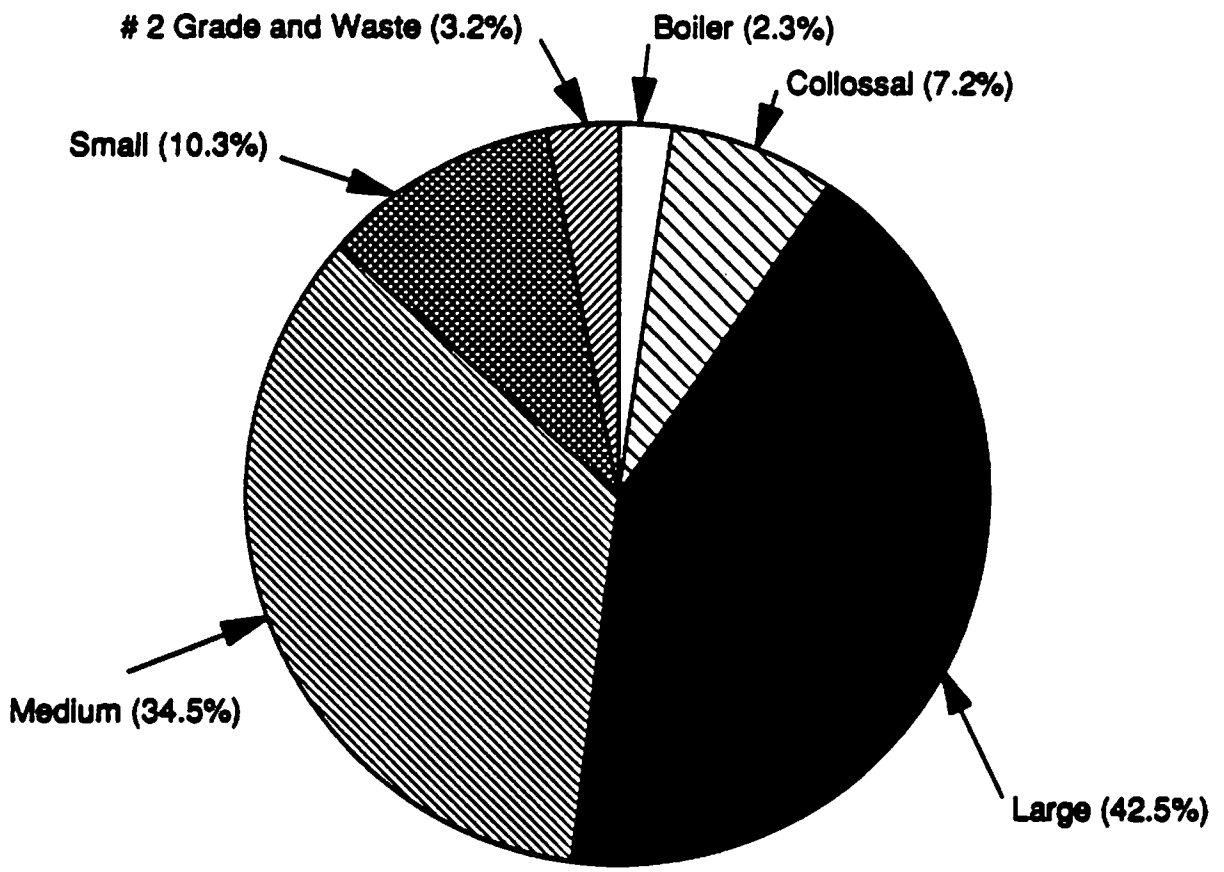

Figure 4. Transplant Yellow Spanish Onion Packout From Case Study in Central Red River Valley, North Dakota, 1988.

Direct Seeded Winter Storage Onions

These onions were planted in 20-inch rows at 3.2 pounds per acre (slightly above the 2.5 pounds per acre recommended for 20 inch row spacing) on 5.3 acres of certified organic land in mid April 1988. The major planting concerns were emergence and weed control in an organic production system.

