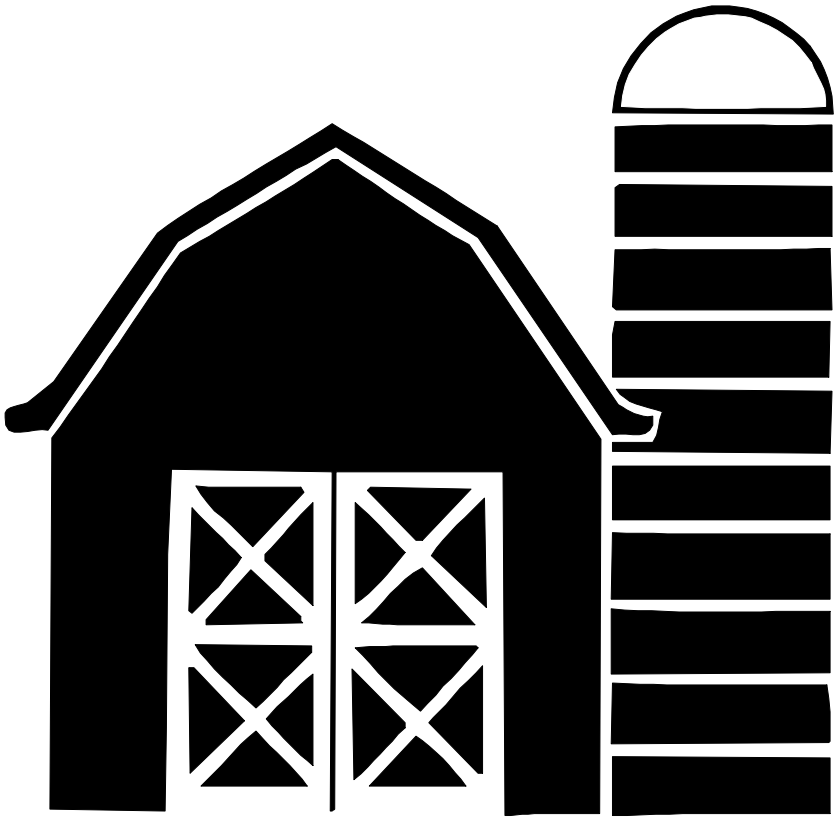
Agricultural Economics Report No. 394 **May 1998**

Shortfalls in 1997 Net Farm Income in North Dakota

(Prepared for Senators Byron Dorgan and Kent Conrad)

Won W. Koo, Richard D. Taylor, Andrew L. Swenson,
D. Demcey Johnson, and George K. Flaskerud



Department of Agricultural Economics ! Agricultural Experiment Station
North Dakota State University ! Fargo, ND 58105-5636

Acknowledgments

This report was prepared for Senator Byron Dorgan and Senator Kent Conrad. The authors wish to extend their appreciation to Professors Timothy Petry, David Saxowsky, and Dwight Aakre for their constructive comments and suggestions. Special thanks go to Ms. Charlene Lucken, who provided editorial comments, and to Ms. Carol Jensen, who helped to prepare the manuscript.

We would be happy to provide a single copy of this publication free of charge. You can address your inquiry to: Carol Jensen, Department of Agricultural Economics, North Dakota State University, P.O. Box 5636, Fargo, ND, 58105-5636, Ph. 701-231-7441, Fax 701-231-7400, e-mail cjensen@ndsuext.nodak.edu . This publication is also available electronically at this web site: http://agecon.lib.umn.edu/ndsu.html

NOTICE:

The analyses and views reported in this paper are those of the author. They are not necessarily endorsed by the Department of Agricultural Economics or by North Dakota State University.

North Dakota State University is committed to the policy that all persons shall have equal access to its programs, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

Information on other titles in this series may be obtained from: Department of Agricultural Economics, North Dakota State University, P.O. Box 5636, Fargo, ND 58105. Telephone: 701-231-7441, Fax: 701-231-7400, or e-mail: cjensen@ndsuext.nodak.edu.

Table of Contents

List of Tables

List of Figures

Abstract

North Dakota net farm income declined in 1997 due to adverse weather conditions and low prices. The total income loss in 1997 was estimated to be $394 million, which was divided into $290 million due to weather and diseases, and $104 million due to lower-than-average prices. Net farm income losses were largest in Region 3 (Northeast), followed by Regions 1 (Northwest) and 6 (East Central). HRS wheat accounted for the largest income loss, followed by durum and barley.

Key Words: Net farm income, crop losses, weather conditions, North Dakota input output model

Highlights

The North Dakota agricultural economy has experienced severe financial stress since 1995, while the overall U.S. agricultural economy has been relatively healthy. Stress has been especially acute since 1997 due to poor weather conditions during the growing season, diseases, and low prices for crops produced in North Dakota.

According to annual reports of the North Dakota Farm and Ranch Business Management education program, average net farm income (NFI) dropped by 59% in 1997, relative to 1996, excluding the Red River Valley. The combined Minnesota-North Dakota Red River Valley report showed an average 62% drop in NFI. Farms with negative NFI in 1997 were almost evenly distributed across size categories. About 30 percent of farms enrolled in the North Dakota Farm and Ranch Business Management system experienced negative NFI in 1997.

