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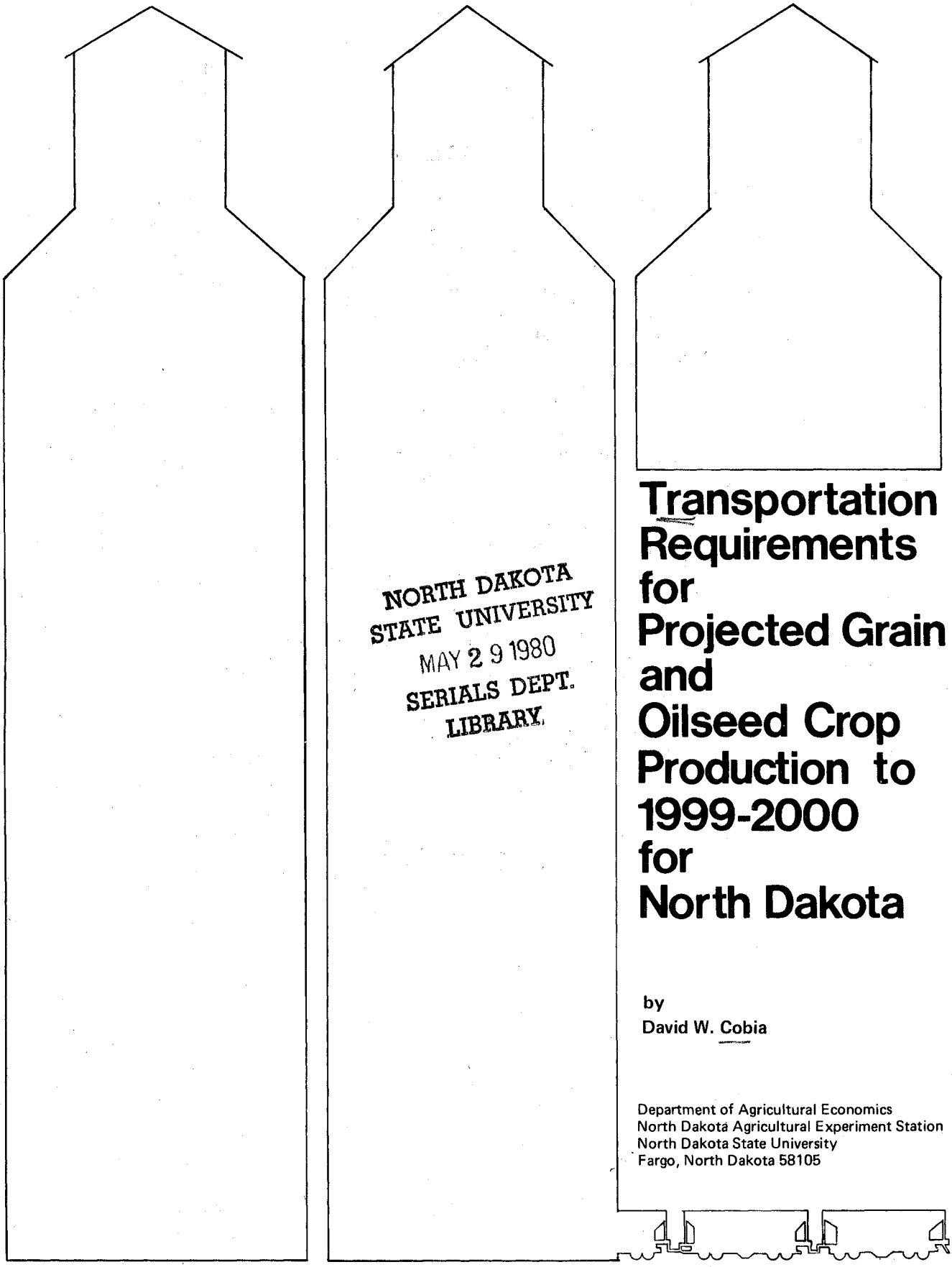

Transportation Requirements for Projected Grain and Oilseed Crop Production to 1999-2000 for North Dakota

by
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FOREWORD

Projections of crop production and livestock consumption of selected grains and oilseed crops reported in this publication were prepared as part of a North Central (NC) Regional Research Committee 137 effort. The objective was to forecast transportation demand by agricultural products to the year 2000. Funding was provided by ND 1360 and NC-137 projects, both titled "Alternative Rural Freight Transportation and Distribution Systems."

Steve Hvinden did the computer work for the charts and final regressions. Karl Schmidt collected much of the data and made the initial regressions. Several staff members from the Agricultural Experiment Station and Cooperative Extension Service at North Dakota State University were liberal in sharing their feelings about fundamental shifts in trends and estimating procedures. Special appreciation for this type of assistance is extended to Duane Berglund, Jack Carter, Roger Johnson, Roald Lund, Hugh McDonald, Thomas Ostenson, Tim Petry, and Richard E. Pyler. Assistance on rations for livestock was given by LaDon Johnson, William Dinusson, and Robert L. Johnson. Comments from William Roath and Jerry Miller, Agricultural Research--USDA, were also very helpful, especially on projections of sunflower production.

Projections given in this publication are not intended as firm predictions. Unforeseen developments will alter trends in ways no one can anticipate.

Some readers may be aware of situations, relationships, or information which would lead to estimates different from those in this report. Anyone with such information is invited to forward them to the author.

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HIGHLIGHTS

Production of eight major grain and oilseed crops in North Dakota was estimated to increase 88% by volume from 1975 to 1999. An expected decline of 18% in consumption of grain by livestock will result in a doubling of grain and oilseeds exported from the state by volume but only 60% by weight for the 1976-2000 period. This expansion of exportable surplus will require a substantial increase in the capacity of the rail and truck industries.

The estimated increase in production came from an increase in harvested acres made possible by a forecast reduction of summer fallow and from an expected increase in yields. An increase of 1400% in sunflower production, which weighs one-half as much per bushel as wheat, accounts for the difference in the increase of volume and weight.

TRANSPORTATION REQUIREMENTS FOR PROJECTED GRAIN AND OILSEED CROP PRODUCTION TO 1999-2000 FOR NORTH DAKOTA

by

David W. Cobia*

INTRODUCTION AND SUMMARY

The production of major grain and oilseed crops and livestock consumption of grain were forecast to the year 2000. These forecasts were made to project the quantities of major crops requiring transportation from North Dakota. This effort was part of a North Central and Southern regional project involving 22 states to forecast the demand for transportation by grain and oilseed crops.[§]

In spite of problems associated with making forecasts, transportation agencies, merchandisers, processors, and others closely associated with North Dakota agriculture should find these projections useful for planning as they adjust to the changing economic and institutional environment. Projections can also serve as a bench mark or point of departure as new fundamental conditions come to light.

These projections primarily were based on trends since 1960 and national forecasts. They were done for three North Dakota transportation regions. Crops involved were wheat, sunflower, barley, oats, flax, soybeans, corn, and rye. Projected acres were multiplied by anticipated yields to obtain total production. Exportable surplus or demand for transportation was obtained by subtracting grain consumed by livestock from production. The base year for which comparisons were made is 1975-1976.

Several projections were made by statistical procedures. Some were statistically significant, while for others the correlation on the trend line was extremely low. Estimates from the latter were used,

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[§]Postal abbreviations of participating states are AL, AR, GA, IL, IN, IA, KS, KY, LA, MI, MN, MS, MO, MT, ND, NE, OH, OK, SC, SD, TN, and TX. Results have been published by Michigan, Minnesota, and Montana (see 3, 4 and 6).

provided the estimates were consistent with fundamentals or no better basis was found. In other cases, fundamental conditions dictated a significant shift from past trends. Estimates for these trends reflect the combined judgment of knowledgeable individuals.

Production of the eight crops was estimated to increase 88% by volume and 66% by weight from 1975 to 1999. An increase of 1400% in sunflower production, which weighs one-half as much as wheat per bushel, accounts for this difference. Corn production is expected to double and soybeans, wheat, and barley production is expected to increase 53, 41, and 27% respectively.

These estimated increases in production result from an increase in both harvested acres and yields. The increase in harvested acres is made possible by a forecast reduction of 34% of summer fallow and a reduction of 71, 34, and 32% in land devoted to flax, rye, and oats, respectively. Yields of all crops are expected to increase. Increases ranged from 16% for flax to 62% for corn.

Livestock consumption of grain is expected to decline 18% during the 1976-2000 period, primarily as a result of a projected decline in milk cow, cattle on feed, sheep, and layer numbers. Beef cow, replacement heifer, and turkey numbers are expected to increase.

Estimated exportable surplus of the eight crops doubled from 1976 to 2000 by volume but increased only 60% by weight. This increase in transportation requirements will require a substantial increase in capacity in the rail and truck industries. Planning for these changes is especially critical in light of the chronic short supply of rail equipment experienced since 1973.

PROCEDURES

Exportable surplus or demand for transportation by selected agricultural products was estimated for 1985, 1990, and 2000 by subtracting estimated grain consumption by livestock and poultry from estimated production. The general approach employed to project crop production and livestock consumption was to extend time trends from the 1960-1976 period to 1985, 1990, and 2000 for relevant transportation regions of

the state. Crop reporting districts were aggregated into three regions which reflected relatively homogeneous transportation flows as determined by the Upper Great Plains Transportation Institute. Region 1 includes crop reporting districts 1 (NW), 2 (NC), and 5 (C); Region 2 includes crop reporting districts 3 (NE), 6 (EC), and 9 (SE); and Region 3 includes crop reporting districts 4 (WC), 7 (SW), and 8 (SC) (Figure 1).

Projected harvested acres and yields of specified crops for each region were multiplied to obtain total production. Consumption of wheat, corn, oats, and barley by livestock and poultry was found by multiplying projected species numbers by the amount of grain in each ration. It was assumed that the grain produced in 1984, 1989, and 1999 would move through the marketing channel in 1985, 1990, and 2000. Further, consumption of grain by livestock in 1985, 1990, and 2000 came from the previous year's crop production. This procedure does not take into account minor uses and flows of grain, such as imports into the state, seed use, and on-farm consumption other than for livestock.

Most other states participating in this effort to estimate demand for transportation prepared forecasts based on their state's share of national forecasts from the National-Interregional Agricultural Projections (NIRAP) model. NIRAP is a computerized model designed to forecast the supply and demand of major agricultural commodities in the U.S. This model--prepared by the Economics, Statistics, and Cooperatives Service, USDA--is used to update projections periodically as new trends are observed. These projections are generally more accurate on a national rather than state level. Most of the long-run projections for North Dakota reported in this publication were not based on the national projections because of recent developments not yet incorporated in the NIRAP model. These developments include recent expansion of sunflower production, anticipated reduction in summer fallow, and trends in some livestock numbers running counter to NIRAP projections.

Harvested acres, average yield, and livestock numbers for the 1960-1976 period were taken from data compiled by the North Dakota Crop and Livestock Reporting Service (5). Harvested acres and yields are

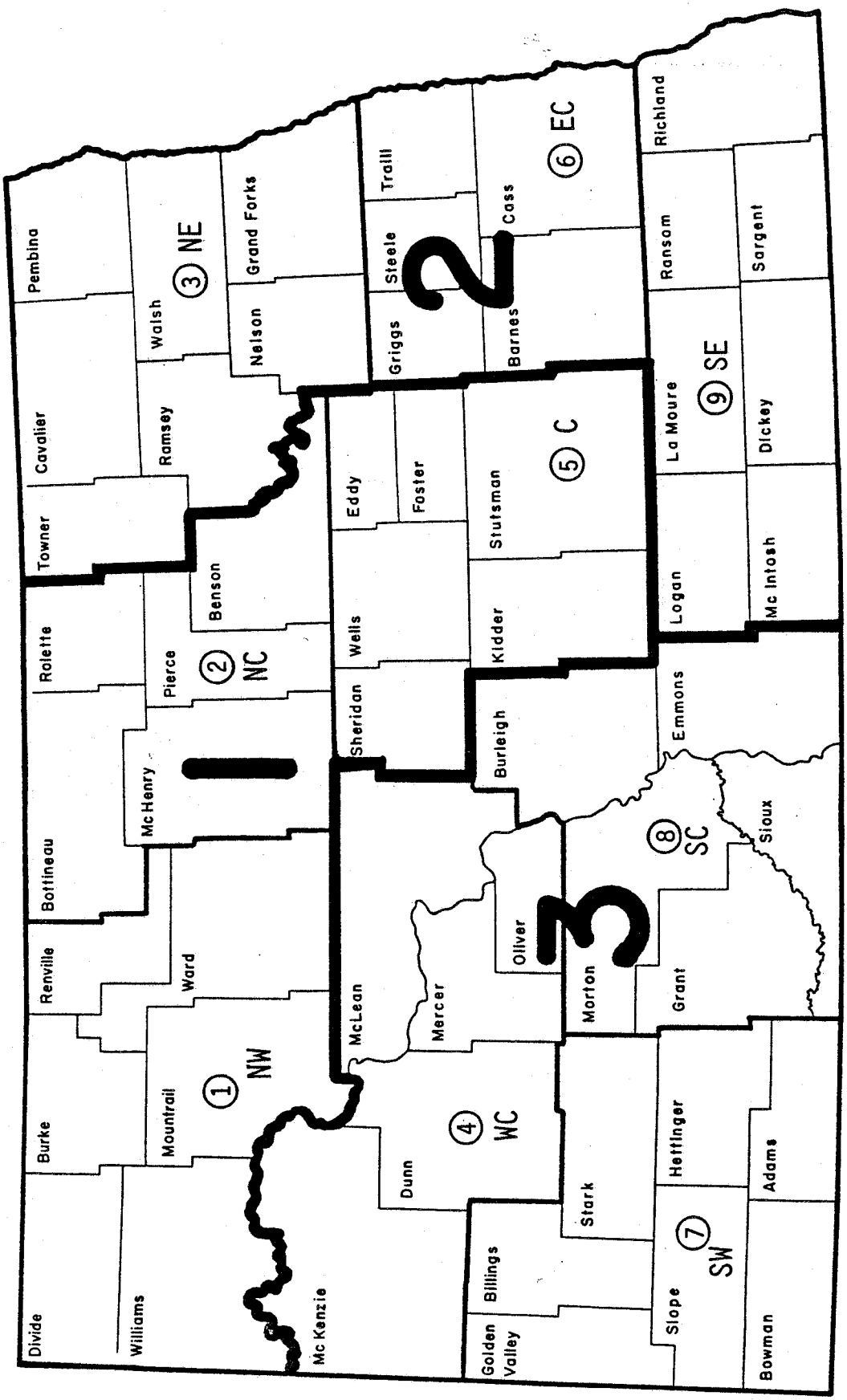

Figure 1. Nine Crop Reporting Districts and Three Transportation Regions of North Dakota

available for each county and crop reporting district. This facilitated preparation of projections for the three regions. Livestock and poultry numbers were released only as state totals. These totals were allocated to the three transportation regions according to county estimates given in the Agricultural Census.