Seedling emergence was good, resulting in optimal plant density, small bulb size. Weeds were controlled with a beet cultivator and hand weeding within the rows. Migrant labor was not available to pull weeds, and some weeds went to seed before they were pulled. Variable growing costs were $427 per acre, with 85 percent going for seed and hand weeding.

TABLE 14. TRANSPLANT ONION OPERATION COSTS FOR CENTRAL RED RIVER VALLEY CASE STUDY, NORTH DAKOTA, 1988[a]

Variable, Fixed and Total Costs	Total Costs	Cost/Acre	Cost/Master
		$	
Variable Costs			
Growing Costs			
Transplants (50,000/acre @ .0078 ea)	2,715	388	1.90
Fish/molasses	35	5	0.03
Inoculant	42	6	0.03
Water (irrigation)	93	13	0.07
Cultural operations			
Fall till	35	5	0.03
Transplanting	2,089	298	1.46
Watering	175	25	0.12
Cultivating			
1st	121	17	0.09
2nd	47	7	0.03
Hand Weeding			
1st	1,050	150	0.74
2nd	47	7	0.03
Interest on operating capital			
6 mo. @ 12%	416	59	0.29
Subtotal	6,865	980	4.81
Harvesting, Packaging, and Marketing Costs			
Hand pick	994	142	0.70
Hauling to warehouse	420	60	0.29
Grading/packing	2,612	373	1.83
Packing materials	411	59	0.29
Warehouse utilities Electric	25	4	0.02
Repairs/maintenance	100	14	0.07
Telephone/marketing	800	114	0.56
Delivery	200	29	0.14
Subtotal	5,562	795	3.90
Total Variable Costs	12,427	1,775	8.71
Fixed Costs			
Land rental	700	100	0.49
Warehouse rental	500	71	0.35
Fixed ownership charges			
Specialized production equipment	301	43	0.21
Other unspecialized equipment	125	18	0.09
Processing/packing equipment	190	27	0.13
Storage equipment	278	40	0.20
Office supplies, subscriptions	110	16	0.08
Vehicle insurance/taxes/licenses	40	6	0.03
Memberships and professional fees	176	25	0.12
Total Fixed Costs	2,420	346	1.70
TOTAL VARIABLE AND FIXED COSTS	14,847	2,121	10.41

[a]Based on seven acres and 1,428 masters of product sold.

SOURCE: Case study, Central Red River Valley, North Dakota, 1988.

TABLE 15. ONION TRANSPLANTS, PRODUCTION, AND PRICE RECEIVED FOR CENTRAL RED RIVER VALLEY, CASE STUDY, NORTH DAKOTA, 1988

Description	Units Sold	Invoice Amount	Amount Received	Amount/ Master	Weight	Price/ Pound
	masters	$			lbs.	$
Red Onions						
Unsized 50 lb.	30	780	402	13.40	1,500	0.27
Culls	6	0	0	0.00	300	0.00
Subtotal	36	780	402	11.17	1,800	0.22
White Onions						
Boilers 20/2 lb.	1	12	12	12.00	40	0.30
Small 16/3 lb.	3	60	60	20.00	144	0.42
Medium 50 lb.	18	360	360	20.00	900	0.40
Large 50 lb.	23	460	460	20.00	1,150	0.40
Colossal 50 lb.	32	480	480	15.00	1,600	0.30
Unsized 50 lb.	44	880	583	13.40	2,175	0.27
Culls	4	0	0	0	200	0.00
Subtotal	125	2,252	1,955	15.64	6,209	0.32
Yellow Onions						
Boilers 20/2 lb.	35	448	448	12.80	1,400	0.32
Small 20/2 lb.	1	14	14	14.00	29	0.50
Small 16/3 lb.	133	2,275	2,117	15.92	6,384	0.33
Medium 20/2 lb.	2	40	40	20.00	64	0.63
Medium 12/3 lb.	20	400	400	20.00	720	0.56
Medium 16/3 lb.	10	200	200	20.00	480	0.42
Medium 10/5 lb.	25	500	500	20.00	1,250	0.40
Medium 50 lb.	379	6,431	5,967	15.74	18,925	0.32
Large 50 lb.	528	8,850	8,409	15.93	26,400	0.32
Colossal 50 lb.	90	1,450	1,296	14.40	4,500	0.29
Unsized 50 lb.	4	78	78	19.50	208	0.38
#2 grade 50 lb.	20	208	204	10.20	1,020	0.20
Culls	20	0	0	0.00	1,000	0.00
Subtotal	1,267	20,894	19,673	15.54	62,380	0.32
TOTAL	1,428	23,922	22,030	15.43	70,389	0.31