Prices received by producers for hard red spring (HRS) wheat and barley have been on a downward trend in real terms for the last 20 years, and prices in 1997 were lower than their 5-year moving averages.

In 1997, North Dakota net farm income declined by about $394 million due to adverse weather and low prices. Of this income loss, $290 million was due to weather and diseases, and $104 million was due to lower-than-average prices. Net farm income losses were largest in Region 3 (Northeast), followed by Regions 1 (Northwest) and 6 (East Central). HRS wheat accounted for the largest income loss, followed by durum and barley.

Estimated losses in 1997 farm income were likely translated into a much larger reduction in general economic activity. Based on the North Dakota input-output model, a reduction of $1,223 in economic activity seems plausible.

Shortfalls in 1997 Net Farm Income in North Dakota

Won W. Koo, Richard D. Taylor, Andrew L. Swenson, D. Demcey Johnson, and George K. Flaskerud*

Introduction

The North Dakota agricultural economy has experienced severe financial stress since 1995, while the overall U.S. agricultural economy has been relatively healthy. Stress has been especially acute since 1997 due to poor weather conditions during the growing season, diseases, and low prices for crops produced in North Dakota. According to annual reports of the North Dakota Farm and Ranch Business Management education program, average net farm income (NFI) dropped by 59% in 1997 (to $15,190), relative to 1996, excluding the Red River Valley (Table 1). The combined Minnesota-North Dakota Red River Valley report showed an average 62% drop in NFI. When farms are grouped by profit category, the same trend emerges: NFI dropped in 1997 for high, medium, and low-profit farms. Low-profit farms have experienced negative NFI income in most years since 1989, but losses in 1997 for this group were larger than in any recent year.

Table 1. Average North Dakota Net Farm Income, Excluding Red River Valley

Year	20% low[a]	60% middle[b]	20% high[c]	All farms
	----------$----------			
1989	(11,931)	17,079	65,500	20,979
1990	(580)	30,639	90,267	36,334
1991	(6,970)	29,416	84,945	33,262
1992	3,467	41,277	119,766	49,413
1993	2,973	46,399	131,774	54,789
1994	(10,956)	32,281	113,661	39,891
1995	(25,144)	24,394	104,162	30,440
1996	(18,619)	28,609	119,059	37,272
1997	(34,394)	13,662	69,391	15,190
'89-96 Avg	(8,470)	31,262	103,642	37,779

[a] The low 20% of farms in terms of farm profitability.
[b] The middle 60% of farms in terms of farm profitability.
[c] The top 20% of farms in terms of farm profitability.
Source: North Dakota Farm and Ranch Business Management Education Program, 1989-1997.

*The authors are professor, research associate, extension farm management specialist, associate professor, and extension crops economist, respectively, in the Department of Agricultural Economics, North Dakota State University, Fargo.

Farms with negative NFI in 1997 were almost evenly distributed across size categories (Table 2). About 30 percent of farms enrolled in the North Dakota Farm and Ranch Business Management system experienced negative NFI in 1997: 32 percent of small-size farms, 28 percent of medium-size farms, and 29 percent of large-size farms.

Table 2. Average North Dakota Net Farm Income by Farm Size, 1997

	Number	Average Size	Gross	Net	% losses[d]
		(ac)	----------($)----------		
Small[a]	140	532	106,604	9,936	32
Medium[b]	280	1,344	206,255	19,335	28
Large[c]	140	2,677	354,921	32,279	29

[a] The smallest 25% of farms when farms are sorted by cropland acres.
[b] The middle 50% of farms when farms are sorted by cropland acres.
[c] The largest 25% of farms when farms are sorted by cropland acres.
[d] Percentage of farms which show a negative net farm income in 1997 to the total farms in each farm size group.
Source: North Dakota Farm and Ranch Business Management Education Program.

Fusarium Head Blight (FHB), commonly known as scab, has been a severe problem for wheat and barley producers in this region. Yield losses due to FHB have been widely reported. In addition, extreme weather across North Dakota (flood in the early spring, late planting dates, excess rain in some areas, and drought in other areas) in 1997 reduced crop yields substantially (Figure 1).

Prices received by producers for hard red spring (HRS) wheat and barley have been on a downward trend in real terms for the last 20 years, and prices in 1997 were lower than their 5-year moving averages. Meanwhile, farm expenses have increased substantially (Figure 2 and Table 3).

The drop in NFI may have accelerated the exodus from agriculture. About 2,000 farms were lost in North Dakota during 1992-1996, compared to 500 during the previous four years (Johnson et al.). Auction sale listings (for mid-March through May) were up 55 percent in the March 16 issue of *AGWEEK* (Rona Johnson), relative to one year ago.

The purpose of this study was to estimate losses in NFI for North Dakota in 1997 and analyze factors contributing to these losses. Special attention was given to effects of yield reductions due to weather and crop diseases, and effects of low prices, on net farm income by crop reporting districts (CRDs).