The basic model used to determine trends was simply $Y = a + bX$ where Y = respective acreage, yield, or livestock numbers and X = years 1960-1976. Semilog and double log transformations of the data, as well as raw data, were made for the regression model. The mathematical model with the best correlation and which resulted in projections most closely reflecting the apparent trends and fundamental conditions was selected. In some cases, to be discussed in the next section, anticipated long-run trends did not lend themselves to this procedure.

PROJECTIONS

All projections of crop acres, yield, and production, together with those for livestock numbers and livestock consumption, are presented and briefly discussed in this section. Information on crop production is presented in three formats. Harvested acres, average yield, and production are given separately for each crop by region and year in Tables 1, 2, and 3 (pp, 6, 7, and 8) and then positioned together by crop in Table 4, p. 9. Tables 1, 2, and 3 should be used where the focus of attention is on harvested acres or yields or production across all crops, while Table 4 should be used when considering projected changes of a given crop. The data for harvested acres and yield from the 1960-1976 period, together with projections, are presented visually in Appendix Figures A.1 (pp. 25-30) and A.2 (pp. 31-35).[§]

Projected livestock numbers are given in Table 5, p. 10, and the annual feeding rate for each species is in Table 6, p. 11. A summary of livestock consumption of wheat, barley, oats, and corn is in Table 7, p. 12.

[§]Equivalent figures are available for the three North Dakota transportation regions. Order AE 8001 "Crop Data From 1960 and Projected to 1999 for Three North Dakota Regions," figures to accompany Agricultural Economics Report No. 137 from the Department of Agricultural Economics, North Dakota State University, Fargo, ND 58105.

TABLE 1. HARVESTED ACRES OF GRAIN AND OILSEED CROPS IN NORTH DAKOTA TRANSPORTATION REGIONS, 1960-1976 AVERAGE AND PROJECTED TO 1984, 1989, AND 1999

Crop#	1960-1976 Average Region 1	Region 2	Region 3	Total	1984 Region 1	Region 2	Region 3	Total	1989 Region 1	Region 2	Region 3	Total	1999 Region 1	Region 2	Region 3	Total
	harvested acres (000)															
Wheat (sf)	2,417	1,711	1,400	5,528	2,422	1,158	1,813	5,393	2,213	998	1,693	4,904	1,777	774	1,608	4,159
Wheat (cc)	499§	1,137§	472§	2,108§	1,286	2,798	557	4,641	1,630	3,089	662	5,381	2,599	3,822	763	7,184
Sunflower	587§	1,249§	74§	1,910§	1,411	1,971	731	4,113	1,647	2,168	868	4,683	1,796	2,168	925	4,889
Barley (sf)	279	323	121	724	128	244	130	502	98	222	124	444	55	194	117	366
Barley (cc)	464	1,193	160	1,817	421	1,081	103	1,605	440	1,104	127	1,671	464	1,181	173	1,818
Oats	551	831	496	1,878	328	438	496	1,262	260	370	496	1,126	162	277	496	935
Flax	432	643	179	1,254	182	179	90	451	147	130	76	353	98	72	56	226
Corn	4	154	18	176	1	158	8	167	5	158	8	171	5	158	8	171
Soybeans	---	182	---	182	---	179	---	179	---	178	---	178	---	177	---	177
Rye	125	91	43	259	38	43	15	96	36	36	15	87	38	25	15	78
Summer Fallow					2,757	1,567	1,943	6,267	2,498	1,363	1,817	5,678	1,980	968	1,725	4,673
Other Crops & Unharv. Acres					906	1,025	1,055	2,986	906	1,025	1,055	2,986	906	1,025	1,055	2,986
TOTAL CROPLAND					9,880	10,841	6,941	27,662	9,880	10,841	6,941	27,662	9,880	10,841	6,941	27,662

#sf = respective crop grown on summer fallow.
§cc = respective crop grown on land previously cropped or continuous crop.
§1978.

TABLE 2. AVERAGE YIELD OF GRAIN AND OILSEED CROPS IN NORTH DAKOTA TRANSPORTATION REGIONS, 1960-1976 AVERAGE AND PROJECTED TO 1984, 1989, AND 1999

Crop#	1960-1976 Average				1984				1989				1999			
	Region				Region				Region				Region			
	1	2	3	Total	1	2	3	Total	1	2	3	Total	1	2	3	Total
	average yield (bu/a--except sunflower)															
Wheat (sf)	25.3	28.6	23.3	25.8	31.9	33.5	27.0	30.6	34.0	35.0	29.0	32.5	38.2	38.0	31.0	35.4
Wheat (cc)	19.1§	23.9§	16.6§	21.1§	24.6	30.1	20.0	27.4	26.3	31.5	21.0	28.6	29.7	34.2	23.0	31.4
Sunflower	40.8§	47.5§	36.4§	45.0§	42.0	48.1	33.2	43.4	46.4	53.1	36.7	47.7	55.2	63.1	43.6	56.5
Barley (sf)	36.8	39.1	36.0	37.6	40.3	40.2	39.5	40.0	41.3	42.4	40.7	41.7	43.4	47.0	42.6	45.2
Barley (cc)	30.7	35.5	27.0	33.5	37.1	43.2	32.2	40.9	38.0	45.6	33.8	42.7	39.9	50.5	37.1	46.5
Oats	40.7	45.2	38.6	42.1	47.2	50.2	45.2	47.5	49.2	52.2	47.2	49.3	53.2	56.2	51.2	52.9
Flax	9.6	9.8	8.4	9.5	10.5	10.5	9.1	10.2	10.8	10.8	9.4	10.5	11.3	11.3	9.9	11.0
Corn	32.7	48.0	27.4	45.5	41.8	69.4	36.5	67.7	44.2	74.9	38.9	72.3	49.2	85.8	43.9	82.8
Soybeans	---	17.5	---	17.5	---	21.1	---	21.1	---	22.4	---	22.4	---	25.1	---	25.1
Rye	23.6	26.7	23.3	24.6	29.4	32.5	29.1	30.8	31.3	34.4	31.0	32.5	35.1	38.2	34.7	36.0

#sf = respective crop grown on summer fallow.
cc = respective crop grown on land previously cropped.
sunflower = 30 lb./bu.

§1978 data.

TABLE 3. PRODUCTION OF GRAIN AND OILSEED CROPS IN NORTH DAKOTA TRANSPORTATION REGIONS, 1960-1976 AVERAGE AND PROJECTED TO 1984, 1989, AND 1999

Crop#	1960-1976 Average				1984				1989				1999			
	Region				Region				Region				Region			
	1	2	3	Total	1	2	3	Total	1	2	3	Total	1	2	3	Total
	production (000 bu)															
Wheat (sf)	61,150	48,935	32,620	142,705	77,262	38,793	48,951	165,006	75,242	34,930	49,097	159,269	67,881	29,412	49,848	147,141
Wheat (cc)	9,531§	27,174§	7,935§	44,540§	31,636	84,220	11,140	126,996	42,869	97,304	13,902	154,075	77,190	130,712	17,549	225,451
Sunflower	23,967§	59,333§	2,700§	86,000§	59,300	94,800	24,300	178,400	76,467	115,133	31,833	223,433	99,133	136,800	40,300	276,233
Barley (sf)	10,267	12,629	4,356	27,252	5,158	9,809	5,135	20,102	4,047	9,413	5,047	18,507	2,387	9,118	4,984	16,489
Barley (cc)	14,245	42,352	4,320	60,917	15,619	46,699	3,317	65,635	16,720	50,342	4,293	71,355	18,514	59,641	6,418	84,573
Oats	22,426	37,561	19,145	79,132	15,482	21,988	22,419	59,889	12,792	19,314	23,411	55,517	8,618	15,567	25,395	49,580
Flax	4,147	6,301	1,504	11,952	1,911	1,880	819	4,610	1,588	1,404	714	3,706	1,107	814	554	2,475
Corn	131	7,392	493	8,016	42	10,965	292	11,299	221	11,834	311	12,366	246	13,556	351	14,153
Soybeans	---	3,185	---	3,185	---	3,777	---	3,777	---	3,987	---	3,987	---	4,443	---	4,443
Rye	2,950	2,430	1,002	6,382	1,117	1,398	437	2,952	1,127	1,238	465	2,830	1,334	955	521	2,810

#sf = respective crop grown on summer fallow.
cc = respective crop grown on land previously cropped.
§sunflower = 30.1b./bu.
§1978 data.

TABLE 4. HARVESTED ACRES, AVERAGE YIELD, AND PRODUCTION OF GRAIN AND OILSEED CROPS IN NORTH DAKOTA TRANSPORTATION REGIONS, 1975 AND PROJECTED TO 1984, 1989, AND 1999

Region	Harvested Acres	Avg. Yield	Production	Harvested Acres	Avg. Yield	Production	Harvested Acres	Avg. Yield	Production	Harvested Acres	Avg. Yield	Production
	000	*bu/a*	*000 bu*	*000*	*bu/a*	*000 bu*	*000*	*bu/a*	*000 bu*	*000*	*bu/a*	*000 bu*
	1975 (Actual)											
	Wheat			Sunflower*			Barley			Oats		
1	3,832	24.9	95,421	74	34.7	2,562	506	34.0	17,183	454	38.9	17,649
2	4,073	28.4	115,664	419	37.1	15,546	1,437	40.0	57,541	440	45.1	19,842
3	2,303	23.1	53,307	5	31.7	152	157	32.3	5,076	476	39.2	18,679
State	10,213	25.9	264,392	498	36.7	18,260	2,100	38.0	79,800	1,370	41.0	56,170
	Flax			Soybeans			Corn			Rye		
1	280	9.7	2,703	---	---	---	1	48.0	48	51	23.5	1,197
2	377	9.3	3,490	149	19.5	2,906	123	51.8	6,372	54	27.8	1,500
3	114	9.8	1,122	---	---	---	8	37.2	312	14	19.9	278
State	770	9.5	7,315	149	19.5	2,906	132	51.0	6,732	119	25.0	2,975
	1984											
	Wheat			Sunflower*			Barley			Oats		
1	3,708	29.4	108,898	1,411	42.0	59,300	549	37.8	20,777	328	47.2	15,482
2	3,956	31.1	123,013	1,971	48.1	94,800	1,325	42.6	56,508	438	50.2	21,988
3	2,370	25.4	60,091	731	33.2	24,300	233	36.3	8,452	496	45.2	22,419
State	10,034	29.1	292,002	4,113	43.4	178,400	2,107	40.7	85,737	1,262	47.5	59,889
	Flax			Soybeans			Corn			Rye		
1	182	10.5	1,911	---	---	---	1	41.8	42	38	29.4	1,117
2	179	10.5	1,880	179	21.1	3,777	158	69.4	10,965	43	32.5	1,398
3	90	9.1	819	---	---	---	8	36.5	292	15	29.1	437
State	451	10.2	4,610	179	21.1	3,777	167	67.7	11,299	96	30.8	2,952
	1989											
	Wheat			Sunflower*			Barley			Oats		
1	3,843	30.7	118,111	1,647	46.4	76,467	538	38.6	20,767	260	49.2	12,792
2	4,087	32.4	132,234	2,168	53.1	115,133	1,326	45.1	59,755	370	52.2	19,314
3	2,355	26.8	62,999	868	36.7	31,833	251	37.2	9,340	496	47.2	23,411
State	10,285	30.5	313,344	4,683	47.7	223,433	2,115	42.5	89,862	1,126	49.3	55,517
	Flax			Soybeans			Corn			Rye		
1	147	10.8	1,588	---	---	---	5	44.2	221	36	31.3	1,127
2	130	10.8	1,404	178	22.4	3,987	158	74.9	11,834	36	34.4	1,238
3	76	9.4	714	---	---	---	8	38.9	311	15	31.0	465
State	353	10.5	3,706	178	22.4	3,987	171	72.3	12,366	87	32.5	2,830
	1999											
	Wheat			Sunflower*			Barley			Oats		
1	4,376	33.2	145,071	1,796	55.2	99,133	519	40.3	20,901	162	53.2	8,618
2	4,596	34.8	160,124	2,168	63.1	136,800	1,375	50.0	68,759	277	56.2	15,567
3	2,371	28.4	67,397	925	43.6	40,300	290	39.3	11,402	496	51.2	25,395
State	11,343	32.8	372,592	4,889	56.5	276,233	2,184	46.3	101,062	935	52.9	49,580
	Flax			Soybeans			Corn			Rye		
1	98	11.3	1,107	---	---	---	5	49.2	246	38	35.1	1,334
2	72	11.3	814	177	25.1	4,443	158	85.8	13,556	25	38.2	955
3	56	9.9	554	---	---	---	8	43.9	351	15	34.7	521
State	226	11.0	2,475	177	25.1	4,443	171	82.8	14,153	78	36.0	2,810

*Assumes 30 lbs./bu.