SOURCE: Case study, approximately 7 acres central Red River Valley, North Dakota, 1988.

Due to high plant density, 1.3 acres of the field were harvested as table onions when the plants reached pencil size. The remaining four acres of onions were hand harvested in early October before a hard frost. Half of the onions were picked by the tops. A small homemade one row onion digger was used to lift the remaining onions. A pull type rod weeder effectively lifted the onions in some parts of the field but skimmed over the soil surface where the ground was packed and hard.

Inadequate moisture resulted in a large percentage of small or "prepack" onions (Figure 5). Variable harvesting, packaging, and marketing costs were exceptionally high due to inadequate harvest equipment and unavailability of grading equipment. Thus, this operation had a net loss (Tables 16 and 17). However, the production of quality winter storage onions in North Dakota is feasible, which area growers have proven.

The organic production of direct seeded onions is troublesome because onions compete poorly against weeds. A heavy weed growth which might occur in normal years, could make hand weeding economically infeasible and result in loss of the crop. Chemical herbicides effectively controls weeds for the conventional grower and can be used in North Dakota.

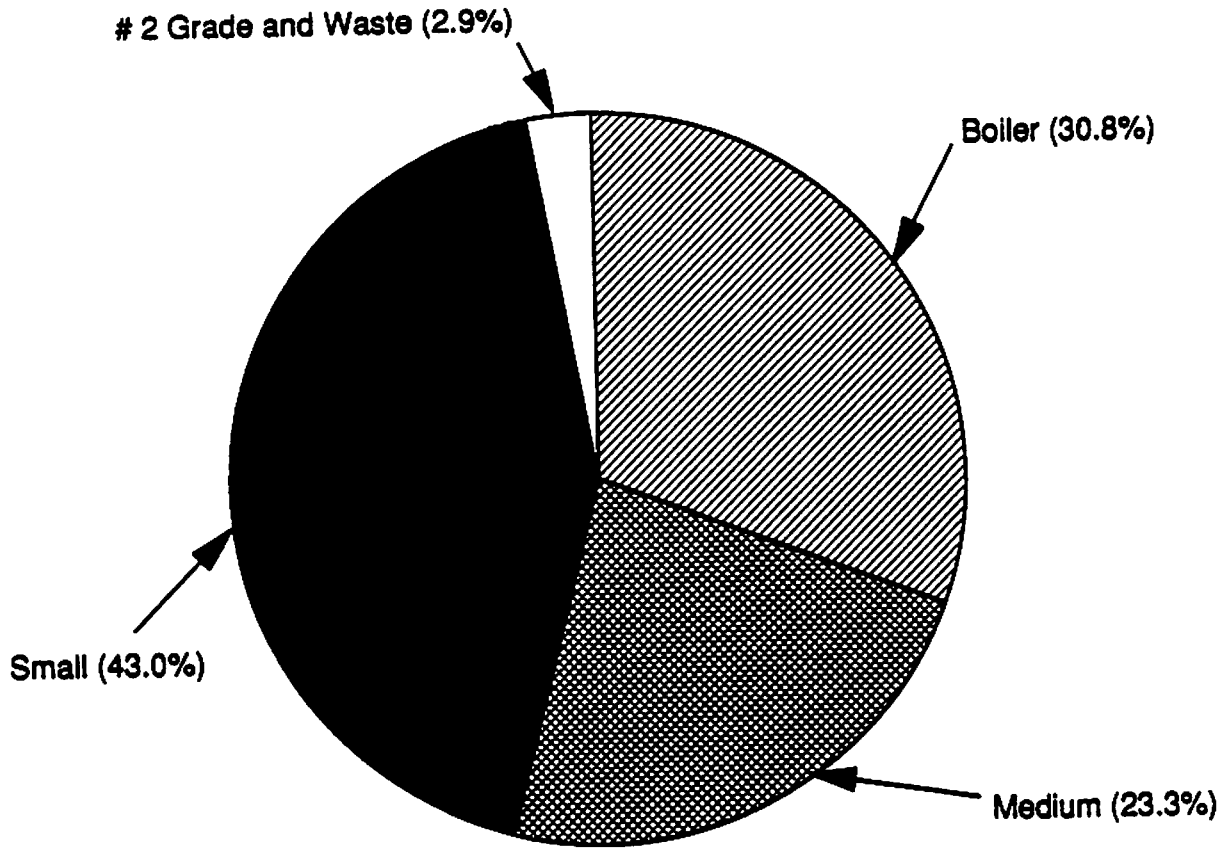

Figure 5. Direct Seeded Storage Onion Packout Percentages From Case Study in Central Red River Valley, North Dakota, 1988.

The major advantage of direct seeded onions over transplants is the considerably lower up-front cost required to establish a seedbed. In an organic system, this advantage may be offset by the higher cost of hand weeding direct seeded onions during their longer life cycle. Since onion seedlings are extremely fragile after emergence, soil cannot be pushed against them during cultivation and drifting soil on windy days can damage or cut them off.