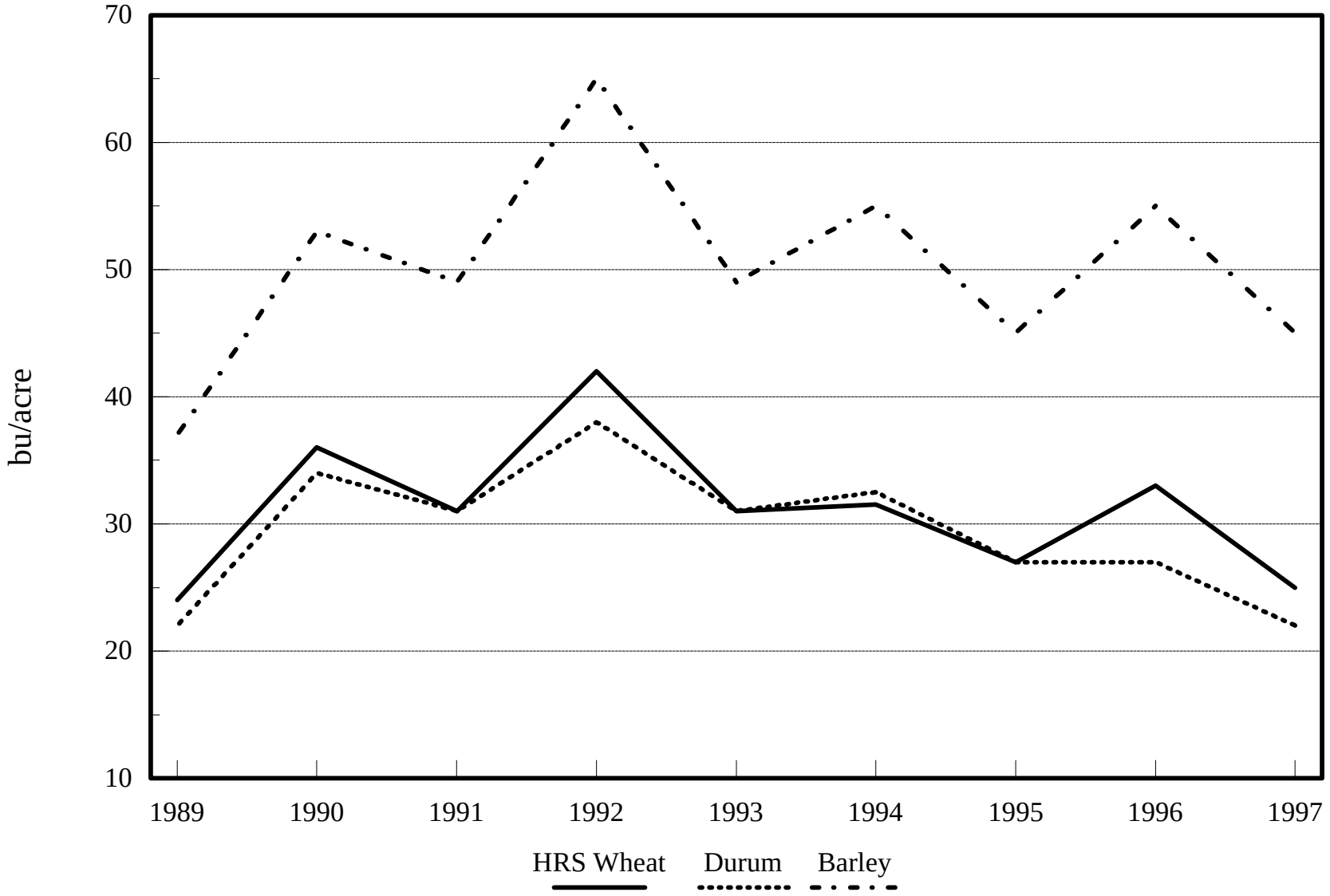


Figure 1. State Average Yields for HRS Wheat, Durum, and Barley

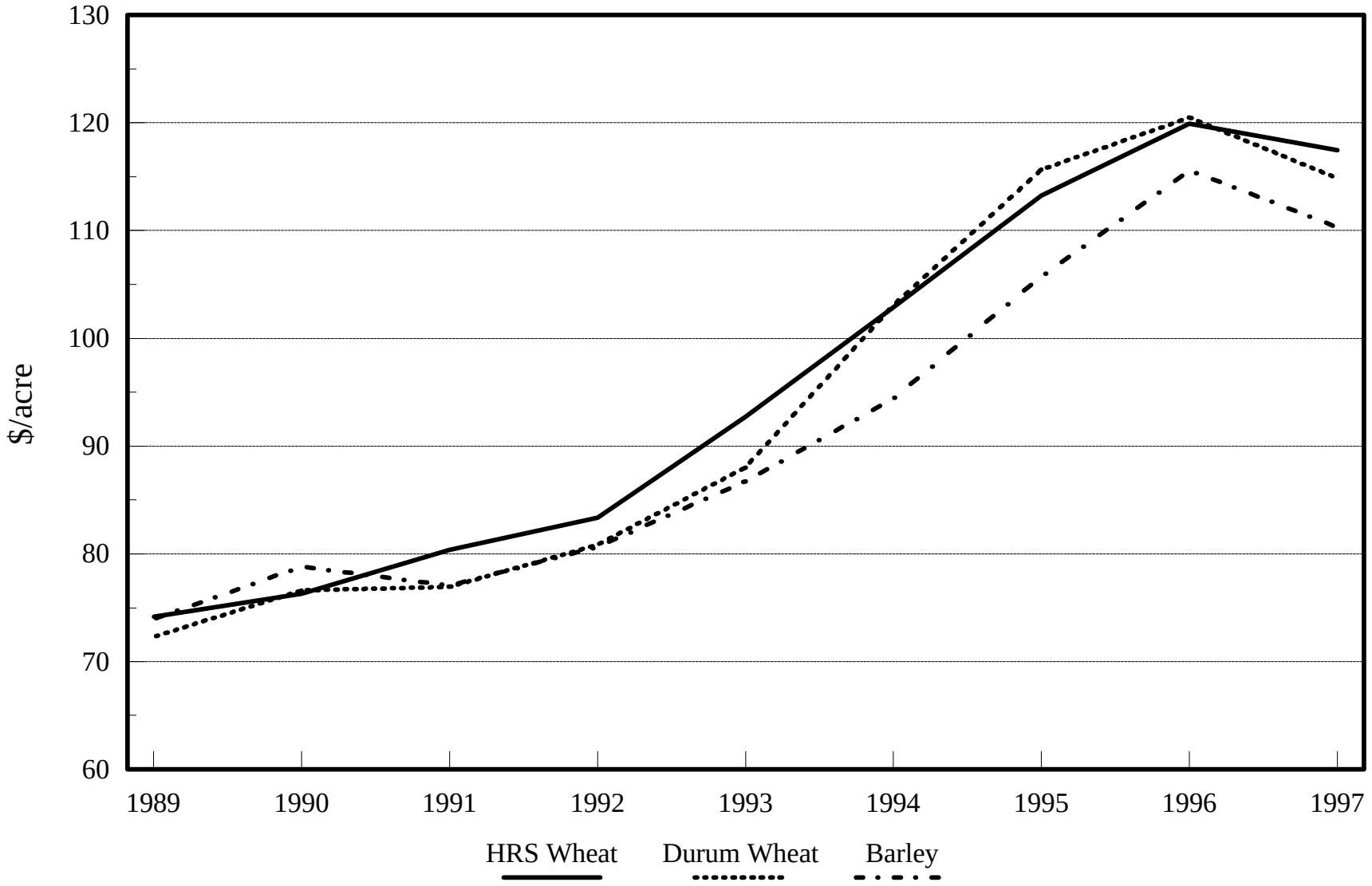


Figure 2. Total Production Costs for HRS Wheat, Durum, and Barley in North Dakota

Table 3. North Dakota Cost of Production for Spring Wheat, Durum, and Barley for 1989 to 1997, Excluding Red River Valley

	1989	1990	1991	1992	1993	1994	1995	1996	1997	% increase
Spring Wheat										
seed	6.52	5.93	4.92	6.64	7.19	8.79	8.43	10.69	8.93	37
fert	6.67	6.71	8.26	9.32	11.73	14.96	18.20	19.27	19.41	191
chem	5.12	4.66	5.45	4.70	6.28	6.87	8.11	9.56	9.52	86
fuel	4.54	4.86	5.45	5.21	5.37	5.69	5.88	6.42	6.22	37
repairs	6.86	7.32	7.31	7.85	8.93	9.45	9.50	9.58	9.36	36
land rent	23.04	24.11	25.18	26.58	25.87	27.27	29.21	28.81	29.61	29
others	8.30	9.79	9.28	9.14	11.42	11.90	14.30	15.34	13.83	67
total direct	**61.05**	**63.38**	**65.85**	**69.44**	**76.79**	**84.93**	**93.63**	**99.67**	**96.88**	**59**
total overhead	13.09	12.90	14.52	13.92	15.95	17.94	19.62	20.27	20.60	57
total cost	**74.14**	**76.28**	**80.37**	**83.36**	**92.74**	**102.87**	**113.25**	**119.94**	**117.48**	**58**
Durum										
seed	7.74	6.95	5.64	7.01	7.24	11.95	11.97	12.88	11.43	48
fert	6.06	5.94	6.90	8.65	10.09	14.27	18.74	17.96	17.31	186
