Agribusiness and Applied Economics Report No. 454 **June 2001**

WHITE WHEAT MARKET and STRATEGY ANALYSIS for NORTH DAKOTA

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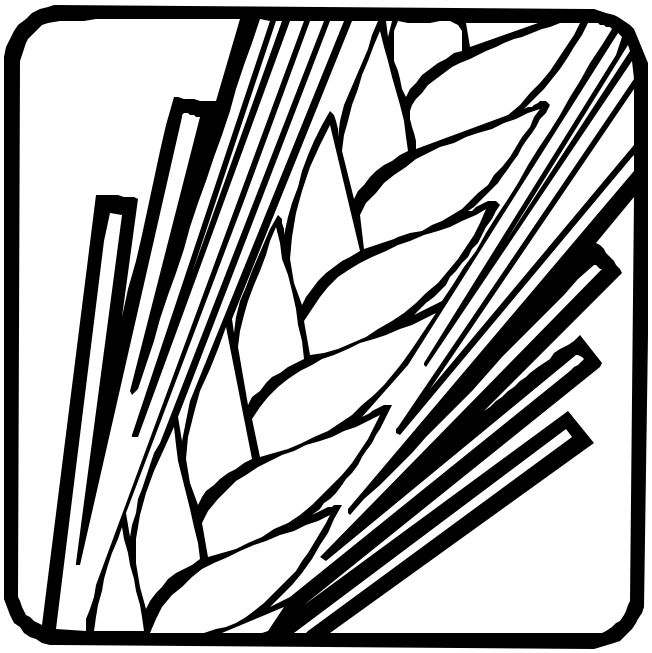

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Acknowledgments

This analysis is based in part upon work supported by the Cooperative State, Education and Extension Service, U.S. Department of Agriculture, under Agreement No. 99-34216-7498. This work is part of the grant entitled "Development of White Spring Wheat as an Alternative Crop," Dr. William Berzonsky, Principal Investigator.

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the view of the U.S. Department of Agriculture.

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Abstract

There is a growing interest and a perceived demand for hard white (HW) wheat to satisfy the needs of the growing Asian noodle market which is currently dominated by Australia. The wheat industry is reviewed with attention to U.S. and Australian production and international markets for white wheat. Quality issues and target markets/market development are discussed. Economic issues associated with production of HW wheat in hard red spring (HRS) wheat producing areas, primarily North Dakota, are explored with emphasis on agronomic issues, segregation and handling costs, yield factors, and price premiums. At present, the development of HW wheat in North Dakota must focus on yield improvements and the development of a robust HW wheat adaptable to climatic conditions in the state to reduce the risks of switching to HW wheat as an alternative crop

Key Words: hard white (HW) wheat, wheat breeding, wheat quality, wheat markets, wheat end uses, agronomics, yield, price premiums

Highlights

Both domestic and international wheat buyers are becoming increasingly more specific and discerning in their buying to meet quality demands of more sophisticated users.

A big factor of interest in hard white (HW) wheat development is the export market, particularly the Asian noodle market. Asia is the fastest growing market in the world and the fastest growing segment of the Asian market is the noodle market.

Several states have directed 40 percent or more of their wheat breeding program to HW wheat. Kansas has made the strongest commitment with 75 percent of their wheat breeding efforts directed toward HW wheat. North Dakota has less than 20 percent of their wheat breeding efforts directed toward HW wheat. Canadian wheat breeders are also targeting the HW wheat markets.

With the premium position of hard red spring (HRS) wheat, the push for development of HW wheat in North Dakota is not nearly as strong as in other states.

Past obstacles to expanded acreage of HW wheat in the United States include tradition, the tendency of white wheat to sprout in the head when subjected to rain at harvest, and lack of a suitable grade classification in the U.S. Grain Standards for Wheat.

Advantages usually attributed to HW wheat include higher milling rates (i.e., more flour per bushel of grain milled to the same color standards), a less bitter aftertaste for some products, and the color qualities preferred by some customers.

The primary challenge associated with the development of the HW wheat market is the realization of a market premium that will more than offset the added marketing costs associated with segregation and handling and potential yield differentials.

The two most discussed economic variables in relation to the introduction of HW wheat on a commercial scale are premium and yield. The level and even realization of price premiums for HW wheat is very uncertain.

Ultimately the adoption of HW wheat depends on whether the producer's net revenue is equal to or greater than would be expected to be realized in planting an alternative crop, in the case of North Dakota, HRS wheat.

While there is much discussion about the development of a "dual purpose" HW wheat the quality characteristics of the two primary markets (bread baking and noodle making) are considerably different and it does not seem likely that a "dual purpose" focus will satisfy the more discerning consumers domestically or internationally.

WHITE WHEAT MARKET and STRATEGY ANALYSIS for NORTH DAKOTA

Edward L. Janzen and William W. Wilson*

1. INTRODUCTION

There is an increasing tendency for differentiation in the international wheat market, i.e., a move away from the highly homogeneous commodity marketing. Both domestic and international wheat buyers are becoming increasingly more specific and differentiated in their buying as they strive to meet the quality demands of more sophisticated customers. This is driven largely by changing consumer tastes and preferences and emerging market segments. There is a growing interest in developing white wheat varieties fueled by the perceived growth in white wheat export demand arising from new customers. Although white wheat is a small percentage of total wheat demand, there is a growing interest in, and a perceived demand for, white wheat to satisfy these customer tastes and to meet the needs of the growing Asian noodle market. The vast majority of this growing demand is for hard white (HW) wheat, a market currently dominated by Australia. Soft white (SW) wheat production in the United States (primarily in the Pacific Northwest) appears to be adequate to meet domestic and export demands for SW wheat.

There is also concern that the emphasis on white wheat breeding programs in other states might leave North Dakota at a substantial disadvantage should the demand for white wheat develop as some industry experts predict. North Dakota's white wheat breeding commitment, relative to other wheat breeding programs, is illustrated in Table 1. Canadian HW wheats are also being developed by Canadian wheat breeders for targeted white wheat markets

The relatively extensive breeding efforts for white wheat reflect the concern or fear of being shut out or limited in the marketplace. Irrespective of whether premiums are realized or not, the possibility that farmers might be "shut out" of markets or limit their marketing opportunities if they do not look at producing white wheat in the future is driving the research efforts in white wheat.