TABLE 5. LIVESTOCK AND POULTRY NUMBERS IN NORTH DAKOTA TRANSPORTATION REGIONS, 1976 AND PROJECTED TO 1985, 1990, AND 2000

Specie	Region 1	Region 2	Region 3	State	Region 1	Region 2	Region 3	State
	(- - - - - - - 1976 - - - - - - -)				(- - - - - - - 1985 - - - - - - -)			
Milk Cows	33,700	38,700	46,600	119,000	22,247	21,870	33,388	77,505
Beef Cows	358,720	337,217	454,063	1,150,000	250,442	245,419	440,241	936,102
Cattle on Feed[#]	231,882	236,908	325,210	794,000	158,888	154,426	277,600	590,914
Other Cattle[§]	96,232	93,057	127,711	317,000	92,421	85,700	165,125	343,246
Pigs	55,778	191,459	102,763	350,000	65,588	199,394	87,633	352,615
Sheep	94,091	92,991	74,918	262,000	78,941	72,674	61,385	213,000
Horses & Mules	9,299	5,464	10,847	25,610	9,707	5,412	11,091	26,210
Layers	135,770	308,297	135,933	580,000	133,640	435,339	85,743	654,722
Other Chickens	11,352	70,350	20,298	102,000	44,409	156,384	30,035	230,828
Broilers	36,803	48,037	48,360	133,200	36,803	48,037	48,360	133,200
Turkeys	566,284	308,896	84,820	960,000	912,678	61,716	175,688	1,150,083
	(- - - - - - - 1990 - - - - - - -)				(- - - - - - - 2000 - - - - - - -)			
Milk Cows	19,043	17,922	30,776	67,741	12,616	10,957	15,800	46,950
Beef Cows	256,533	254,234	492,245	1,002,986	271,837	275,048	635,821	1,182,706
Cattle on Feed[#]	163,324	158,646	311,164	633,134	178,170	172,062	396,349	746,582
Other Cattle[§]	93,537	85,298	188,935	367,770	96,153	85,720	251,796	433,669
Pigs	64,651	191,035	96,929	352,615	66,627	189,076	96,912	352,615
Sheep	80,190	71,201	61,609	213,000	82,493	68,518	61,989	213,000
Horses & Mules	9,707	5,412	11,091	26,210	9,707	5,412	11,091	26,210
Layers	82,105	414,472	63,353	559,930	51,493	243,506	23,324	318,323
Other Chickens	34,991	141,601	20,817	197,409	16,459	87,862	7,907	112,228
Broilers	36,803	48,037	48,360	133,200	36,803	48,037	48,360	133,200
Turkeys	934,657	63,203	179,919	1,177,779	976,489	66,031	187,972	1,230,492

[#]Primarily backgrounding feeder cattle.
[§]Replacement heifers, bulls over 500 lbs., etc.

TABLE 6. ANNUAL FEEDING RATE PER HEAD OF SPECIFIED SPECIES OF LIVESTOCK AND POULTRY USED TO ESTIMATE CONSUMPTION OF SELECTED GRAINS IN NORTH DAKOTA FOR 1976, 1984, 1989, AND 1999†

Specie	Wheat	Barley	Oats	Corn
		-bu./year-		
Milk Cows	0.57	13.81	67.39	9.68
Beef Cows	0.22	1.13	1.69	0.22
Cattle on Feed#	0.83	3.04	20.12	3.50
Other Cattle§	0.11	0.20	1.54	0.70
Pigs	0.12	8.81	7.74	3.27
Sheep	---	0.21	1.16	0.05
Horses and Mules	---	1.67	17.59	2.68
Layers	0.12	0.31	0.22	0.86
Broilers	0.10	0.06	0.19	0.30
Other Chickens	0.15	0.15	0.16	0.10
Turkeys	0.10	0.02	---	0.32

†These feeding rates are intended to approximate the average of what is fed rather than recommended feeding rates.
#Primarily backgrounding feeder cattle.
§Replacement heifers, bulls over 500 lbs., etc.

Exportable surplus or estimated demand for transportation for 1976, 1985, 1990, and 2000 is given in Table 8, p. 13. Data to facilitate comparison of projected changes from 1975-1976 to 1999-2000 are given in Tables 9 and 10, pp. 14 and 15.

Acreage

Projected land devoted to crops is limited by cropland acres available. Cropland, as defined by the Agricultural Stabilization and Conservation Service (ASCS), USDA, includes land that has been once plowed or cultivated. It excludes wild hay and pasture on uncultivated land and other uses such as shelter belts and farmsteads. Additional land could be brought under cultivation while other cropland is lost to urban development, roads, etc. Cropland in North Dakota has been

TABLE 7. ESTIMATED GRAIN CONSUMED BY LIVESTOCK AND POULTRY IN NORTH DAKOTA TRANSPORTATION REGIONS FOR 1976 AND PROJECTED TO 1985, 1990, AND 2000

Grain	1976				1985				1990				2000			
	Region				Region				Region				Region			
	1	2	3	State	1	2	3	State	1	2	3	State	1	2	3	State
	bushels (000)															
Wheat	388	408	457	1,253	335	308	413	1,056	334	307	451	1,092	346	294	548	1,188
Barley	2,181	3,482	3,162	8,825	1,769	2,997	2,677	7,443	1,723	2,883	2,882	7,488	1,704	2,777	3,094	7,575
Oats	8,433	9,862	11,762	30,057	6,073	6,985	9,811	22,869	5,940	6,742	10,498	23,180	5,843	6,515	11,534	23,892
Corn	1,801	2,378	2,303	6,482	1,559	1,982	1,971	5,512	1,501	1,910	2,099	5,510	1,485	1,726	2,293	5,504
Total	12,803	16,130	17,684	46,617	9,736	12,272	14,872	36,880	9,498	11,842	15,930	37,270	9,378	11,312	17,469	38,159

TABLE 8. ESTIMATED GRAIN AND OILSEEDS REQUIRING TRANSPORTATION FROM NORTH DAKOTA TRANSPORTATION REGIONS FOR 1976 AND PROJECTED TO 1985, 1990, AND 2000

Grain	Region 1	Region 2	Region 3	State	Region 1	Region 2	Region 3	State
	bushels (000)							
	1976				1985			
Wheat	95,033	115,256	52,850	263,139	108,563	122,705	59,678	290,946
Sunflower#	2,562	15,546	152	18,260	59,300	94,800	24,300	178,400
Barley	15,002	54,059	1,914	70,975	19,008	53,511	5,775	78,294
Oats	9,216	9,980	6,917	26,113	9,409	15,003	12,608	37,020
Flax	2,703	3,490	1,122	7,315	1,911	1,880	819	4,610
Corn	-1,753	3,994	-1,991	250	-1,517	8,983	-1,679	5,787
Soybeans	---	2,906	---	2,906	---	3,777	---	3,777
Rye	1,197	1,500	278	2,975	1,117	1,398	437	2,952
Total (net)	123,960	206,731	61,242	391,933	197,791	302,057	101,938	601,786
	1990				2000			
Wheat	117,777	131,927	62,548	312,252	144,725	159,830	66,849	371,404
Sunflower#	76,467	115,133	31,833	223,433	99,133	136,800	40,300	276,233
Barley	19,044	56,872	6,458	82,374	19,197	65,982	8,308	93,487
Oats	6,852	12,572	12,913	32,337	2,775	9,052	13,861	25,688
Flax	1,588	1,404	714	3,706	1,107	814	554	2,475
Corn	-1,280	9,924	-1,788	6,856	-1,239	11,830	-1,942	8,649
Soybeans	---	3,987	---	3,987	---	4,443	---	4,443
Rye	1,127	1,238	465	2,830	1,334	955	521	2,810
Total (net)	221,575	333,057	113,143	667,775	267,032	389,706	128,451	785,189

#Assumes 30 lbs./bu.

relatively stable in the recent past (Table 11) increasing only 2% from 1967 to 1976 when the total was 27,662,130 acres. This is the total that was used to reconcile crop projections of acres harvested. Total land in farms reported by ASCS was 41,958,488 acres in 1976. This leaves 14,296,358 acres for noncropland use. There is a total of 44,334,720 acres in the state.

TABLE 9. STATE SUMMARY OF HARVESTED ACRES, AVERAGE YIELD, AND PRODUCTION OF GRAINS AND OILSEEDS FOR NORTH DAKOTA, 1975-1976 COMPARED TO 1999-2000 PROJECTIONS

Crop	1975-1976				1999-2000				% Change			
			Production				Production				Production	
	Acres	Yield	Bu.	Cwt.	Acres	Yield	Bu.	Cwt.	Acres	Yield	Bu.	Cwt.
	000	*bu/a*	*000*	*000*	*000*	*bu/a*	*000*	*000*				
Wheat	10,213	25.9	264,392	158,635	11,343	32.8	372,592	223,555	+11	+27	+41	
Sunflower	498	36.7	18,260	5,478	4,889	56.5	276,233	82,870	+881	+54	+1,413	
Barley	2,100	38.0	79,800	38,304	2,184	46.3	101,062	58,510	+4	+22	+27	
Oats	1,370	41.0	56,170	17,974	935	52.9	49,580	15,866	-32	+29	-12	
Flax	770	9.5	7,315	4,096	226	11.0	2,475	1,386	-71	+16	-66	
Soybeans	149	19.5	2,906	1,744	177	25.1	4,443	2,666	+19	+29	+53	
Corn	132	51.0	6,732	3,770	171	82.8	14,153	7,926	+30	+62	+110	
Rye	119	25.0	2,975	1,666	78	36.0	2,810	1,574	-34	+44	-6	
Summer Fallow	7,080	---	---	---	4,673	---	---	---	-34	---	---	
Total			438,550	231,667			823,348	384,353			+88	+66

TABLE 10. SUMMARY OF ESTIMATED CHANGE IN GRAIN AND OILSEED PRODUCTION, LIVESTOCK CONSUMPTION, AND EXPORTABLE SURPLUS FROM 1975-1976 TO 1999-2000, NORTH DAKOTA

Item	1975-1976		1999-2000		% Change	
	Bu.	Cwt.	Bu.	Cwt.	Bu.	Cwt.
	- - - - - - - - - - *000* - - - - - - - - - -					
Production	438,550	231,667	823,348	384,353	+ 88	+66
Fed to Livestock	46,617	18,236	38,159	15,076	- 18	-17
Exportable Surplus	391,933	229,844	789,189	369,277	+101	+61

An allowance of 2,986,000 acres was made for unharvested acres and crops not included in the projections such as sugarbeets, potatoes, pinto beans, mustard, and canary seed. Increases in cropland were assumed to be offset by increased land devoted to these other crops. Thus, cropland and the allowance for unharvested acres and other crops was left constant for the projection period.

Projections of harvested acres for specified crops are in Table 1 and Appendix Figure A.1. Substantial increase in sunflower production and reduced summer fallow is expected to be the major change in cropping patterns. These two changes are the major reasons that the USDA's NIRAP projections were not used. The rationale for the sunflower and summer fallow projections is given first because of their impact on other crops.

Sunflower

Extending trends of sunflower production results in impossible projections. Land in sunflower would exceed cropland acres in 1986 by seven million acres if the compound growth rate of 39% for the 1962-1979 period was used. During the 1974-1979 period, the growth rate has been over 55% and reached 80% in 1979.

Recent expansion has been driven by substantially higher grower profits from sunflower than from competing crops. For example, sunflower grossed 50% more per acre than wheat in 1978. This situation has existed since 1974.

TABLE 11. TOTAL CROPLAND ACRES, NORTH DAKOTA

Year	Cropland Acres*
1967	27,111,467
1970	27,319,701
1971	27,501,537
1973	27,512,996
1974	27,558,923
1976	27,662,130

*Includes land plowed up once for cropping; excludes pasture and wild hay land not plowed up, shelterbelts, farmsteads, forestland, etc.

SOURCE: Hippe, Martin, Agricultural Stabilization and Conservation Service, USDA, Fargo, North Dakota.

It is felt that sunflower will not be grown on the same scale as wheat in North Dakota. Unique harvesting and drying requirements are new to most North Dakota farmers. Disease and insect problems can be a plague. Harvesting is typically during inclement weather. High profits from sunflower can overcome these objections for many but not all farmers. This is particularly true in the western three-fourths of the state where farmers are unfamiliar with and have not had row crop machinery. Also the relative profitability of sunflower may decline.

The upper limit on production density is thought to be the likelihood of serious disease and insect problems when the crop is grown continuously or on a two-year rotation. Projections were based on anticipated average rotation or percent of cropland acres in sunflower for each region. The two counties with the highest density in 1978 were Foster with 26% and Cass with 22% of cropland acres in sunflower. The data for recent and projected years are given in Table 12.

Projections given in Table 12 reflect a continued expansion but at a decreasing rate. The 4.889 million acre forecast for 1999 assumes that sunflower will continue to be relatively profitable compared to

TABLE 12. RELATIONSHIP OF HARVESTED SUNFLOWER ACRES TO TOTAL CROPLAND ACRES IN NORTH DAKOTA TRANSPORTATION REGIONS FOR 1977-1979 AND PROJECTED TO 1984, 1989, AND 1999

Year	Region	Harvested Acres	% Harvested Acres Are Of Cropland	Average# Rotation
		000		*years*
1977	1	378	3.8	26.0
	2	904	8.3	12.0
	3	38	0.5	183.0
	State	1,320	4.8	21.0
1978	1	578	5.8	17.1
	2	1,229	11.3	8.8
	3	73	1.1	95.2
	State	1,880	6.8	14.7
1979†	1	1,189	12.0	8.3
	2	1,833	16.9	5.9
	3	418	6.0	16.6
	State	3,440	12.4	8.0
1984	1	1,411	14.3	7.0
	2	1,971	18.2	5.5
	3	731	10.3	9.5
	State	4,113	14.9	6.7
1989	1	1,647	16.7	6.0
	2	2,168	20.0	5.0
	3	868	12.5	8.0
	State	4,683	16.9	5.9
1999	1	1,796	18.1	5.5
	2	2,168	20.0	5.0
	3	925	13.3	7.5
	State	4,889	17.7	5.7

#Average rotation = cropland acres ÷ harvested acres.
†Estimated on the basis of data available July 1979 from ESCS, USDA at Fargo, ND.

competing crops. This projection will not be reached if they are only as profitable as competing crops. The increase in sunflower acres, on a statewide basis, will come primarily from a reduction in summer fallow.

Summer Fallow

Total summer fallow for 1999 was estimated to be 4.7 million acres. This represents a reduction of two million acres from 1978. Projected summer fallow was allocated to the three regions and to wheat and barley according to past trends. There are four factors which led to the estimated reduction in summer fallow.

Farmer participation in government programs has influenced the amount of summer fallow. It is anticipated that as the worldwide demand for food increases, government programs involving summer fallow will become less important.

The introduction of sunflower will result in a reduction in summer fallow. Sunflower has an extensive root system and performs well compared to other crops when planted in the rotation following shallow rooted cereals. A common practice has been to plant sunflower on land to be fallowed--thus extending the rotation one year. Summer fallow will be reduced by one-third in some areas where this practice is adopted.

Results from a recent cost study which traced yield differences from 1944 through 1977 show that continuous cropping is often more profitable than including summer fallow in the rotation.[§] Increased yields from higher soil moisture and soil nitrogen do not offset the opportunity cost of idle land. These relationships are more pronounced in eastern North Dakota than in western North Dakota where rainfall is lower. Continuous cropping also becomes increasingly profitable as crop prices increase relative to production costs.

[§]A comprehensive report on the relative profitability of including summer fallow in the rotation for different regions of North Dakota and different crop prices is in a recently completed study by Mir B. Ali (1).