chem	3.91	5.76	5.85	5.08	6.53	8.39	9.30	10.98	10.51	169
fuel	4.60	5.64	5.44	5.44	5.66	5.58	5.91	6.18	5.17	12
repairs	7.48	6.89	7.19	7.88	8.73	10.08	9.99	9.76	9.64	29
land rent	21.03	23.65	25.46	24.76	26.31	26.56	28.49	26.81	27.71	32
others	9.13	9.62	8.19	9.87	9.60	9.95	12.66	13.32	14.10	54
total direct	**59.95**	**64.45**	**64.67**	**68.69**	**74.16**	**86.78**	**97.06**	**97.89**	**95.87**	**60**
total overhead	12.35	12.15	12.25	12.13	13.86	16.29	18.60	22.60	18.99	54
total cost	**72.30**	**76.60**	**76.92**	**80.82**	**88.02**	**103.07**	**115.66**	**120.49**	**114.86**	**59**
Barley										
seed	5.79	5.06	4.47	4.74	5.21	5.18	6.25	8.73	6.23	08
fert	7.23	6.21	7.55	9.02	11.21	14.03	17.59	18.66	17.99	149
chem	5.17	5.15	5.60	4.63	5.48	6.95	7.01	8.45	9.36	81
fuel	4.83	6.46	5.30	5.58	5.62	5.65	6.09	6.83	6.35	31
repairs	7.46	7.37	7.28	7.86	9.19	9.43	9.82	9.92	9.23	24
land rent	22.63	24.81	24.10	25.57	25.37	26.40	28.31	27.77	28.52	26
others	8.30	9.43	8.49	7.88	8.57	9.28	11.29	13.30	13.87	67
total direct	**61.41**	**64.49**	**62.79**	**65.28**	**70.65**	**76.92**	**86.36**	**93.66**	**91.55**	**49**
total overhead	12.55	14.31	14.25	15.37	16.09	17.50	19.40	21.92	18.77	50
total cost	**73.96**	**78.80**	**77.04**	**80.65**	**86.74**	**94.42**	**105.76**	**115.58**	**110.32**	**49**