The primary challenge associated with development of the white wheat market is the realization of a market premium that will more than offset the added marketing costs associated with segregation and handling and potential yield differentials.

The objective of this study is to analyze factors required for HW wheat to be competitive with hard red spring (HRS) wheat in North Dakota and provide some insight into issues related to potential development of HW wheat in North Dakota. Issues and previous studies are reviewed and key economic factors are identified and discussed. A framework is developed to analyze the impacts of these key economic variables on the potential success of HW wheat in North Dakota.

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Table 1. Wheat Breeding Efforts/Commitments Directed Toward White Wheat (Percent of Wheat Breeding Program)

Public Breeding Programs	
Kansas State	75%
Colorado	50%
Oregon State	50%
Oklahoma	30%
Montana	20-40%
South Dakota	20-40%
Washington	20-40%
Canada	20-40%
North Dakota	*< 20%*
Minnesota	< 20%
California	< 20%
Texas	< 20%
Private Breeding Programs	
AgriPro	20-40%
Western Plant Breeders	20-40%
Hybritech	20-40%
Cargill	20-40%

Source: "New Hard White Wheat to be Released to Industry," *Grainnet*, http://www.grainnet.com/ArticleLibrary/articles.html?ID=1012 accessed 09/09/99.

2. WHEAT INDUSTRY and MARKETING

2.1. Background

The scope of the domestic wheat economy is reviewed in this section and the importance and characteristics of the wheat sector in North Dakota agriculture is discussed. The Australian wheat industry is reviewed since it is the major force in the international white wheat market.

2.2. Domestic Wheat Markets by Class [1]

U.S wheat production, domestic use, and exports by class are summarized in Table 2.a. Production, domestic use, and exports by class are also displayed in Figures 1 through 3. Hard red winter (HRW) is the largest wheat class, followed by HRS, soft red winter (SRW), and white wheat. While there is no breakdown between hard white wheat and soft white wheat, Table 2.b. does provide a breakdown by winter white and spring white for the last three years.

Table 2.a. U.S. Wheat Statistics by Class, 1989/90-1999/00

Production (million bushels)

Yr begin June 1	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00**
Hard winter	711	1,196	901	967	1,066	971	825	759	1,098	1,179	1,055
Hard spring	434	555	431	707	512	515	475	631	491	486	448
Soft red	549	544	325	427	401	438	456	420	472	443	453
White	251	313	219	266	347	300	325	352	332	301	247
Durum	45	122	104	100	71	97	102	116	88	138	99
All classes	2,037	2,730	1980	2,467	2,396	2,321	2,183	2,277	2,482	2,547	2,302

Domestic use (million bushels)

Yr begin June 1	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00**
Hard winter	439	681	507	494	560	586	481	485	573	599	539
Hard spring	224	238	215	264	282	282	262	324	253	284	295
Soft red	212	265	259	215	226	232	207	270	257	282	283
White	57	105	65	70	104	103	108	126	104	116	96
Durum	60	76	86	85	68	80	82	96	69	103	84
All classes	992	1,365	1,132	1,128	1,240	1,287	1,140	1,301	1,257	1,384	1,296

Exports (million bushels)

Yr begin June 1	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00**
Hard winter	359	370	559	464	486	422	384	286	362	453	485
Hard spring	280	201	380	438	266	292	330	300	241	247	215
Soft red	345	230	105	210	173	212	250	140	180	105	160
White	193	216	193	195	249	222	238	237	205	198	150
Durum	55	53	45	47	54	40	39	38	53	40	40
All classes	1,232	1,069	1,282	1,354	1,228	1,188	1,241	1,002	1,040	1,042	1,050

* Data, except production, are approximations. Imports and exports include flour and products in wheat equivalent.

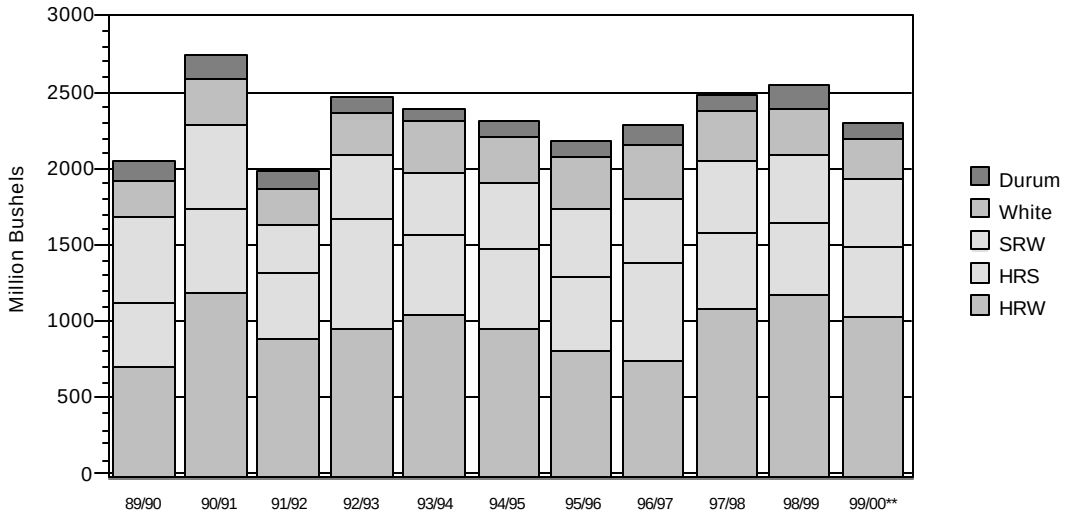
Source: *Wheat Situation and Outlook Yearbook*, USDA/ ERS, March 2000.

[1] Current U.S. wheat statistics do *not* separate soft white wheat from hard white wheat. Statistics are only reported for total white wheat as a class.