The major advantages of transplant onions over direct seeded onions are:

a) they permit an early harvest of late maturing varieties (eg. spanish type) which normally implies higher prices.

b) they facilitate weed control in an organic production system where chemical weed control cannot be used.

The major disadvantages are the increased cost of seedlings over seed and the slow transplanting process.

TABLE 16. DIRECT-SEEDED ONION OPERATION COSTS FOR CENTRAL RED RIVER VALLEY CASE STUDY, NORTH DAKOTA, 1988[a]

Variable, Fixed, and Total Costs	Total Costs	Cost/Acre	Cost/Master
		$	
Variable Costs			
Growing Costs			
Seed (3 lb./acre @ $32/lb.	424	106	1.20
Cultural operations			
Fall till	20	5	0.06
Planting	35	9	0.10
Cultivating			
1st	69	17	0.20
2nd	27	7	0.08
3rd	15	4	0.04
Handweeding			
1st	600	150	1.70
2nd	300	75	0.85
3rd	120	30	0.34
Interest on operating capital			
6 mo. @ 12%	97	24	0.28
Subtotal	1,707	427	4.84
Harvesting, Packaging, and Marketing Costs			
Hand pick	1,784	446	5.05
Hauling to warehouse	104	26	0.30
Grading/packing	1,050	263	2.98
Packing materials	489	122	1.39
Warehouse utilities			
Heat	300	75	0.85
Electric	75	19	0.21
Repairs/maintenance	50	13	0.14
Telephone/marketing	300	75	0.85
Delivery	700	175	1.98
Subtotal	4,852	1,214	13.75
Total Variable Costs	6,559	1,641	18.58
Fixed Costs			
Land rental	400	100	1.13
Warehouse rental	600	150	1.70
Fixed ownership charges			
Specialized production equipment	143	36	0.41
Other unspecialized equipment	142	36	0.41
Processing/packing equipment	123	31	0.35
Storage equipment	149	37	0.42
Office supplies, subscriptions	28	7	0.08
Vehicle insur./taxes/licenses	20	5	0.06
Membership and professional fees	44	11	0.13
Total Fixed Costs	1,649	413	4.67
TOTAL VARIABLE AND FIXED COSTS	8,208	2,054	23.25

[a]Based on four acres and 353 masters of product sold.