Source: North Dakota Farm Business Management Education Program.

Method

Net farm income (NFI) losses due to weather, diseases, and price changes are calculated for nine crop reporting districts of North Dakota (see Figure 3). Since North Dakota produces mainly HRS wheat, durum wheat, and barley, net farm income losses are calculated for these three crops.

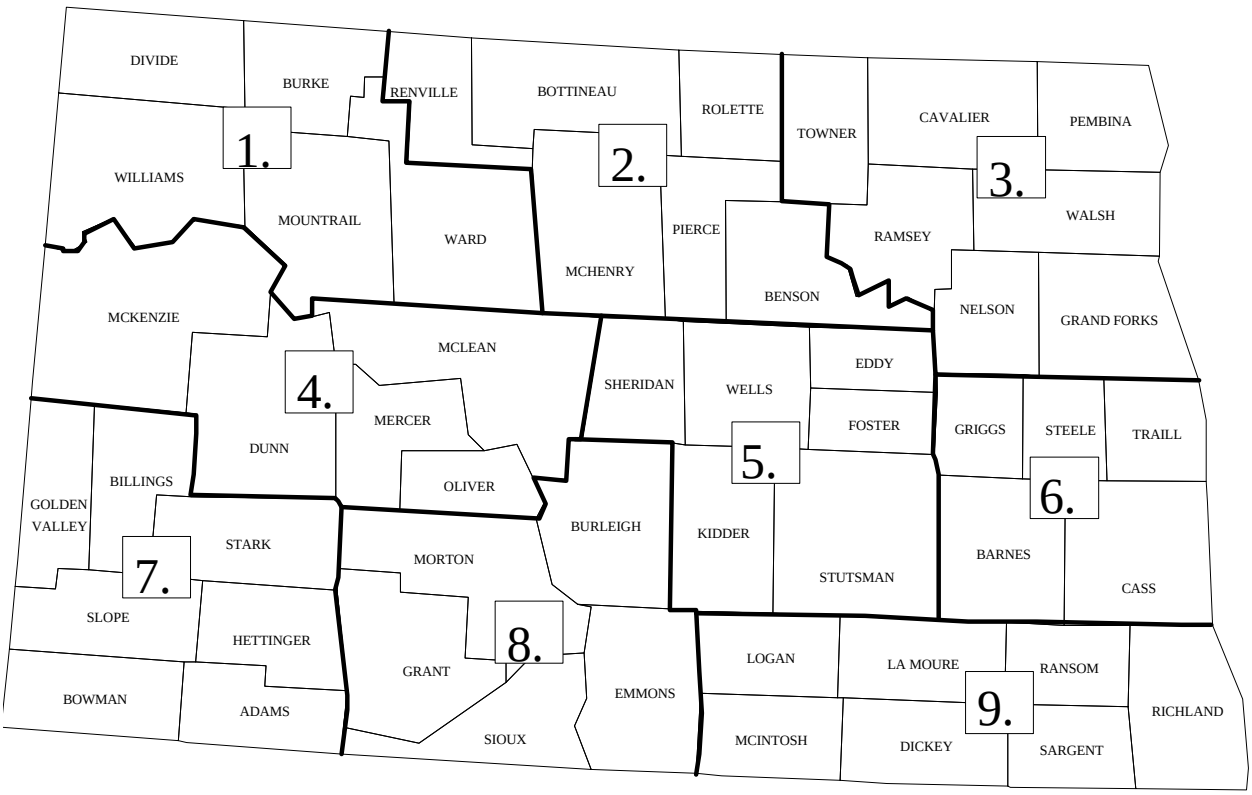


Figure 3. North Dakota Crop Reporting Districts (CRD)

The total NFI losses due to adverse weather (and associated diseases) and price conditions are calculated by multiplying the losses per acre by the total harvested acres in a region, as follows:

$$L_{it} = (y^e_{it}\, p^e_{it} - y_{it}\, p_{it})\, A^h_{it} \quad (1)$$

where L_{it} is the total loss in net farm income in region i in time t

y^e_{it} is the estimated long-run trend yield for region i in time t
y_{it} is the actual yield for region i in time t
p^e_{it} is the estimated 5-year moving average price for region i in time t
p_{it} is the actual price received by farmers for region i in time t
A^h_{it} is harvested acres for region i in time t.

The first term in the parenthesis of Equation 1 represents normal average revenue per acre and the second term represents the actual revenue per acre. The loss in farm income is calculated by multiplying the difference between these two terms by total harvested acres.