Table 2.b. U.S. Wheat Production by Class, 1998-2000							
Year	WINTER			SPRING			Total
	Hard Red	Soft Red	White	Hard Red	White	Durum	
	1,000 bu	*1,000 bu*	*1,000 bu*	*1,000 bu*	*1,000 bu*	*1,000 bu*	*1,000 bu*
1998	1,179,452	442,677	258,604	486,370	42,099	138,119	2,547,321
1999	1,050,757	454,261	191,572	447,908	55,200	99,322	2,299,010
2000	843,664	470,866	248,203	498,485	52,417	109,805	2,223,440

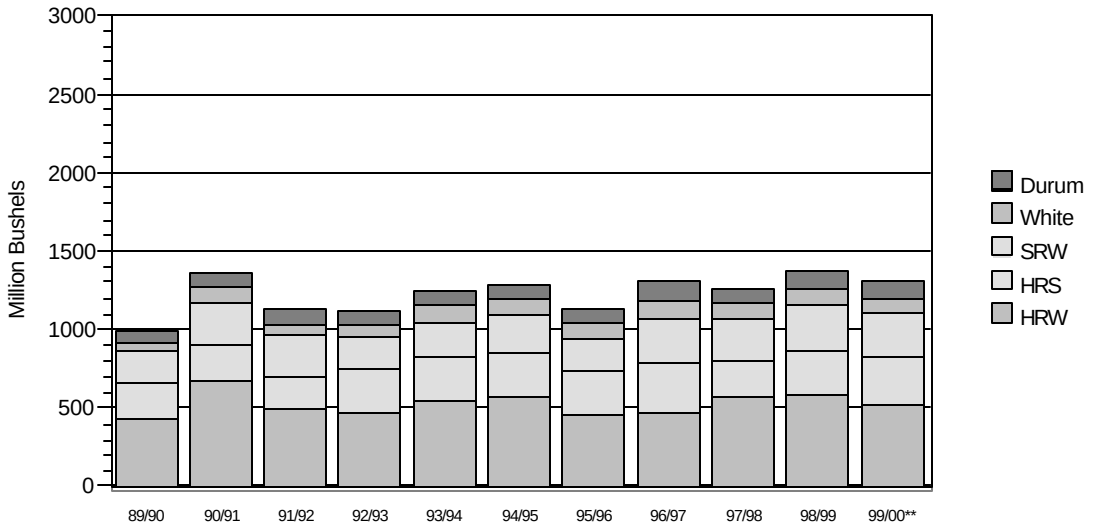
Wheat class estimates are based on the latest varietal data available.
Source: *Crop Production 2000 Summary*, USDA/ NASS, January 2001.

Figure 1. U.S. Wheat: Production, by Class



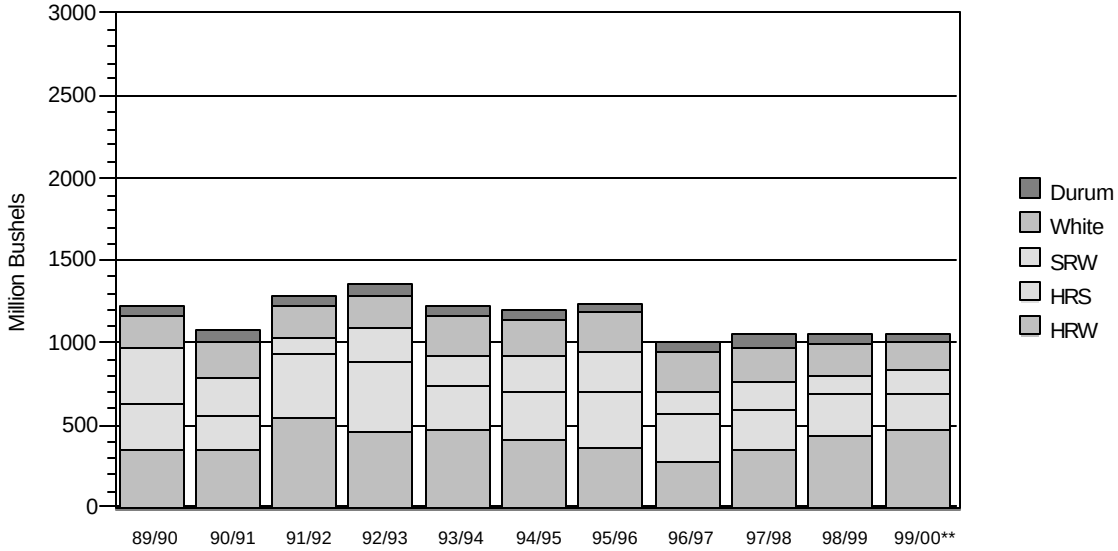
Source: Wheat Situation and Outlook Yearbook, March 2000, USDA/ERS

Figure 2. U.S. Wheat: Domestic Use, by Class



Source: Wheat Situation and Outlook Yearbook, March 2000, USDA/ERS

Figure 3. U.S. Wheat: Exports, by Class



Source: Wheat Situation and Outlook Yearbook, March 2000, USDA/ERS

Acreage percentage breakdown by class by state for 1997-1999 (Table 3) indicates the extent and in which states winter white wheat and spring white wheat are grown. Almost all of the white wheat currently grown in the United States is SW wheat with production concentrated in Washington, Oregon, Idaho, and California.

Total HW wheat acreage planted in 1998 was 100,000 to 140,000 acres, with a 50-50 split between winter and spring varieties. HW wheat accounts for 2-3 percent of U.S. white wheat acreage, and just 0.2 percent of all U.S. wheat acreage. The top five HW wheat producing states in 1998 were Montana (40,500 acres), Colorado (20,000 to 50,000 acres), Kansas (10,000 to 20,000 acres), Idaho (15,000 acres), and California (12,000 acres) (Lin & Vocke, poster). In 2000, an estimated 160,000 acres were planted to HW wheat in Kansas, nearly quadruple the acreage planted in 1999. [2] More recent figures for HW wheat acreage are not currently available for the other states.

Total U.S. supply and demand for white wheat is summarized in detail in Table 4. USDA statistics currently do not distinguish between HW wheat and SW wheat. It is important that the vast majority of this wheat is exported with a much smaller share being used domestically.