Soil erosion from summer fallow is about five times more than for cereal grains and about 2½ times that of sunflower (2). Thus farmers should reduce summer fallow to conserve soil, reduce soil deposits in undesirable locations, and reduce air and water pollution. The impact of soil erosion on the relative importance of summer fallow as a cultural practice may be negligible in the near future.

Barley

Barley acreage is projected to increase slightly to 2.184 million by 1999. A substantial reduction of barley on summer fallow will be more than made up by increases on land previously cropped.

A squeeze on barley supplies will result from a fairly predictable and moderate increase in demand for barley by the malting and livestock industry. This should increase barley prices relative to wheat and sunflower. Unless relatively better barley prices are received, acreage devoted to this crop will likely decline.

Wheat

Acres of harvested wheat will increase at a rate about three times that of barley or 13% for the 1984-1999 period. Like barley, a significant decrease of wheat on previously summer fallowed land will be more than offset by increases on previously cropped land. The relatively strong trend for wheat acreage to increase during 1960-1976 was sufficient to partially offset competition from sunflower.

Oats, Rye, and Flax

Acres of harvested oats, rye, and flax for the 1960-1976 period exhibit a fairly consistent pattern of declining acreage (see Appendix Figure A.1, pp. 27, 28, 29). This is a reflection of the poor profits obtained by growers of these crops. Except for flax in 1974, these crops have not yielded an income per acre better than sunflower, wheat, or barley since 1973. As a result, it is estimated that land devoted to oats, rye, and flax will decline substantially over the projection period.

Corn and Soybeans

Corn for grain is grown in the southeast and south central part of the state. Much of it is on irrigated land. Acreage projections assume that increases in corn production on land coming under irrigation will almost be offset by decreases in dryland corn as a result of increased competition from sunflower and wheat.

Soybeans are expected to maintain acreage in the face of increasing competition from sunflower and wheat. Short season varieties have been developed which can successfully grow in southeastern North Dakota. Other areas of the state are short on moisture and number of frost-free growing days which restrict the potential of this crop in North Dakota.

Yields

The average yields of most crops, though quite variable, reflect a slight increase over time. These increases are likely the result of improved varieties, use of fertilizer, and other improved management practices. New disease and insect strains put constant pressure on plant breeders to develop new resistant varieties. In most cases, projected yields are extensions of trends for the 1960-1976 period (Table 2 and Appendix Figure A.2).

Sunflower yield increases were reduced slightly from the trend line because of the short period for which data were available, expected expansion in areas with lower yield potential, and significantly higher yields in recent years believed to be the result of unusually favorable weather and rapid adoption of hybrids. It is unlikely that the rate of increase in average yields of the past few years can be maintained. Higher yields can be realized from new hybrids better adapted to growing season and areas of relatively low rainfall.

Barley yields on continuous cropped land have been higher in Region 2 than for barley on summer fallow. This recent development is likely caused by heavier fertilizer applications on previously cropped land than on summer fallow and by relatively more continuous crop, barley, being grown on better yielding land.

The most consistent pattern of increasing yields was for corn, rye, wheat, and barley on previously cropped land (see Appendix Figure A.2).

Production

Total production for each of the eight crops given in Table 3 was obtained by multiplying the harvested acres in Table 1 by the projected yields in Table 2. Harvested acres, yield, and production for each crop by region and year are given in Table 4. Total production from the eight crops is estimated to increase 88% on a bushel basis and 66% by weight from 1975 to 1999 (Table 9).

Declines in production of flax, oats, and rye from 1975 to 1999 were forecast to be 66, 12, and 6%, respectively. Increases in yields were not sufficient to offset the declines in acreage.

Sunflower production was estimated to increase 14 times by 1999. An estimated two-thirds of this increase had been realized by 1979. Wheat and barley production is expected to increase 41 and 27%, respectively. The doubling of corn production is expected to come primarily from increased yields but also from an estimated 30% increase in acreage.

Livestock and Poultry Consumption of Grain

Projected milk cow, beef cow, cattle on feed, and turkey numbers were based on the USDA's NIRAP projections. Estimates from livestock experts and statistical procedures led to the number projections for the other species. Moderate increases in numbers were projected for other cattle, turkeys, and other chickens (Table 5, p. 10). The decline in milk cow numbers was expected to continue. Moderate reductions in sheep and layer numbers are also expected. Little change in the number of the other species were projected. Livestock numbers for 1985, 1990, and 2000 were allocated to each region on the basis of county estimates given in the Agricultural Census.

Annual feed consumption given in Table 6 (p. 11) represents what is thought to be the state average of what is actually fed. These data are not intended to represent recommended rations. Variations in feeding rates

sometimes occur. For example, it is estimated that 21 million bushels of wheat were fed from the 1977 wheat crop because of the sprout damage experienced that year. A normal wheat feeding is estimated to be about 1.3 million bushels.

Feeding rates from Table 6 were multiplied by projected livestock and poultry numbers in Table 5 to obtain grain consumed in the state (Table 7). Livestock consumption of grain in North Dakota is estimated to decline by 8.5 million bushels or 18% from 1976 to 2000. The bulk of this decline is related to the estimated reduction in milk cow, cattle on feed, sheep, and layer numbers. Among the grains, oats accounts for 6.2 million bushels of the reduction. Wheat fed to livestock is estimated to decline only 5% while the reduction in barley, corn, and oats is 14, 15, and 21%, respectively.

Exportable Surplus

The estimated quantity of grain and oilseeds requiring transportation services from North Dakota for the base year 1976 and projected to 1985, 1990, and 2000 is listed in Table 8. It was assumed that the production of one year would be consumed by livestock or move through the marketing channel the next year. Therefore, estimated livestock consumption for 1976, 1985, 1990, and 2000 (Table 7) was subtracted from the previous year's production (Table 3) to obtain exportable surplus (Table 8).

It is estimated that, on a bushel basis, production of the eight crops increased 88% from 1975 to 1999 while grain fed to livestock is estimated to decline 18% (Table 10). This would result in a doubling of exportable surplus in 24 years. A doubling of transportation capacity will not be required because the increase in weight will be 61%. This difference results from the dramatic increase in sunflower production which weighs only one-half as much as wheat.

An increase in transportation requirements of at least 60% from 1976 to 2000 is estimated for North Dakota. This added burden is on top of the chronic rail transportation equipment shortage since 1973. Wise policy and investment decisions by private and public agencies are required to meet existing and future transportation demands.

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Appendix Figures

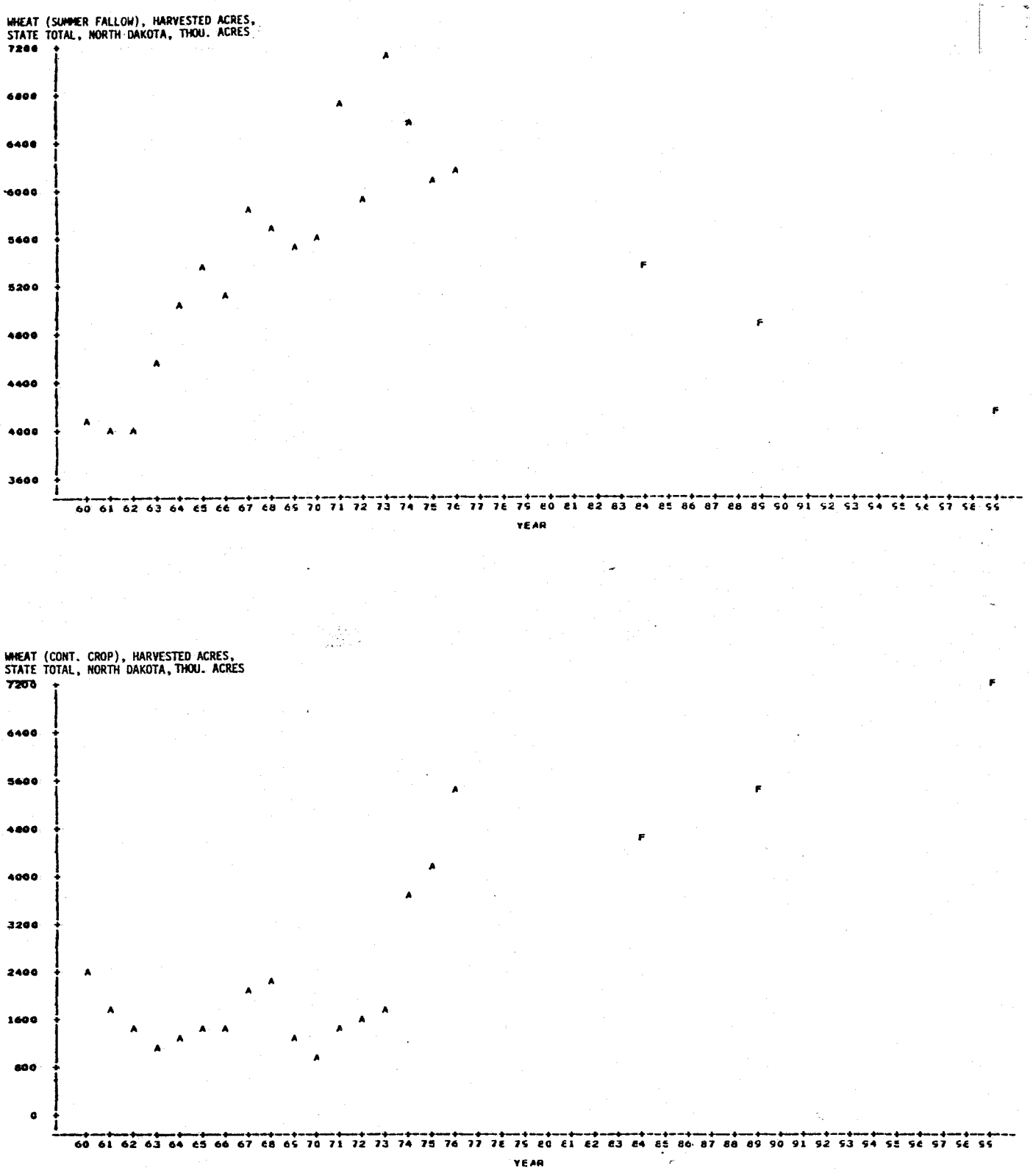
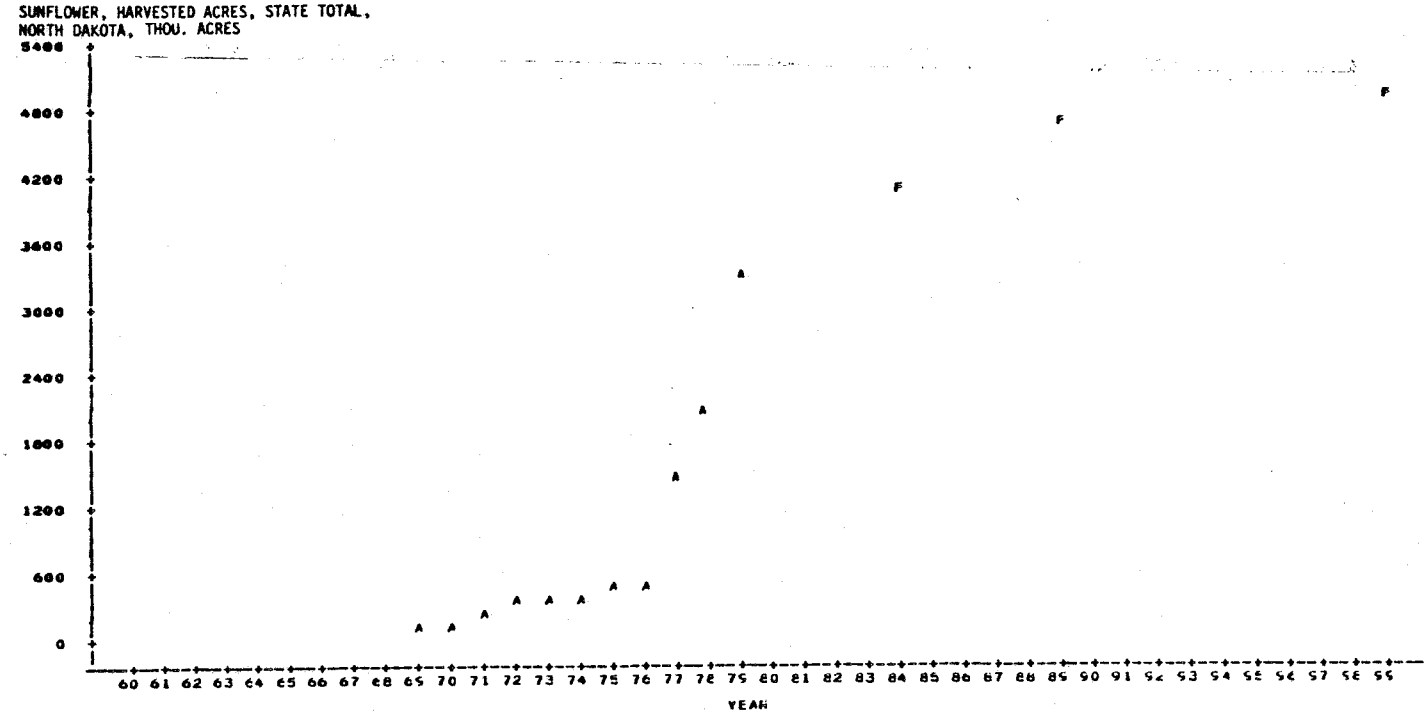
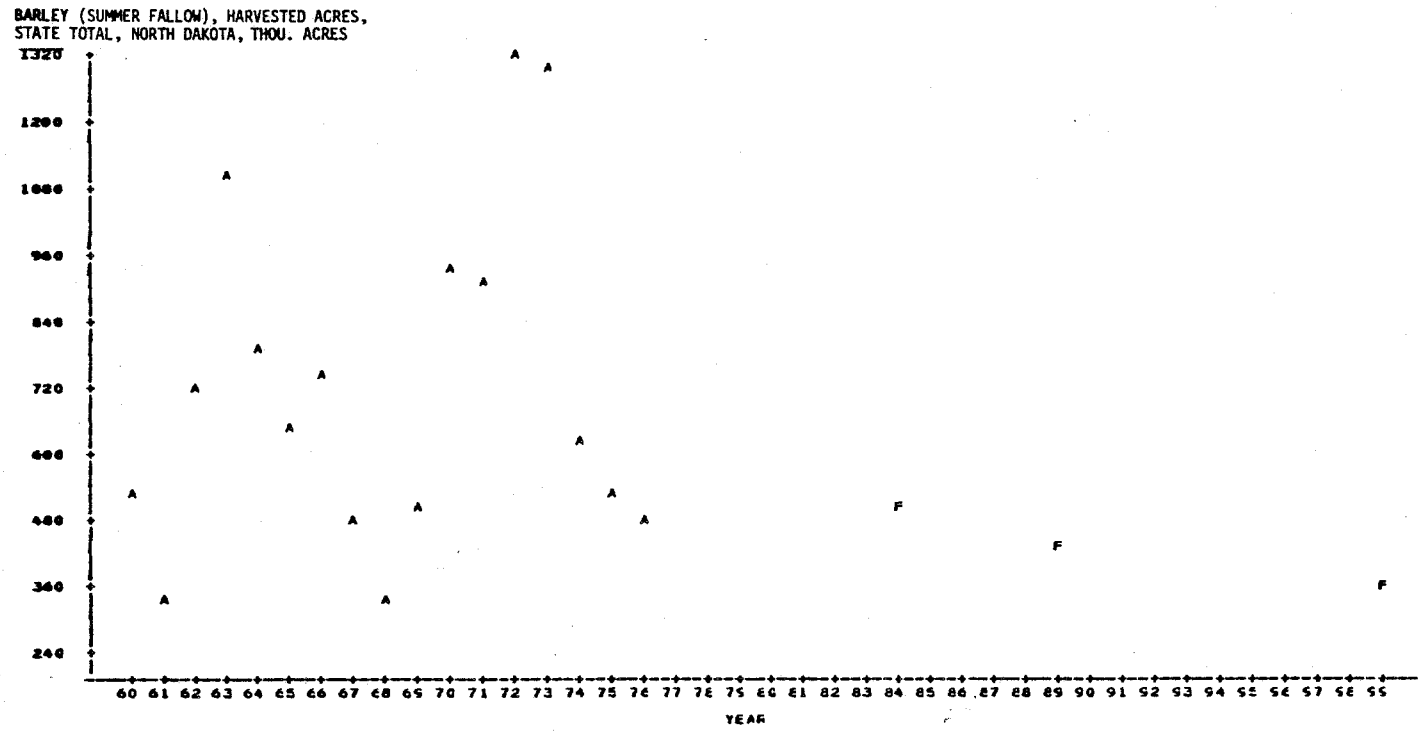