Total losses in NFI in a given year consist of income losses due to adverse weather and diseases, those due to changes in crop prices received by farmers, and those due to the interaction of production and price. Income loss per acre due to weather and disease is calculated by multiplying the estimated yield shortfall (trend yield minus actual yield) by the net price received. Similarly, the income loss per acre due to low prices is calculated by multiplying the actual price reduction (relative to the 5-year average) by the long-run trend yield. The income loss due to the interaction of production and price is the product of deviations of yield and price from their average values. To separate the total NFI loss into 'production' and 'price' components, Equation 1 is rewritten as

$$L_{it} = [(y^e_{it} - y_{it})\, p_{it} + (p^e_{it} - p_{it})\, y_{it} + (y^e_{it} - y_{it})\, (p^e_{it} - p_{it})]\, A^h_{it} \quad (2)$$

The last term of Equation 2 represents the interaction of yield and price deviations. This term can be allocated equally to 'production' and 'price' components, as follows:

$$L_{it} = [(y^e_{it} - y_{it})\, p_{it} + \tfrac{1}{2}\, (y^e_{it} - y_{it})\, (p^e_{it} - p_{it})]\, A^h_{it} + [(p^e_{it} - p_{it})\, y_{it} + \tfrac{1}{2}\, (y^e_{it} - y_{it})\, (p^e_{it} - p_{it})]\, A^h_{it} \quad (3)$$

The first term of Equation 3 represents the contribution of adverse yields to lost NFI, and the second term represents the contribution of lower-than-average prices. When the actual prices are higher than the long-run average price, and actual yields are lower than the long-run trend yields, the total net income losses are calculated as:

$$L_{it} = [(y^e_{it} - y_{it})\, p^e_{it} + (p^e_{it} - p_{it})\, y_{it}]\, A^h_{it} \quad (4)$$

Conversely, when the actual yields are higher than the long-run trend yield, and actual prices are lower than the long-run price, total net income losses are calculated as:

$$L_{it} = [(y^e_{it} - y_{it})\, p_{it} + (p^e_{it} - p_{it})\, y^e_{it}]\, A^h_{it} \quad (5)$$

Equation 3, 4, or 5 are used to calculate net farm income losses due to production and those due to prices, depending on the relationship of actual prices and yields to their long-run average values.

The long-run trend yield of a crop is estimated by regressing actual yields against a linear trend as follows:

$$y^e_{it} = a_0 + a_1 \text{ trend} + e_{it}$$

where e_{it} represents deviations of yields from the long-run trend yield. These deviations are due to weather, crop diseases, and other factors.

Yield equations for HRS wheat, durum wheat, and barley were estimated for each crop reporting district, using data from 1970 to 1997 obtained from the North Dakota Agricultural Statistics Service. Estimated yield shortfalls for 1997 are shown in Table 4. Table 5 shows deviations of actual prices received in 1997 from their 5-year moving averages.

Results

Adverse weather conditions, late planting, and diseases caused an average yield reduction of about 22 percent for HRS wheat relative to the trend yield (Table 4). Average yield reductions were about 26 percent for durum wheat and 18 percent for barley. Yield losses were greatest in Region 6 (East Central), followed by Regions 3 (North Central) and 1 (Northwest).

Prices received for HRS wheat and barley were lower than their 5-year average in all CRDs (Table 5). Prices received for durum wheat were higher than average in several CRDs, while lower in others. Differences in average prices received for durum may reflect differences in crop quality across producing regions.

Table 4. Estimated Trend Yields, Actual Yields, and Differences by Regions of North Dakota, 1997

	Estimated			Actual			Difference			
CRD	Spring	Durum	Barley	Spring	Durum	Barley	Spring	Durum	Barley	
	bu/acre									
1	29.1	29.1	46.0	21.9		21.9	42.1	- 7.2	- 7.2	- 3.9
2	29.0	28.2	49.0	23.6		21.0	44.4	- 5.4	- 7.2	- 4.6
3	35.5	27.5	57.0	27.1		22.0	46.0	- 8.4	- 5.5	-11.0
4	28.0	28.1	41.5	24.1		22.5	43.0	- 3.9	- 5.6	1.5
5	29.5	28.2	50.9	22.1		21.0	45.9	- 7.4	- 7.2	- 5.0
6	36.8	34.5	60.9	27.9		27.1	50.0	- 8.9	- 7.4	-10.9
7	26.7	27.9	36.8	26.8		28.3	35.8	0.1	0.4	- 1.0
8	23.8	24.9	37.5	19.7	18.9	32.8	- 4.1	- 6.0	- 4.7	
9	33.0	28.9	52.1	26.5		23.1	46.0	- 6.5	- 5.8	- 6.1

Table 5. Deviations of the 1997 Actual Prices From 5-year Moving Average, North Dakota

CRD Region	Spring	Durum	Barley
	$/bu		
1	-0.36	0.00	-0.29
2	-0.42	0.16	-0.27
3	-0.26	0.46	-0.15
4	-0.38	-0.15	-0.14
5	-0.42	0.08	-0.19
6	-0.35	0.59	-0.18
7	-0.43	-0.19	-0.06
8	-0.42	1.17	-0.03
9	-0.38	0.11	-0.18

The total losses in NFI for North Dakota crop reporting districts are divided into losses due to weather and diseases, and losses due to lower-than-average prices (Figure 4). Table 6 shows estimated losses in NFI due to weather conditions in 1997. The largest losses in NFI due to weather and crop diseases are found in Region 1 ($67.6 million), followed by Region 3 ($66.7 million) and Region 6 ($42 million). In addition to adverse weather and disease problems during the growing season, Region 3 had late planting because of flooding in early spring. Other large weather-related losses occurred in Region 2 ($29.8 million) and Region 5 ($29 million). Weather-related losses in NFI were largest for HRS wheat ($176 million), followed by durum wheat ($83.4 million) and barley ($30.8 million).