Wheat production in North Dakota has long been a mainstay of North Dakota agriculture. In 1998 and 1999 wheat accounted for 45 percent of the acres harvested of the principal crops grown in the state. HRS wheat and durum account for the majority of the wheat production, with the balance being limited production of winter wheat. North Dakota wheat acreage and production summaries for the past 11 years are presented in Table 5 with wheat production by class displayed in Figure 4. In 1999, North Dakota produced 72 percent of the nation's durum and 33 percent of the nation's spring wheat, ranking number one in these two wheat classes and second only to Kansas in total wheat production. [3]

Wheat and wheat products rank as the leading agricultural export in North Dakota. HRS wheat exports, however, have generally been declining as noted in Figure 5. The reduction is evidenced at all of the major destinations/ports. Primary destinations for HRS wheat shipments from North Dakota for the past 10 years are noted in Table 6. The percent of total HRS Wheat shipments from North Dakota to each of the major destinations/ports is displayed in Figure 6.a. (10-year average) and Figure 6.b. (1999/00). HRS wheat shipments from North Dakota to the PNW area, which would be predominantly for export, averaged nearly 19 percent over the most recent 10 years; however, the percent to the PNW for the most recent two years has been 14.1 and 13.5 percent, respectively. The vast majority of the remaining shipments have gone to Minneapolis, Duluth, Midland, and the Gulf, and other eastern destinations. Shipments going to Minneapolis are likely for domestic use, though that cannot be verified. This provides some insights into the market areas where North Dakota HRS wheat is competitive in the international wheat economy.

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[2] "Kansas Hard White Wheat Acreage Quadrupled Since 1999," *Grainnet*, posted February 15, 2001.

[3] *North Dakota Agricultural Statistics 2000*, USDA/NASS, June 2000.

Table 3. Wheat Classes: Acreage, Percentage Breakdown by State, 1997-99[1]

State	Winter									Spring[2]					
	Hard red			Soft red			**White**			Hard red			**White**		
	1997	1998	1999	1997	1998	1999	1997	1998	1999	1997	1998	1999	1997	1998	1999
	(percent)			(percent)			(percent)			(percent)			(percent)		
Alabama	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Arizona	100	100	100	--	--	--	--	--	--	--	--	--	--	--	--
Arkansas	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
California	86	95	95	--	--	--	14	5	5	--	--	--	--	--	--
Colorado	100	100	100	--	--	--	--	--	--	84	84	84	16	16	16
Delaware	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Florida	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Georgia	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Idaho	13	13	16	--	--	--	87	87	84	30	50	43	70	50	57
Illinois	2	2	2	98	98	98	--	--	--	--	--	--	--	--	--
Indiana	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Iowa	70	70	70	30	30	30	--	--	--	--	--	--	--	--	--
Kansas	99	99	99	1	1	1	--	--	--	--	--	--	--	--	--
Kentucky	4	4	4	96	96	96	--	--	--	--	--	--	--	--	--
Louisiana	2	2	2	98	98	98	--	--	--	--	--	--	--	--	--
Maryland	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Michigan	--	5	3	50	47	58	50	48	39	--	--	--	--	--	--
Minnesota	100	100	100	--	--	--	--	--	--	100	100	100	--	--	--
Mississippi	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Missouri	3	3	3	97	97	97	--	--	--	--	--	--	--	--	--
Montana	99	99	99	--	--	--	1	1	1	99	99	99	1	1	1
Nebraska	100	100	100	--	--	--	--	--	--	--	--	--	--	--	--
Nevada	--	--	--	--	--	--	100	100	100	12	12	12	88	88	88
New Jersey	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
New Mexico	100	100	100	--	--	--	--	--	--	--	--	--	--	--	--
New York	1	1	1	2	2	2	97	97	97	--	--	--	--	--	--
North Carolina	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
North Dakota	100	100	100	--	--	--	--	--	--	100	100	100	--	--	--
Ohio	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Oklahoma	99	99	99	1	1	1	--	--	--	--	--	--	--	--	--
Oregon	2	2	1	--	--	--	98	98	99	15	15	27	85	85	73
Pennsylvania	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
South Carolina	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
South Dakota	100	100	100	--	--	--	--	--	--	100	100	100	--	--	--
Tennessee	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Texas	94	94	94	6	6	6	--	--	--	--	--	--	--	--	--
Utah	93	93	93	--	--	--	7	7	7	71	71	71	29	29	29
Virginia	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Washington	9	7	8	--	--	--	91	93	92	28	24	26	72	76	74
West Virginia	--	--	--	100	100	100	--	--	--	--	--	--	--	--	--
Wisconsin	--	--	--	93	93	93	7	7	7	100	100	100	--	--	--
Wyoming	100	100	100	--	--	--	--	--	--	97	97	97	3	3	3

-- = Not applicable.

[1] Acreage percentages are based on a variety acreage survey collected at 5-year intervals from all wheat-producing states, adjusted as other variety survey information becomes available to USDA's Agricultural Statistics Board. The percentages are used for U.S. wheat class production estimates and forecasts.

[2] Excludes durum.

Source: National Agricultural Statistics Service, USDA.

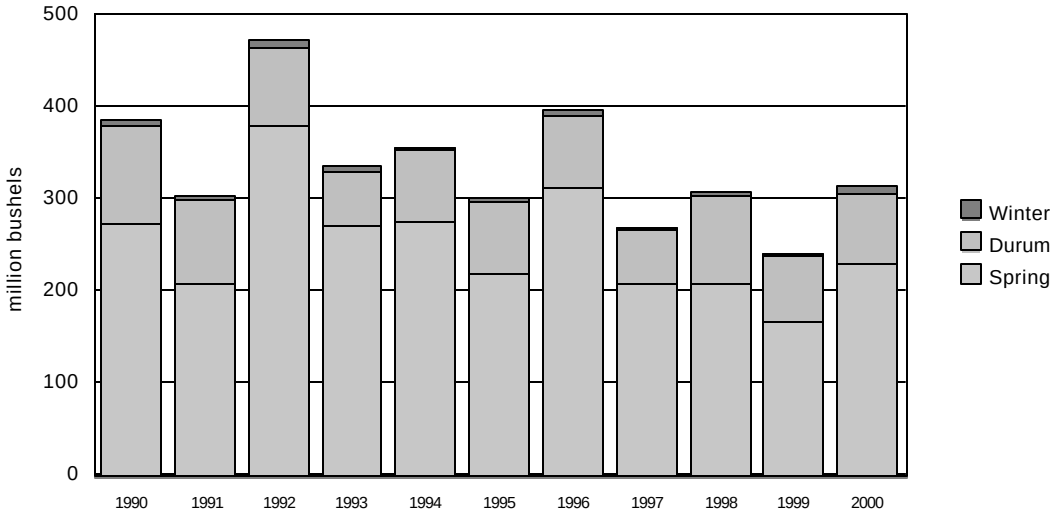
Table 4. U.S. White Wheat Supply and Disposition