Figure A.1. Harvested Acres of Specified Crops for North Dakota, 1960-1976 and Projected to 1984, 1989, and 1999 (A=Actual, F=Forecast)





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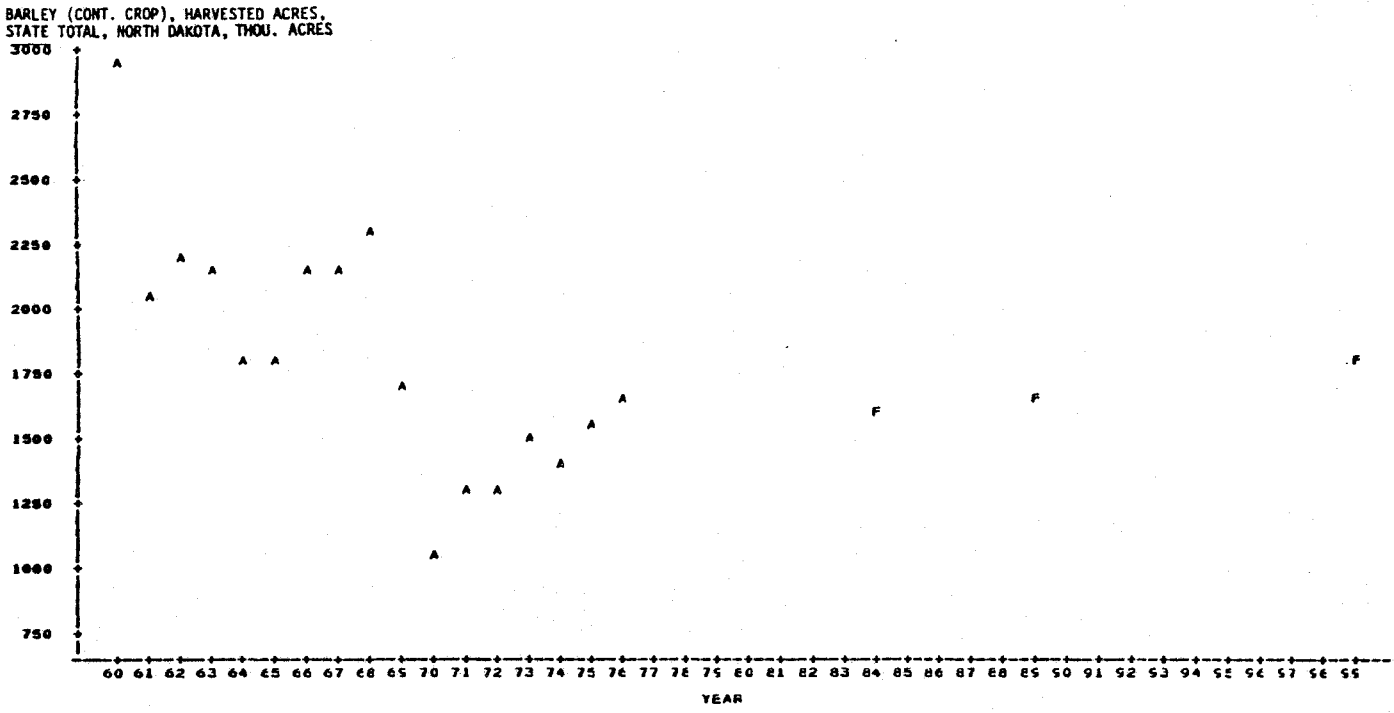

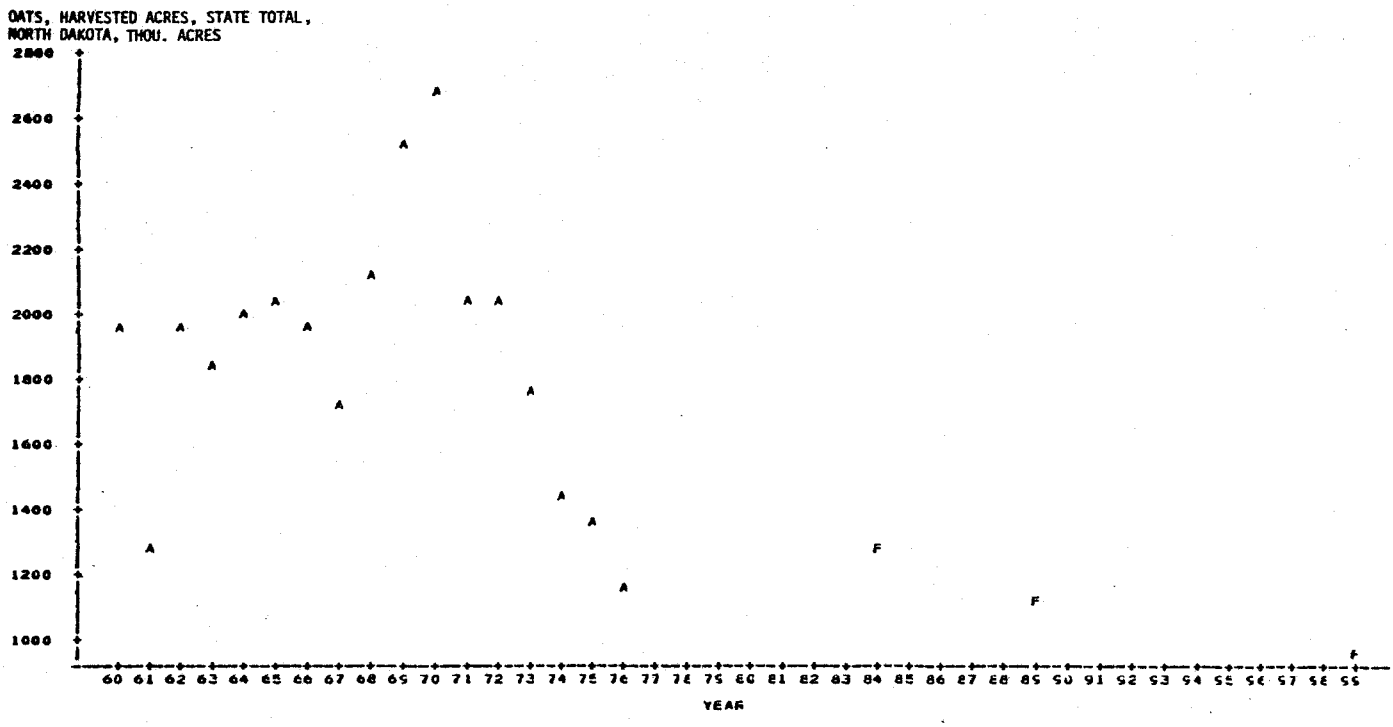

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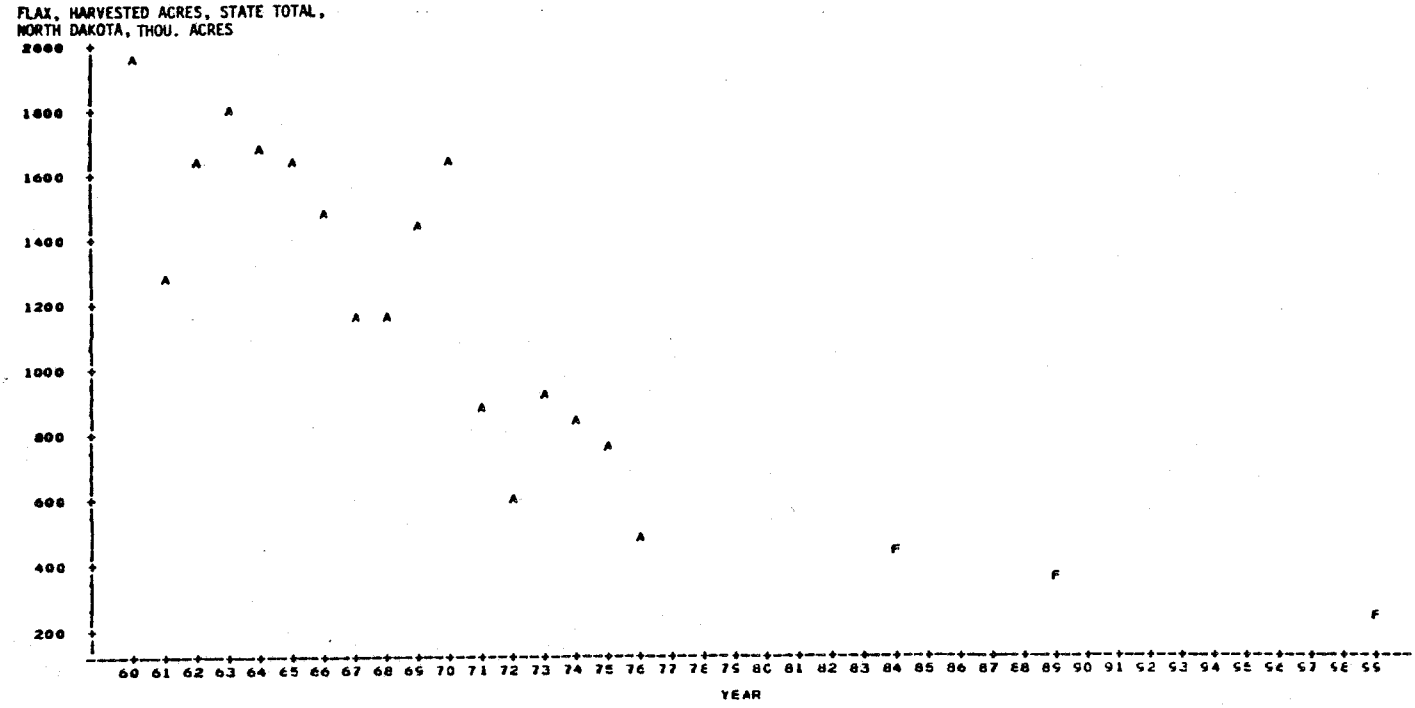