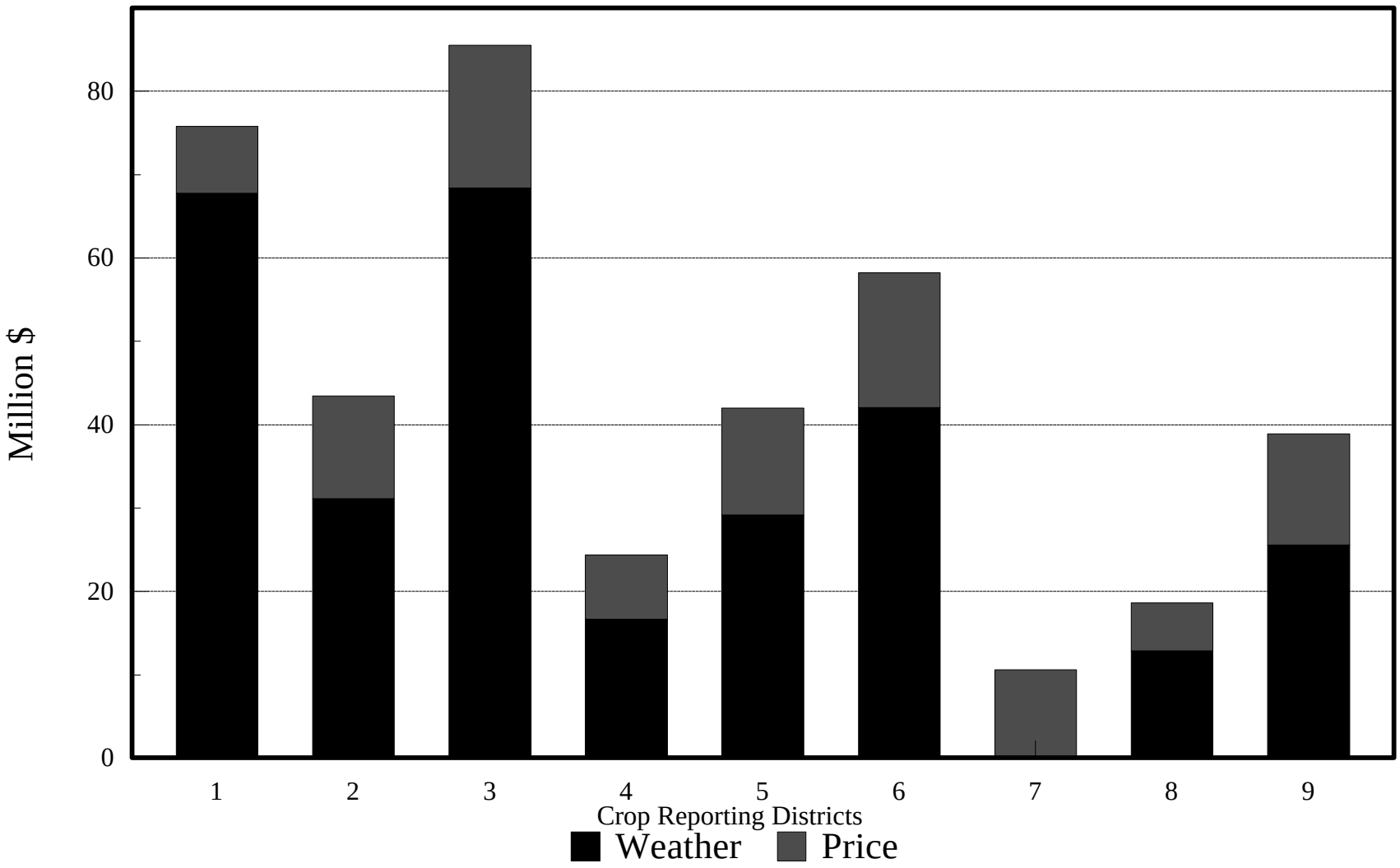


Figure 4. Total Farm Income Losses by Crop Reporting Districts for North Dakota in 1997

Table 6. Estimates Loss Due to Weather Conditions for North Dakota in 1997

CRD Region	Spring Wheat	Durum	Barley	Total Weather
	----------$----------			
1	14,081,472	51,896,750	1,665,729	67,643,951
2	13,707,360	12,468,758	3,600,606	29,776,725
3	47,141,472	4,332,009	15,223,814	66,697,295
4	7,602,582	10,758,384	(251,865)	18,109,101
5	24,454,188	2,279,791	2,268,140	29,002,119
6	35,465,254	254,738	6,242,430	41,962,422
7	(283,475)	(247,111)	151,570	(379,016)
8	9,996,620	1,306,890	586,234	11,889,744
9	23,798,515	366,560	1,337,298	25,502,373
Total	**175,963,988**	**83,416,769**	**30,823,957**	**290,204,714**

The total weather-related loss in net farm income is $290.2 million. A large portion of these income losses was due to diseases, such as FHB. According to Johnson et al., in five crop reporting districts (Regions 2, 3, 5, 6, and 9), FHB caused a $108 million reduction in crop value for HRS and durum wheat in 1997.