	1995/96	1996/97	1997/98	1998/99	1999/00E	2000/01P
			(million acres)			
Area:						
Planted	5.1	5.3	4.9	4.7	4.5	4.3
Harvested	4.9	5.1	4.7	4.5	4.1	4.2
			(bushels per harvested acre)			
Yield per acre	66.7	68.9	70.2	67.4	60.4	71.9
			(million bushels)			
Supply:						
Beg. stocks	57	55	59	90	87	91
Production	325	352	332	301	247	301
Imports	19	15	8	11	7	6
Total supply	401	422	399	401	341	398
Domestic use:						
Food	77	85	80	75		
Seed	7	7	6	6		
Residual	24	34	18	35		
Total domestic	108	126	104	116	89	116
Exports	238	237	205	198	160	200
Total use	346	363	309	314	249	316
Ending Stocks	55	59	90	87	94	82

E = estimated, P = projected.

1 ERS estimates of area, yield, and domestic use.

Figure 4. Wheat Production, North Dakota



Source: North Dakota Agricultural Statistics Service

Table 5. North Dakota Wheat Statistics, by Class

SPRING WHEAT

	Acres Planted	Acres Harvested	Yield Per Acre	Production	Marketing Yr. Avg. Price	Value of Production	Value/Acre Harvested
	(000)	(000)	(bu)	(mil bu)	($/bu)	($mil)	($)
1990	8,000	7,700	36.0	277.2	2.44	676.4	87.84
1991	7,000	6,850	31.0	212.4	3.14	666.8	97.34
1992	9,200	9,100	42.0	382.2	3.19	1,219.2	133.98
1993	9,600	8,850	31.0	274.4	3.81	1,045.3	118.11
1994	9,100	8,850	31.5	278.8	3.40	947.8	107.10
1995	8,300	8,200	27.0	221.4	4.71	1,042.8	127.17
1996	9,600	9,500	33.0	313.5	4.05	1,269.7	133.65
1997	8,800	8,400	25.0	210.0	3.48	730.8	87.00
1998	6,700	6,600	32.0	211.2	3.04	642.0	97.28
1999	5,900	5,600	30.0	168.0	2.85	478.8	85.50
2000	6,800	6,400	36.0	230.4			

DURUM WHEAT

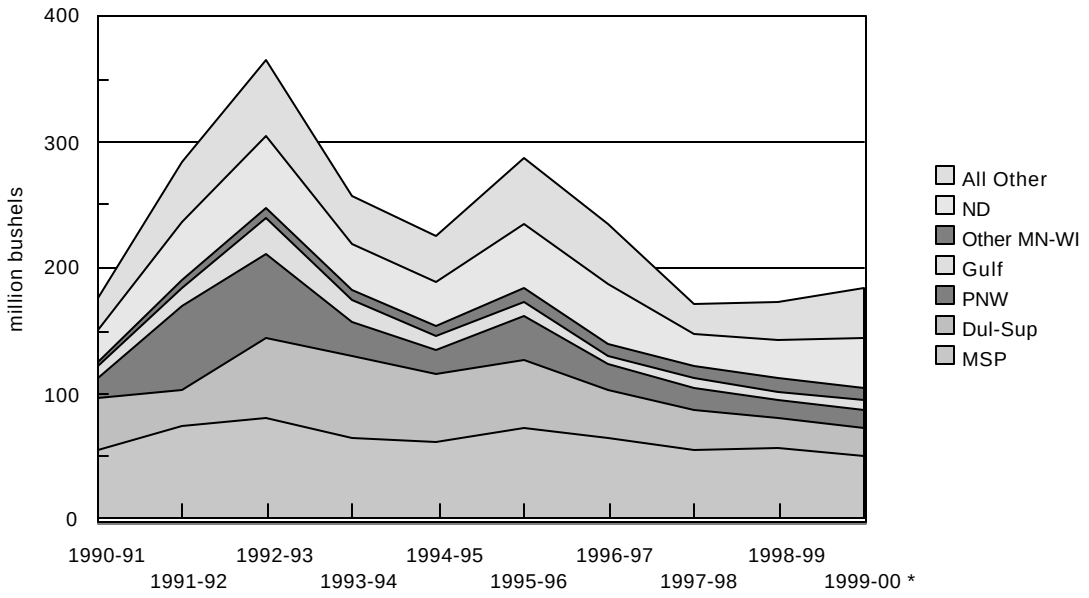
	Acres Planted	Acres Harvested	Yield Per Acre	Production	Marketing Yr. Avg. Price	Value of Production	Value/Acre Harvested
	(000)	(000)	(bu)	(mil bu)	($/bu)	($mil)	($)
1990	3,100	3,050	34.0	103.7	2.50	259.3	85.00
1991	2,900	2,850	31.0	88.4	2.84	250.9	88.04
1992	2,250	2,230	38.0	84.7	3.00	254.2	114.00
1993	2,000	1,870	31.0	58.0	4.68	271.3	145.08
1994	2,450	2,350	32.5	76.4	4.67	356.7	151.77
1995	2,950	2,880	27.0	77.8	5.75	447.1	155.25
1996	3,000	2,940	27.0	79.4	4.53	359.6	122.31
1997	2,750	2,630	22.0	57.9	4.91	284.1	108.02
1998	3,000	2,950	32.0	94.4	3.00	283.2	96.00
1999	3,450	3,000	24.0	72.0	2.58	185.8	61.92
2000	3,250	2,900	27.0	78.3			