SOURCE: Case study, Central Red River Valley, North Dakota, 1988.

TABLE 17. PRICE RECEIVED FOR SALES OF DIRECT SEEDED WINTER ONIONS FOR CENTRAL RED RIVER VALLEY CASE STUDY, NORTH DAKOTA, 1988

Description	Units Sold	Invoice Amount	Amount Received	Amount/ Master	Total Lbs.	Price/ Pound
	masters	$			lbs.	$
Boilers 50 lb.	90	1,440	1,440	16.00	4,500	0.32
Boilers 20/2 lb.	6	92	92	15.33	240	0.38
Boilers 25/2 lb.	15	283	283	18.87	750	0.38
Subtotal	111	1,815	1,815	16.35	5,490	0.33
Small 50 lb.	72	1,390	1,390	19.31	3,600	0.39
Small 12/3 lb.	13	260	260	20.00	468	0.56
Small 16/3 lb.	58	1,190	1,190	20.52	2,784	0.43
Small 10/5 lb.	16	300	300	18.75	800	0.38
Subtotal	159	3,140	3,140	19.75	7,652	0.41
Medium 50 lb.	77	1,940	1,940	25.19	3,850	0.50
Medium 10/5 lb.	6	120	120	20.00	300	0.40
Subtotal	83	2,060	2,060	24.82	4,150	0.50
TOTAL	353	7,015	7,015	19.87	17,292	0.41

SOURCE: Case study, 4 acres Central Red River Valley, North Dakota, 1988.

Greentop Table Onions

A winter storage variety of greentop table onions were planted and harvested from 1.3 acres. Due to high plant density, the onions were harvested before bulbing for sale as table onions.

The greentop table onion operation consisted of hand pulling, gathering onions into baskets, and transferring them to a warehouse where they were spray washed with water. Washed plants were bunched and tied with rubber bands with six to eight plants per bunch. Forty-eight bunches were packed in cartons lined with plastic coated paper for moisture resistance and were marketed to supermarkets in Fargo and Grand Forks biweekly during July. Onion tops were left intact, and no ice was applied due to lack of icing capability.

The major problem was that onion tops quickly lost their fresh appearance, especially if delayed from one delivery day to the next. Onions not sold quickly in supermarkets soon lost their market appeal. Only quality fresh products were acceptable to consumers. Approximately one-third of the hand-harvested onions were discarded due to lack of freshness.

Revenue from the sale of greentop onions ($1,224) covered most variable costs not fixed costs (Table 18). Fixed costs, when allocated on the basis of equipment usage, were substantial, although the facilities were underutilized during mid-summer when alternative opportunity costs were low.

Fresh greentop onions have market potential for local markets. Local demand for onions in the summer was strong, but varieties that retain their fresh appearance must be selected. The operation is labor intensive, and labor demand is greatest in mid-summer when school-aged youth can work. Irrigation, though not essential, is desirable to ensure a mild onion product.

TABLE 18. TABLE ONION OPERATION COSTS FOR CENTRAL RED RIVER VALLEY CASE STUDY, NORTH DAKOTA, 1988[a]

Variable, Fixed and Total Costs	Total Cost	Cost/Acre	Cost/Master
		$	
Variable Costs			
Growing Costs			
Seed	138	106	1.15
Cultural operations			
Fall till	7	5	0.05
Planting	11	9	0.09
Cultivating			
1st	23	17	0.19
2nd	9	7	0.07
Handweeding			
1st	195	150	1.63
Interest on operating capital			
4 mo. @ 12%	15	12	0.13
Subtotal	398	306	3.39
Harvesting, Packaging, and Marketing Costs			
Hand pick	145	112	1.21
Hauling to warehouse	50	38	0.42
Grading/packing	260	200	2.17
Packing materials	60	46	0.50
Warehouse utilities			
Water	20	15	0.17
Electric	70	54	0.58
Repairs/maintenance	20	15	0.17
Telephone	150	115	1.25
Delivery	495	381	4.13
Subtotal	1,270	976	10.58
Total Variable Costs	1,668	1,287	13.96
Fixed Costs			
Land rental	130	100	1.08
Warehouse rental	400	308	3.33
Fixed ownership charges			
Specialized production equipment	24	18	0.20
Other unspecialized equipment	88	68	0.73
Processing/packing equipment	8	6	0.07
Storage equipment	117	90	0.98
Office supplies, subscriptions	10	7	0.80
Vehicle insur./taxes/licenses	20	15	0.17
Membership and professional fees	15	12	0.13
Total Fixed Costs	812	624	6.77
TOTAL VARIABLE AND FIXED COSTS	2,480	1,911	20.73