The losses in NFI due to price changes are shown in Table 7. Region 3 had the largest loss due to price reductions ($17.1 million), followed by Region 6 ($16.1 million). The total price-related losses were highest for HRS wheat ($85 million), followed by barley ($21 million). For durum wheat, the 1997 price received was higher than the 5-year moving average, resulting in higher farm income. For the three crops combined, the total loss in NFI due to price changes was $103.9 million.

Table 7. Estimated Loss Due to Prices for North Dakota Farmers in 1997

CRD Region	Spring Wheat	Durum	Barley	Total Price
	----------$----------			
1	5,265,240	(146,982)	2,897,609	8,015,867
2	8,394,960	(1,341,782)	5,291,997	12,345,175
3	13,140,992	(1,714,581)	5,707,941	17,134,352
4	5,711,202	1,460,316	514,605	7,686,123
5	10,829,808	(129,770)	2,165,610	12,865,648
6	13,207,858	(118,518)	3,027,570	16,116,910
7	9,777,125	686,876	161,905	10,625,907
8	6,668,550	(999,297)	75,172	5,744,425
9	12,387,305	(36,400)	1,036,995	13,387,900
Total	**85,383,040**	**(2,340,138)**	**20,879,404**	**103,922,306**

In general, yield reductions due to weather and diseases might be expected to raise domestic crop prices. However, Canada is a large surplus producer of small grains, and any production shortfall in the United States is likely to be met in part by imports from Canada. This negates much of the (positive) effect of a poor crop on U.S. wheat and barley prices.

Table 8 shows the total estimated farm income losses for 1997 (sum of 'production' and 'price' components). Region 3 experienced the largest income loss ($83.8 million), followed by Region 1 ($75.7 million). Net farm income losses are the highest for HRS wheat ($261.3 million), followed by durum wheat ($81.1 million). Total NFI losses in 1997 were $394.1 million. These are divided into losses due to weather and diseases ($290.2 million) and the loss due to price changes ($103.9 million).

Table 8. Estimated Total Farm Income Loss for 1997 in North Dakota

CRD Region	Spring Wheat	Durum	Barley	Total
	----------$----------			
1	19,346,712	51,749,768	4,563,338	75,659,818
2	22,102,320	11,126,976	8,892,604	42,121,900
3	60,282,464	2,617,428	20,931,755	83,831,647
4	13,313,784	12,218,700	262,740	25,795,224
5	35,283,996	2,150,021	4,433,750	41,867,767
6	48,673,112	136,219	9,270,000	58,079,331
7	9,493,650	439,765	331,475	10,246,890
8	16,665,170	307,593	661,406	17,634,169
9	36,185,820	330,160	2,374,294	38,890,274
Total	**261,347,028**	**81,076,631**	**51,703,361**	**394,127,020**

The total economic impact of NFI losses was estimated via the North Dakota input-output model (Leistritz). Based on expenditure patterns and sectoral linkages in the model, the reduction in 1997 crop value would lead to a much larger decrease in total economic activity in North Dakota, on the order of $1,214 million. The total economic impact (direct and indirect) of weather-related losses would be approximately $894 million, and that for price-related losses would be approximately $320 million.

Concluding Remarks

In 1997, North Dakota net farm income declined by about $394 million due to adverse weather and low prices. Of this income loss, $290 million was due to weather and diseases, and $104 million was due to lower-than-average prices. Net farm income losses were largest in Region 3 (Northeast), followed by Regions 1 (Northwest) and 6 (East Central). HRS wheat accounted for the largest income loss, followed by durum and barley.

Estimated losses in 1997 farm income were likely translated into a much larger reduction in general economic activity. Based on the North Dakota input-output model, a reduction of $1,214 million in economic activity seems plausible. Of this amount, $894 million would have been due to adverse weather, and $320 million due to low prices.

References

Johnson, Demcey, George Flaskerud, Richard Taylor, and Vidya Satyanarayana. *Economic Impacts of Fusarium Head Blight in Wheat*. Agricultural Economics Report. Department of Agricultural Economics, NDSU, Fargo, (Forthcoming).

Johnson, Rona K., ed. 1998 "Upcoming Auctions." *AGWEEK*, March 17, 1997 and March 16, 1998 issues, Grand Forks, ND.

Leistritz, F. L. Personal Communication, May 1998.

North Dakota Agricultural Statistics. http://www.nass.usda.gov/nd. Country estimates, Fargo.

North Dakota Farm and Ranch Business Management Program, Region Reports, 1989 to 1997. North Dakota Vocational-Technical Education.

North Dakota Farm and Ranch Business Management Program, State Reports, 1989 to 1997. North Dakota Vocational-Technical Education.