WINTER WHEAT

	Acres Planted	Acres Harvested	Yield Per Acre	Production	Marketing Yr. Avg. Price	Value of Production	Value/Acre Harvested
	(000)	(000)	(bu)	(mil bu)	($/bu)	($mil)	($)
1990	250	160	27.0	4.3	2.14	9.2	57.78
1991	100	90	33.0	3.0	2.76	8.2	91.08
1992	200	170	35.0	6.0	2.86	17.0	100.10
1993	150	130	33.0	4.3	2.80	12.0	92.40
1994	40	38	33.0	1.3	3.07	3.9	101.32
1995	40	38	30.0	1.1	4.66	5.3	139.79
1996	80	75	30.0	2.3	4.05	9.1	121.51
1997	75	65	22.0	1.4	3.17	4.5	69.74
1998	70	60	35.0	2.1	2.69	5.6	94.15
1999	60	57	40.0	2.3	2.49	5.7	99.60
2000	120	113	45.0	5.1			

Source: North Dakota Agricultural Statistics Service, USDA.

Figure 5. HRS Wheat Shipments from ND



Source: UGPTI, Dept Pub No 138, September 2000

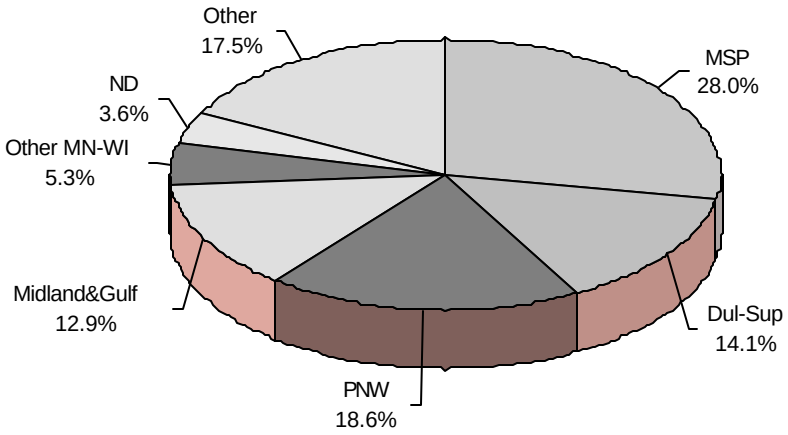
Table 6. Destinations for HRS Wheat Shipments from North Dakota

	MSP	Dul-Sup	PNW	Midland& Gulf	Other MN-WI	ND	Other	Total
	mil bu	mil bu	mil bu	mil bu	mil bu	mil bu	mil bu	mil bu
1990-91	56.356	39.229	39.521	16.898	9.604	4.042	25.422	191.072
1991-92	74.837	23.892	29.290	66.246	12.546	7.005	47.604	261.420
1992-93	81.210	38.573	62.458	66.819	30.071	6.684	58.446	344.261
1993-94	64.995	36.159	66.186	25.342	18.321	6.425	37.948	255.376
1994-95	62.588	34.840	52.971	18.672	12.411	7.510	34.894	223.886
1995-96	71.860	28.842	56.223	33.524	11.848	9.972	52.109	264.378
1996-97	65.310	36.028	37.722	21.048	7.151	8.741	47.145	223.145
1997-98	54.824	32.140	32.646	18.040	6.173	10.182	25.321	179.326
1998-99	57.498	24.326	23.672	13.389	7.423	10.514	30.890	167.712
1999-00 *	49.971	28.285	23.271	15.270	6.066	11.228	38.739	172.830
(Pct of Total)	28.9%	16.4%	13.5%	8.8%	3.5%	6.5%	22.4%	100.0%
10-yr ave	63.945	32.231	42.396	29.525	12.161	8.230	39.852	228.341
(Pct of Total)	28.0%	14.1%	18.6%	12.9%	5.3%	3.6%	17.5%	100.0%

* Preliminary Results

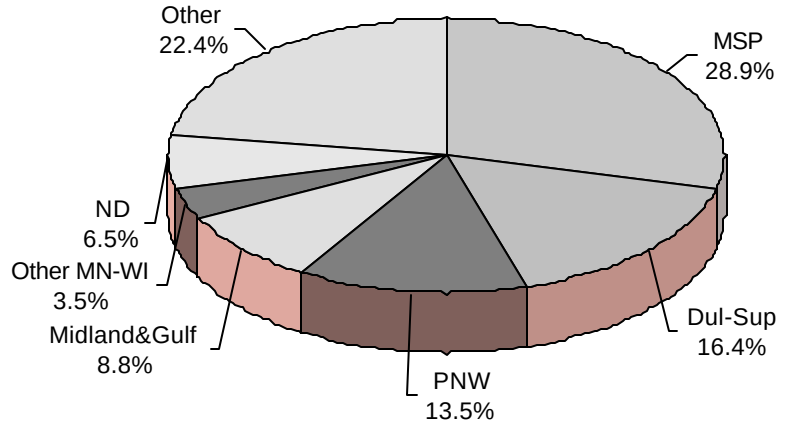
Source: *1999-2000 ND Grain and Oilseed Transportation Statistics*, UGPTI Pub. No. 138, September 2000.

Figure 6.a. Destinations for HRS Wheat Shipments from ND
Percent of Total (10-yr avg)



Source: UGPTI, Dept Pub No 138, September 2000

Figure 6.b. Destinations for HRS Wheat Shipments from ND
Percent of Total (1999-2000)



Source: UGPTI, Dept Pub No 138, September 2000

2.3. International Markets for White Wheat

While exports represent perhaps more a disposition of present production than a representation of the actual size of the white wheat market, they do indicate where the present markets are located.

Australia is the primary world producer and exporter of HW wheat. AWB (Australian Wheat Board) wheat receivals by class definition are summarized in Table 7 and Figure 7a and 7b. The majority of the wheat grown in Australia is white wheat. Australian Standard White (ASW) has been the largest class but has been declining in percentage terms as other wheat classes (still primarily white) have been defined. Australian General Purpose (AGP) includes both feed wheat and wheat that is considered unsuitable for flour milling because of defects such as sprouting, light weight or high levels of unmillable material. The high percentage of AGP in the last two reported crop years would suggest that overall the quality of the Australian wheat crop was not up to its usually high quality standards in those two years.