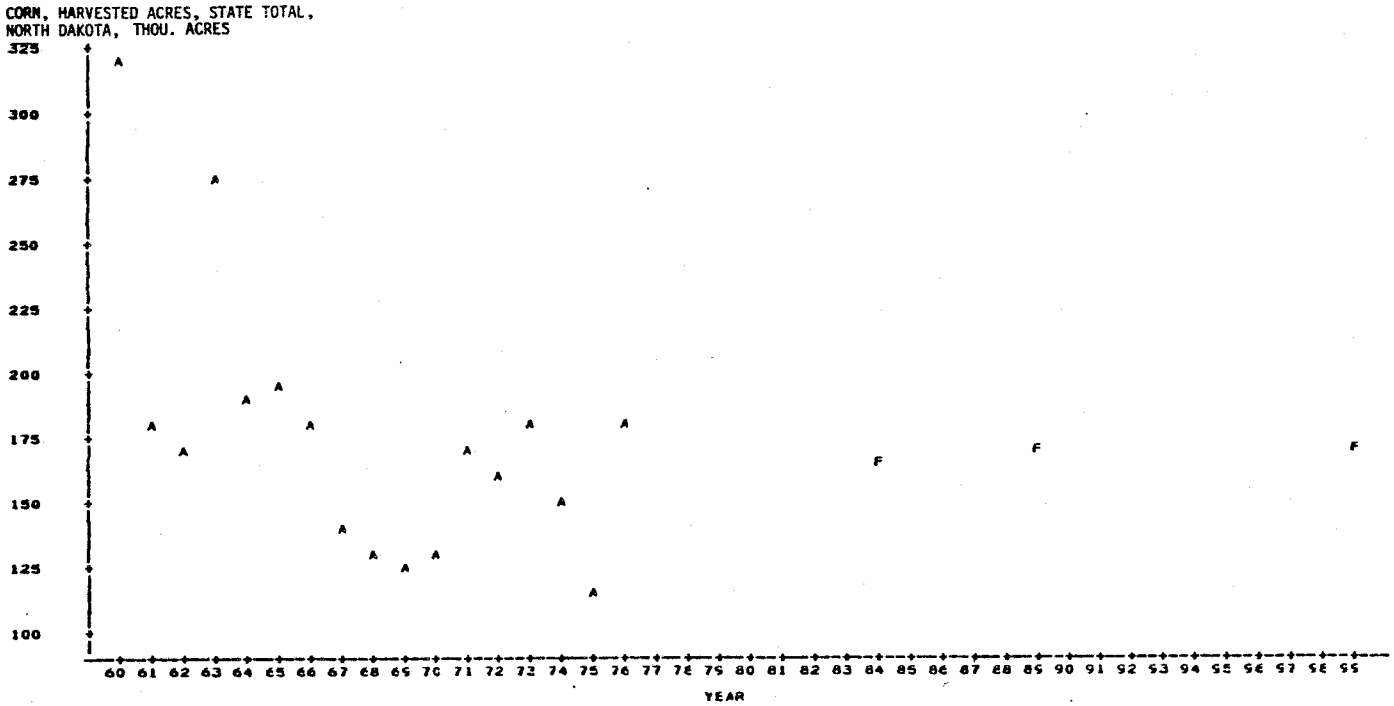

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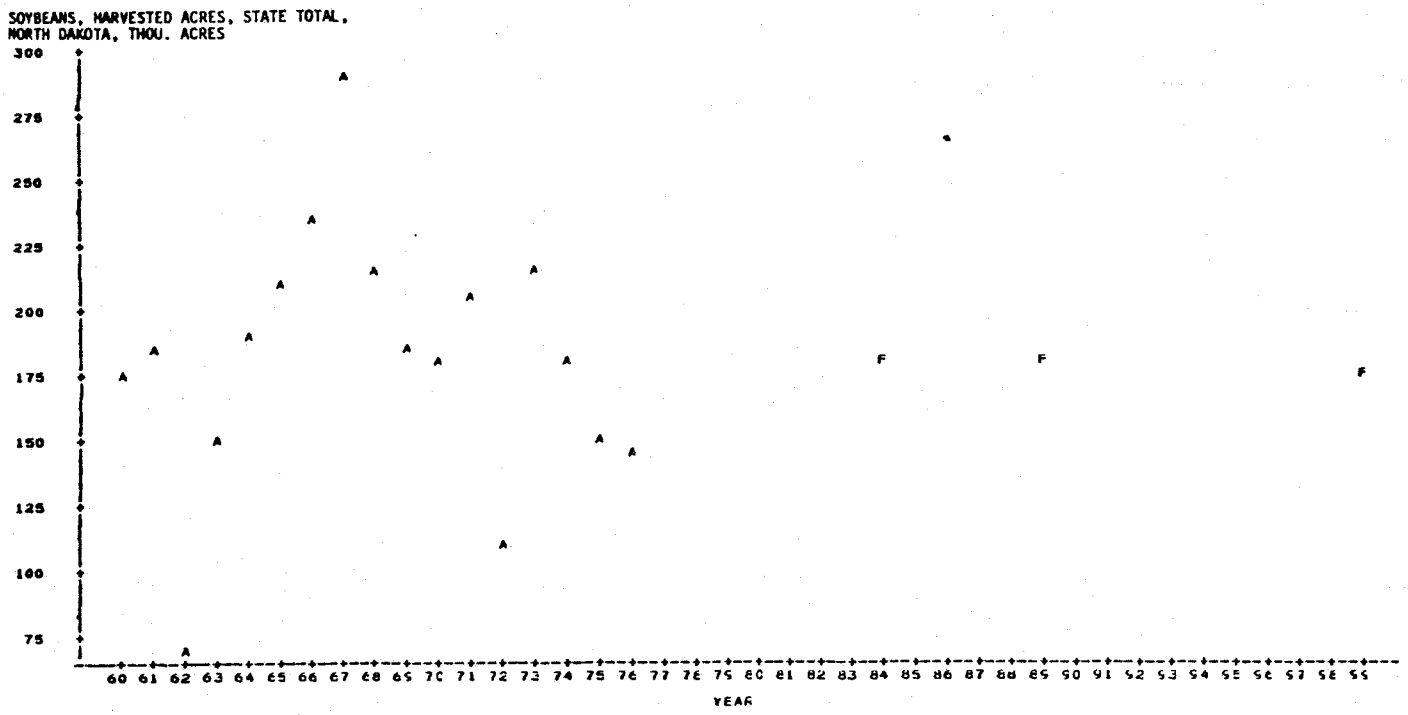

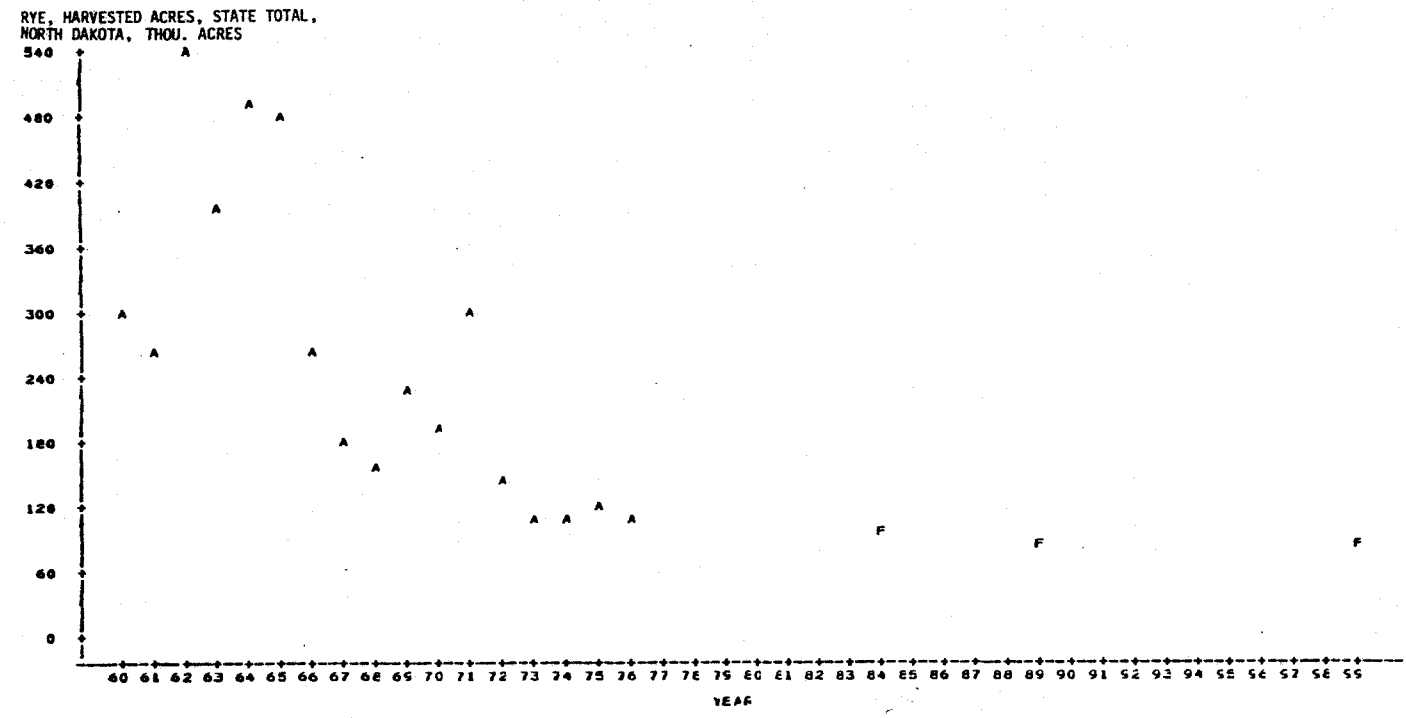

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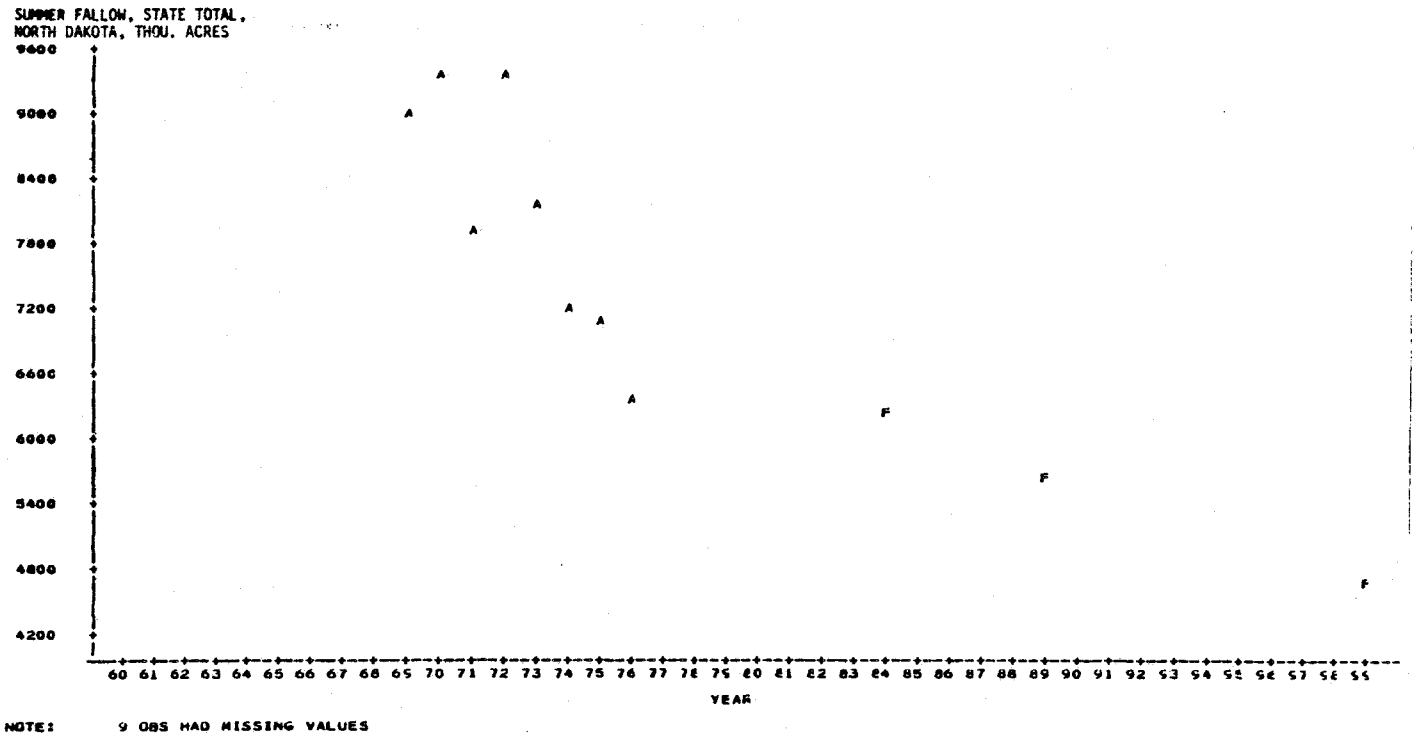

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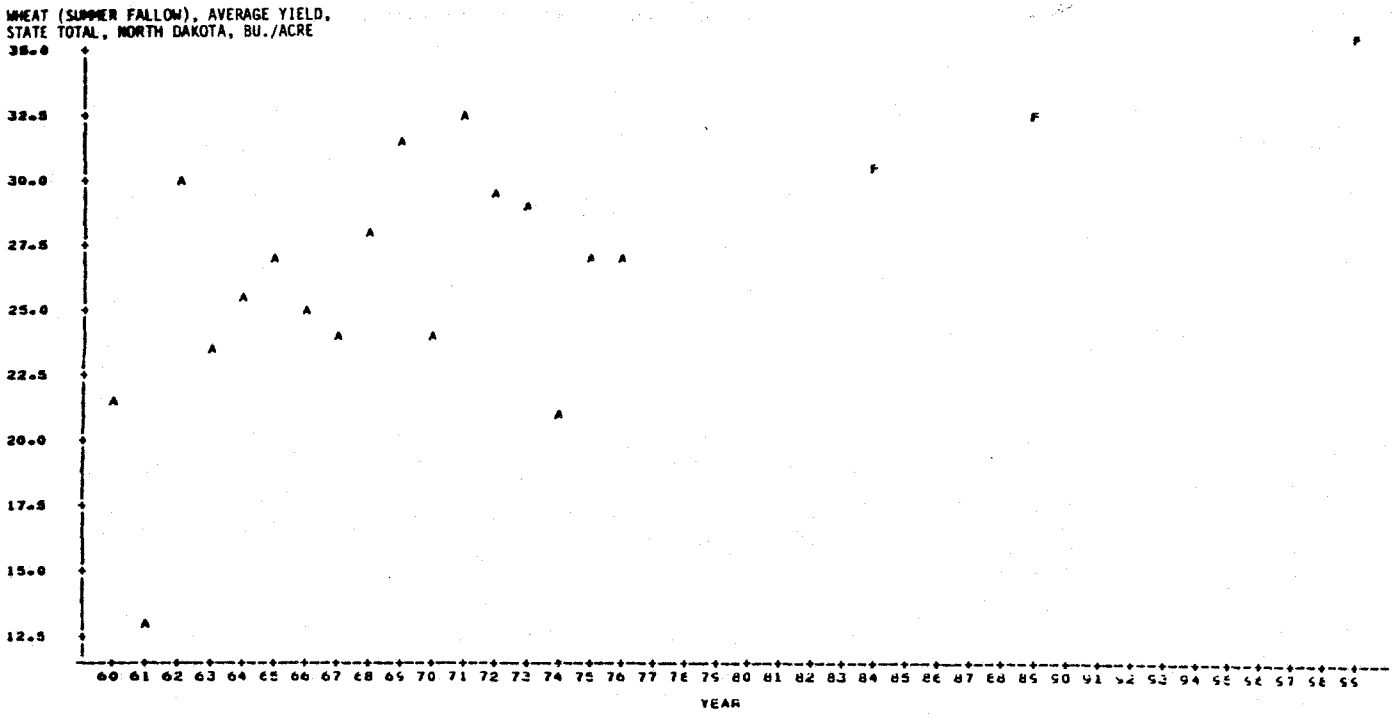