[a]Based on 1.3 acres and 120 masters of product sold.

SOURCE: Case study, Central Red River Valley, North Dakota, 1988.

Expanded Model

The expanded model for this study is based on a study by the Agricultural Economics Department of Michigan State University. Entitled "Costs of Producing Carrots" the study covered fixed and variable costs associated with a commercial sized carrot farm and profitability of carrots under alternative yield and price assumptions.

The same methodology in the Michigan study was used to develop a commercial onion operation for North Dakota. Onions were selected because the case study and a horticultural crop survey indicated North Dakota had favorable conditions for their successful production (Dufner et al. 1990). Although North Dakota does not have a commercial onion operation, this model is available to individuals who want to start an operation specializing in the production of onions.

The following assumptions were made for this model: 1) the farm would consist of 300 acres with 250 acres tillable, 2) 100 acres would be planted to onions, and 3) the remaining 150 acres would be used for grain or other vegetable crops.

Onion Enterprise

Both fixed and variable costs of onions from the Michigan study were used. Some fixed and variable inputs differed between the carrot and onion enterprises. Some inputs were added that specifically pertained to the production of onions. Price and yield used to determine gross receipts are from the case study presented in this paper. Various scenarios are presented to illustrate how losses/returns change with price and yield.

Fixed Costs

Total fixed costs were $448 per acre. Interest on investment and depreciation were the two largest fixed costs at $191 and $142 per acre, respectively. Repairs and maintenance costs were estimated at $25 per acre. Land was rented and amounted to $84 per acre (Table 19).

Variable Costs

Variable inputs for the onion enterprise are presented on a per acre basis for both amount used and cost. Variable costs for raising onions amounted to $2,305.72 per acre. Growing costs accounted for $1,000 per acre. Major growing costs were herbicide and additives, labor, fertilizer, and machinery repair. Harvesting and marketing costs amounted to $857. Packing and promotion accounted for almost 80 percent of harvesting and marketing costs (Table 19).

Total Costs and Net Returns

Variable and fixed costs were subtracted from gross receipts to arrive at per acre and per master net returns for onion production (Table 19). The onion operation was profitable at $7 per master and a yield of 400 masters per acre. This was perceived to be a possible price and yield under the case study conditions. The price received could possibly be higher, depending upon targeted markets (organic) and regional location of markets. Price also can vary if the farmer uses irrigation, because a higher quality product is produced.

TABLE 19. ESTIMATED PER ACRE AND PER BAG COSTS AND RETURNS FOR ONION PRODUCTION CENTRAL RED RIVER VALLEY, NORTH DAKOTA, 1988