Production, yields and exports of Australian wheats are shown in Table 8. Total Australian wheat exports (which are HW wheat) are depicted in Figure 8. Total exports the past four years have ranged from 13.2 to the 18.9 metric tonnes range, averaging 15.8 million metric tonnes for the four years. Exports by primary destinations are depicted in Figure 9.a. (1997/98) and Figure 9.b. (1998/99). Primary exports of Australian wheat are to Asian countries (Indonesia, Japan, Korea, India, Pakistan, and Malaysia) and the Middle East (Egypt and Iran).

Table 7. Australia: Wheat Board Percentage of Wheat Receivals by Class

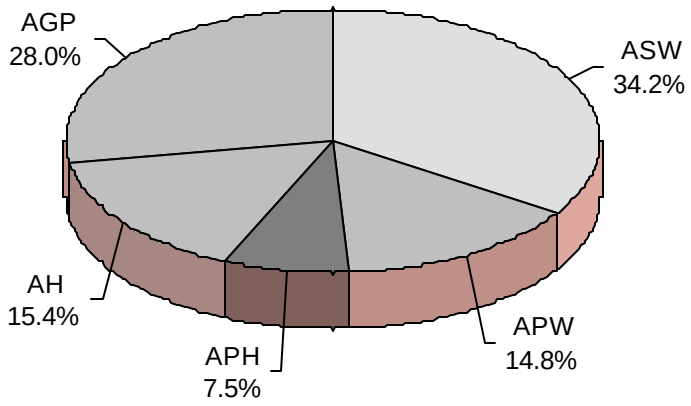
	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
ASW	78.7	78.3	82.1	52.6	77.3	73.4	41.2	36.5	34.2	35.2
APW	-	-	-	-	-	-	23.8	29.5	14.8	9.9
APH	5.3	2.6	2.2	5.2	5.5	1.9	12.0	8.5	7.5	2.9
AH	12.2	14.6	10.2	5.6	9.1	18.5	16.8	16.9	15.4	12.8
AGP	3.8	4.5	5.5	36.6	8.1	6.2	6.2	8.6	28.0	39.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

ASW - Australian Standard White (including Australian Durum and Soft wheat)
APW - Australian Premium White
APH - Australian Prime Hard Wheat
AH - Australian Hard Wheat
AGP - Australian General Purpose, including feed wheat

TOTAL RECEIVALS (000 tonnes)										
	13,057	13,382	8,075	13,584	15,123	7,008	15,137	21,866	14,387	18,918

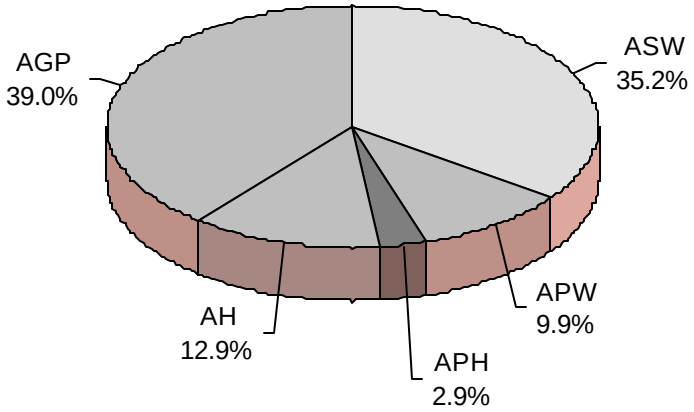
Source: AWB Limited, "Wheat Statistics,"
(http://awb.com.au/corporate/news_wheatstats.html), accessed 01/30/2001)
"Australian Wheat Board, Annual Report 1998-99.

Figure 7.a. AWB: Percentage of Wheat Receivals by Class 1997/1998



Source: Australian Wheat Board, Annual Report 1998-99

Figure 7.b. AWB: Percentage of Wheat Receivals by Class 1998/1999

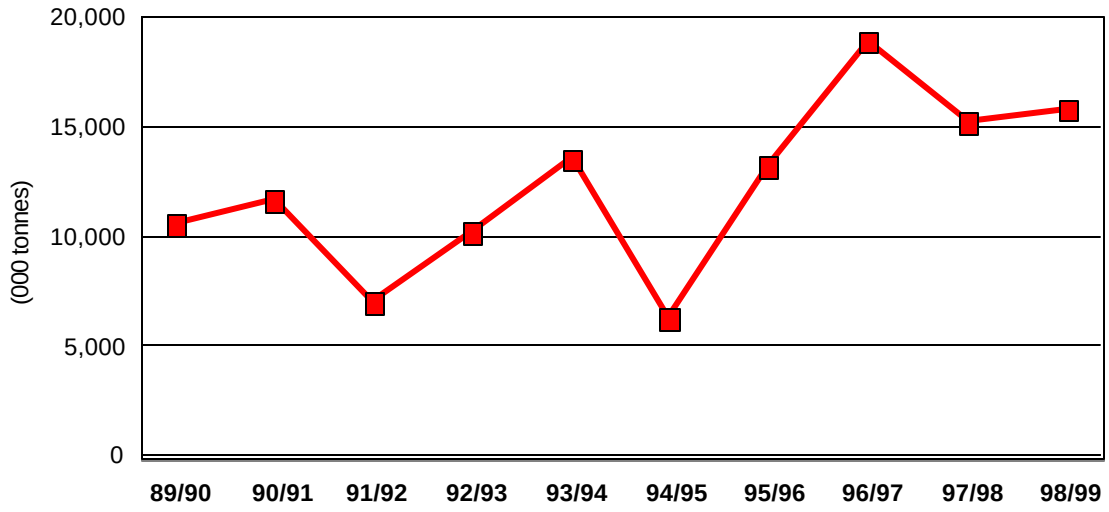


Source: Australian Whaet Board, Annual Report 1998-99

Table 8. Australia: Wheat Production and Yields										
	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99
Production (000 tonnes)	14,213	15,066	10,557	14,738	16,249	9,024	16,975	23,586	19,417	23,006
Yield (tonnes/hectare)	1.57	1.63	1.49	1.78	1.92	1.13	1.75	2.08	1.86	2.09
Exports (000 tonnes)	10,664	11,772	7,115	10,251	13,674	6,339	13,215	18,973	15,240	15,899