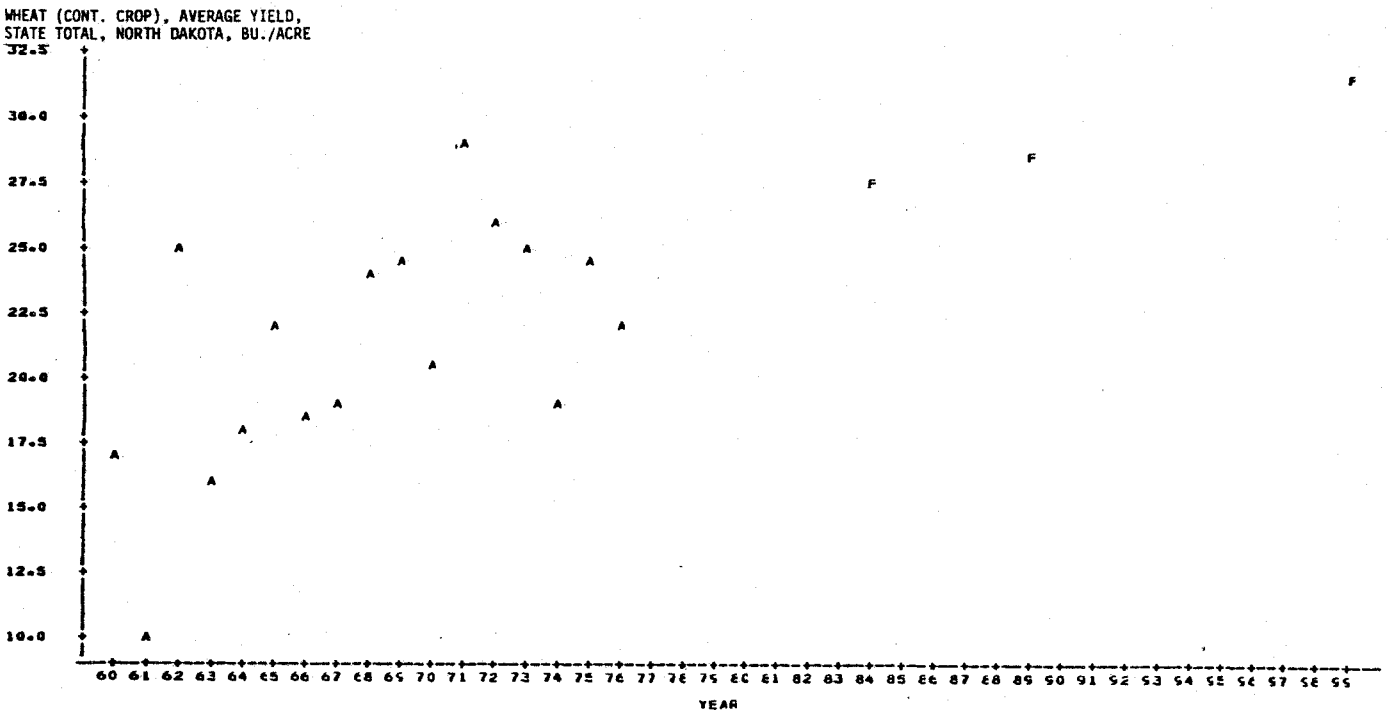
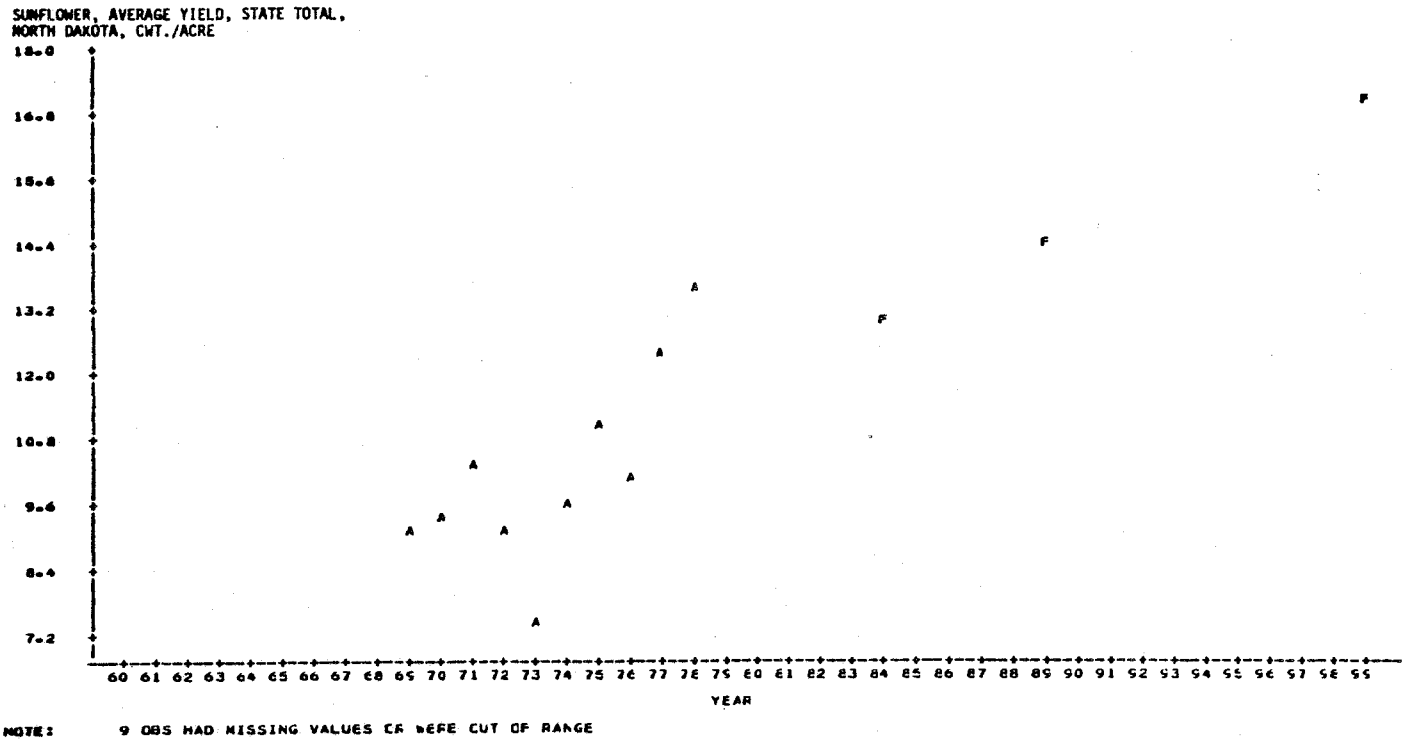
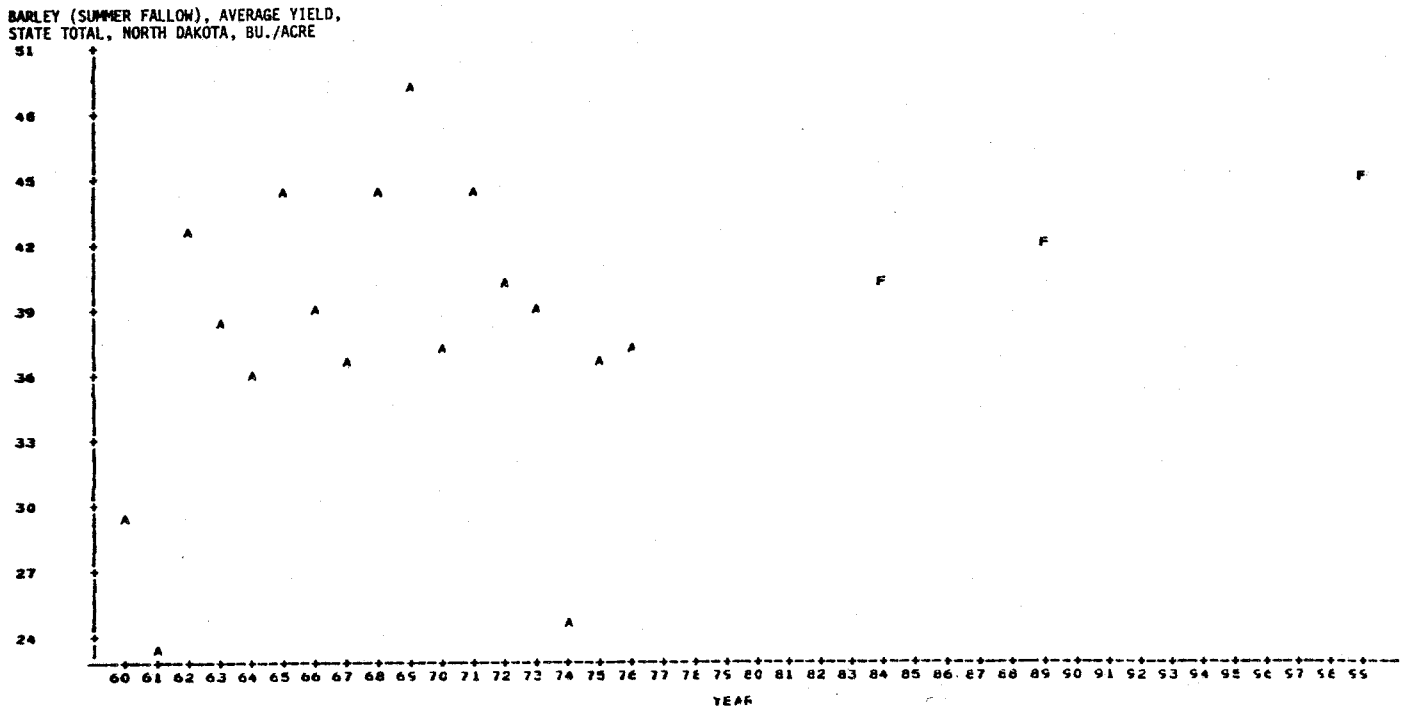


Figure A.2. Average Yield of Specified Crops for North Dakota, 1960-1976 and Projected to 1984, 1989, and 1999 (A=Actual, F=Forecast)





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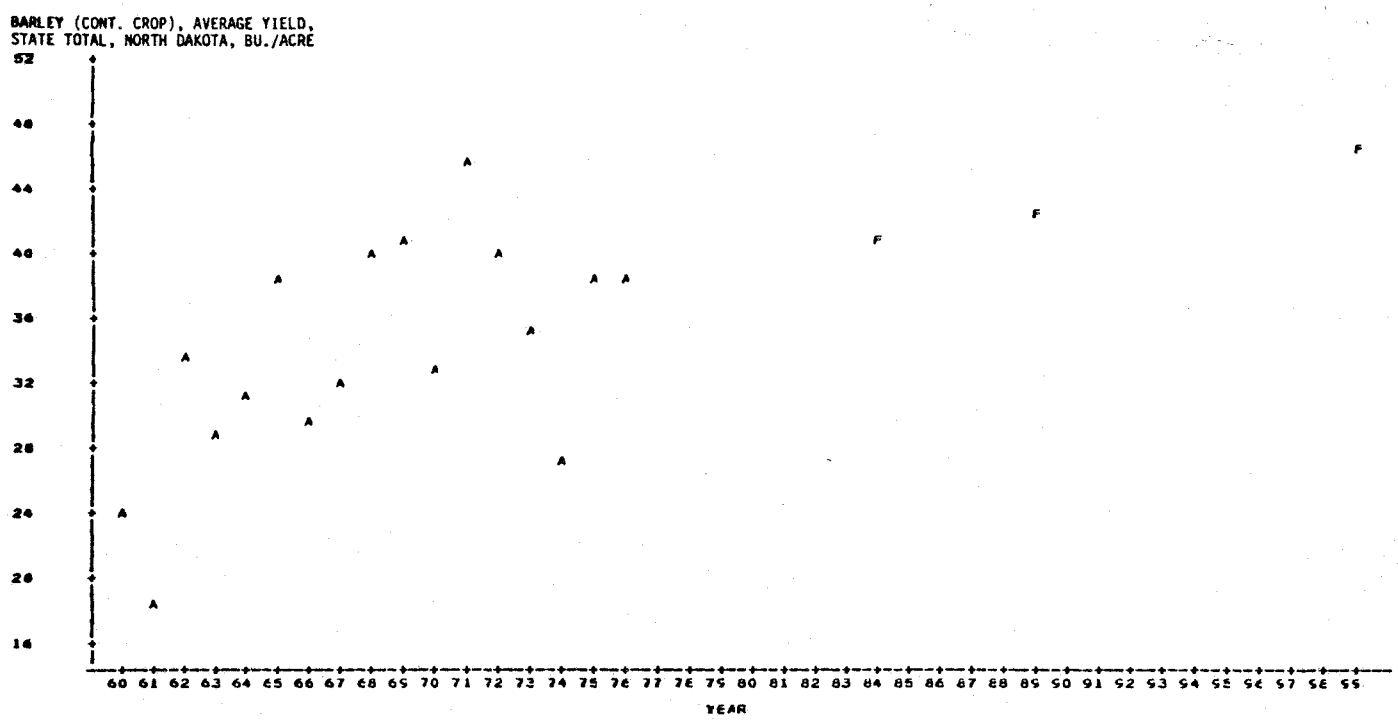