Item	Per Acre	Per Master
	---$---	
Price	7.00	--
GROSS RECEIPTS (400 bags)	2,800.00	--
Variable Costs		
Growing		
- Seed	97.50	0.24
- Fertilizer	104.60	0.26
- Spray and Additives	361.90	0.90
- Cultural labor	155.85	0.39
- Fuel, oil	85.00	0.32
- Machinery repair	102.00	0.26
- Machine hire	9.00	0.02
- Utilities	18.00	0.05
- Supplies	10.00	0.03
- Miscellaneous (travel, etc.)	11.00	0.03
- Interest on operating capital	46.35	0.12
Subtotal	1,001.20	2.50
Harvesting and Marketing Costs		
- Labor	72.75	0.18
- Fuel and Electricity	40.00	0.10
- Transportation	80.00	0.20
- Packing	500.00	1.25
- Promotion and brokerage	164.00	0.41
Subtotal	856.75	2.14
TOTAL VARIABLE COSTS	1,857.95	4.65
Fixed Costs		
- Depreciation	141.68	0.35
- Interest on investment	190.66	0.48
- Repairs and Maintenance	25.23	0.06
- Rent	84.00	0.21
- Insurance	6.20	0.02
TOTAL FIXED COSTS	447.77	1.12
TOTAL VARIABLE AND FIXED COSTS	2,305.72	5.77
Net return (loss)	494.28	1.24

Net returns for possible prices and yields are presented in Table 20. These values were computed assuming only harvesting, packaging, and promotion costs varied directly with yields. A yield of 300 masters and a price between $6 and $7 would have to be received to cover all costs (Table 20). The results presented are hypothetical and will vary depending on a producers' situation.

TABLE 20. NET INCOME (LOSS) PER ACRE AT VARIOUS PRICES AND YIELDS, ONION PRODUCTION, CENTRAL RED RIVER VALLEY, NORTH DAKOTA, 1988

Yield	Average Price Received Per Master				
	5	6	7	8	9
Bags Sold/Acre					
100	(1,163)	(1,063)	(963)	(863)	(763)
200	(877)	(677)	(477)	(277)	(77)
300	(591)	(291)	9	309	609
400	(305)	95	495	895	1,295

Summary and Conclusions

The potential for competitive commercial production of onions in North Dakota was examined in this study. Total and seasonal U.S. production and foreign trade statistics were presented. Onions were divided by type: spring, summer non-storage, summer storage, and California. Market shares, seasonal prices, monthly shipments, and returns to storage were presented. Regional market share (production) and population along with per capita consumption were used to determine regional demand. Results indicate North Dakota lies in a net import region, suggesting a potential for North Dakota to produce onions. Transportation costs from North Dakota and competing regions were analyzed. North Dakota's advantage (disadvantage) in transportation costs versus other production regions were determined for the Fargo, Minneapolis, Chicago, New York, Atlanta, and Sioux Falls markets.

North Dakota onions have a transportation advantage over the Pacific Northwest and Denver origins for all the markets. Michigan onions have a transportation advantage over North Dakota for the Chicago, New York, and Atlanta markets.

North Dakota's competitiveness in any market is determined by production and transportation costs relative to production and transportation costs for other originating regions. However, since production costs for each region were not available, competitiveness comparisons were unobtainable.

A case study of a small vegetable production/marketing operation was analyzed. A vegetable operation was started in the central Red River Valley in 1987 and continued in 1988. Production in 1987 concentrated on carrots and shifted to onions in 1988. Results of the operation, including machinery utilization, production, sales, variable and fixed costs, packout, prices, and net return data were analyzed for onions. Operational problems became an integral part of the analysis.

An expanded model was developed from the case study data and followed the methodology of a Michigan State University study. The expanded model evaluated economic feasibility of a commercial-sized operation producing either carrots or onions. Assumptions used in the expanded model included a 300 acre farm with 250 tillable acres (100 acres planted to onions and 150 acres planted to other vegetables or small grains). Onion yields were estimated at 400 masters per acre using a $7 per master market price.

Onions were estimated to have positive net returns. Onion production in the central Red River Valley of North Dakota was estimated to have per acre fixed and variable costs of $448 and $857, respectively. Onion receipts were estimated at $2,800 per acre with estimated net returns of $494 per acre. Net returns under various price and yield scenarios also were presented. Positive net returns were indicated for yields of 300 masters per acre and $7 per master.

Feasibility studies estimate costs and returns using generally acceptable assumptions available from trade sources. However, an individual producer's costs and/or returns may vary significantly from assumptions used in this report. Therefore, each producer considering vegetable production and marketing should analyze the specific costs and returns that are inherent to their operation.

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