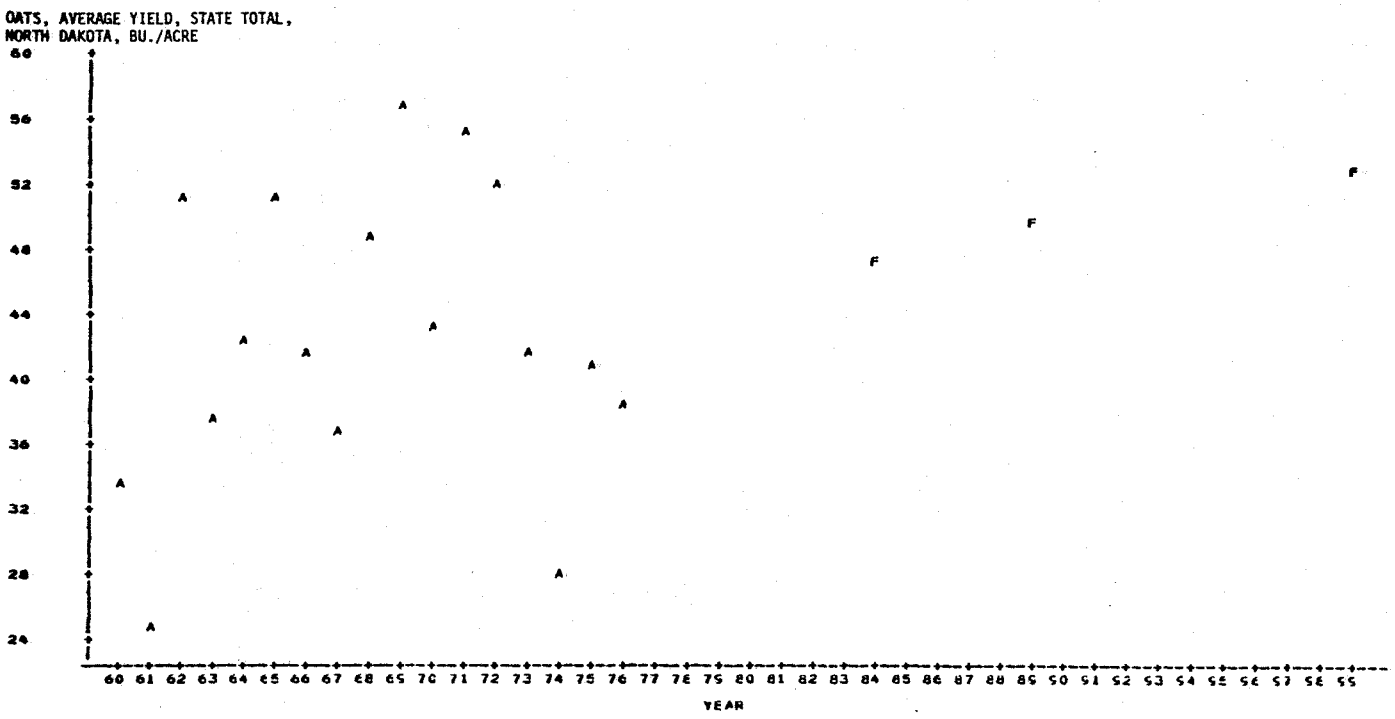
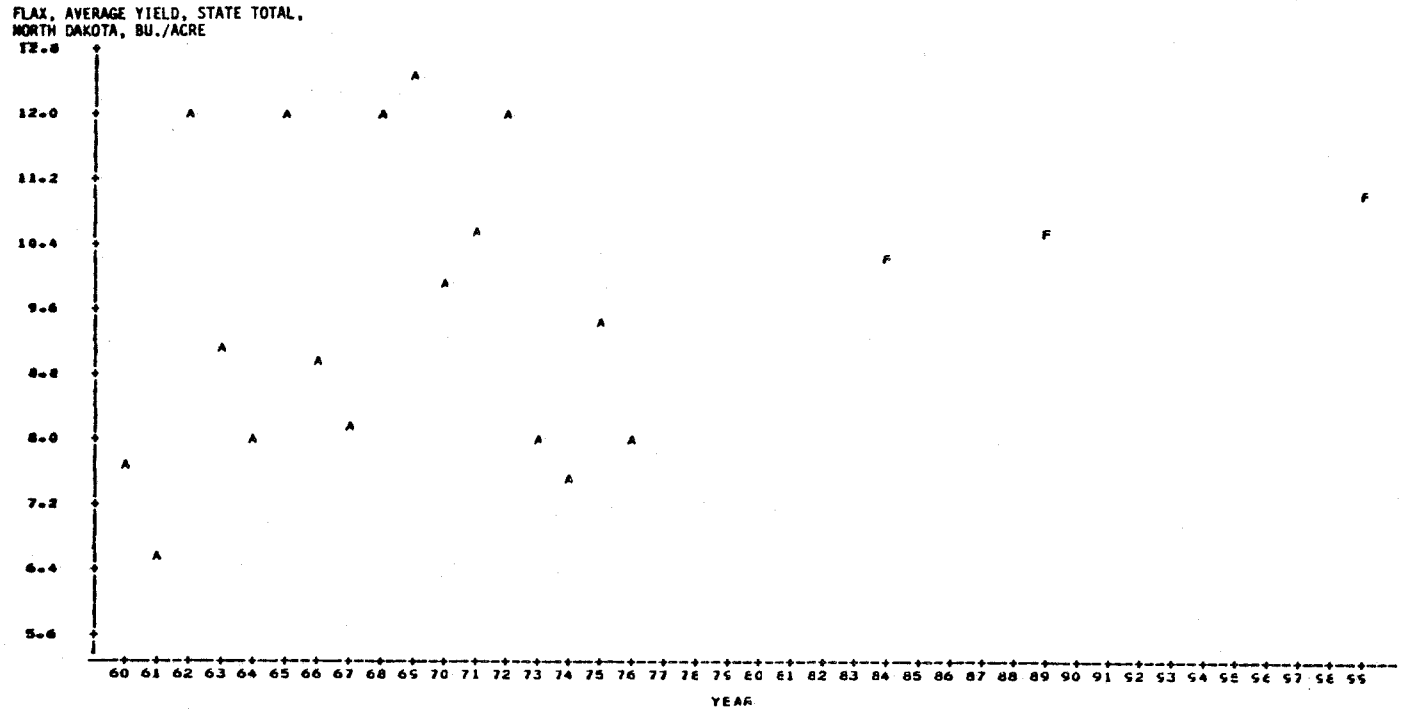


Figure A.2. Continued



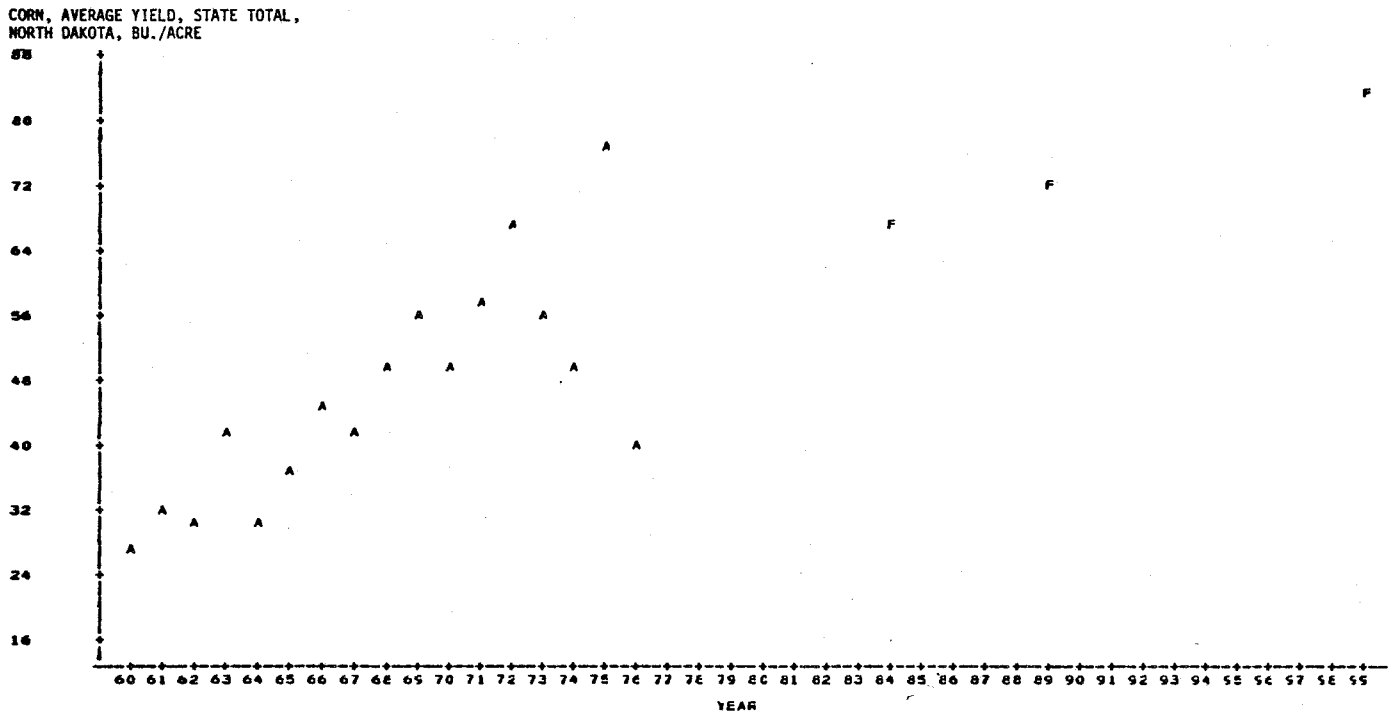
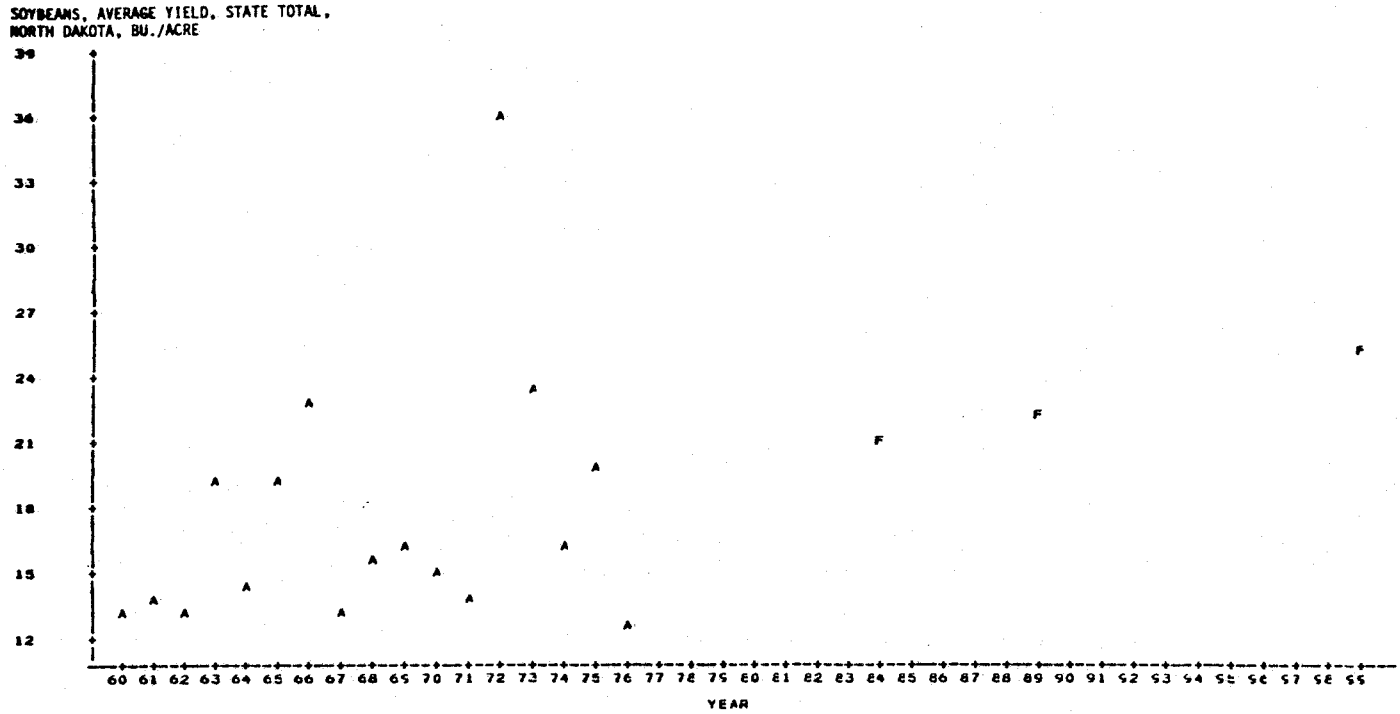


Figure A.2. Continued



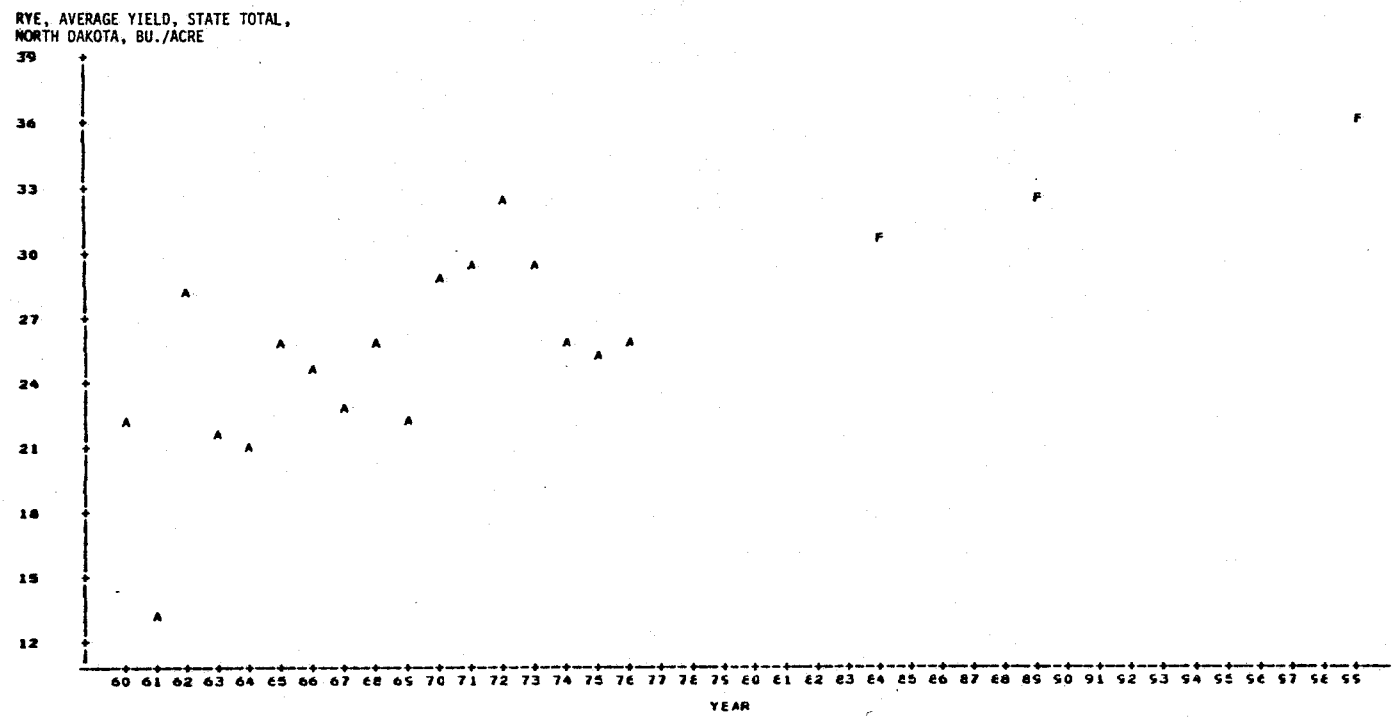


Figure A.2. Continued

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Appendix Figures[§]

[§]Equivalent figures are available for the three North Dakota transportation regions. Order AE 8001, "Crop Data From 1960 and Projected to 1999 for Three North Dakota Regions," figures to accompany Agricultural Economics Report No. 137 from the Department of Agricultural Economics, North Dakota State University, Fargo, ND 58105.