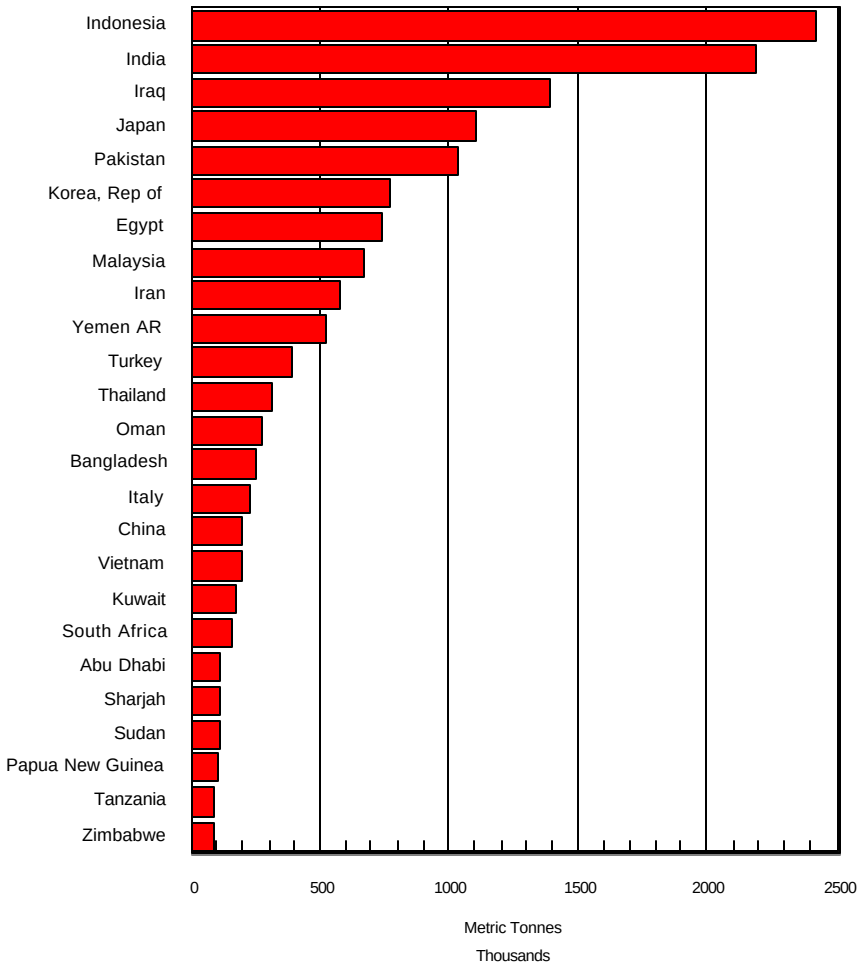
Source: Australian Wheat Board, Annual Report 1998-99.

Figure 8. Australia: Wheat Exports



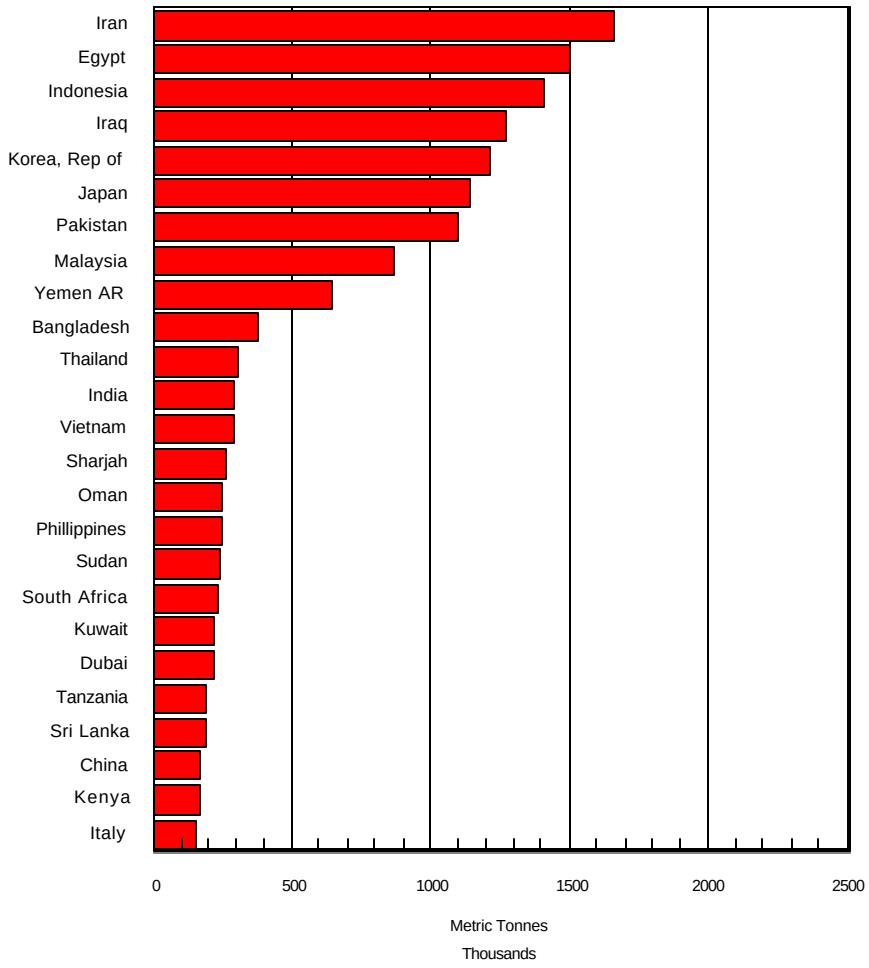
Source: Australian Wheat Board, Annual Report 1998-99

Figure 9.a. Australia: Exports of Wheat by Primary Destination, 1997/98
(Top 25 Destinations)



Source: Australian Wheat Board, Annual Report 1997-98

Figure 9.b. Australia: Exports of Wheat by Primary Destination, 1998/99
(Top 25 Destinations)

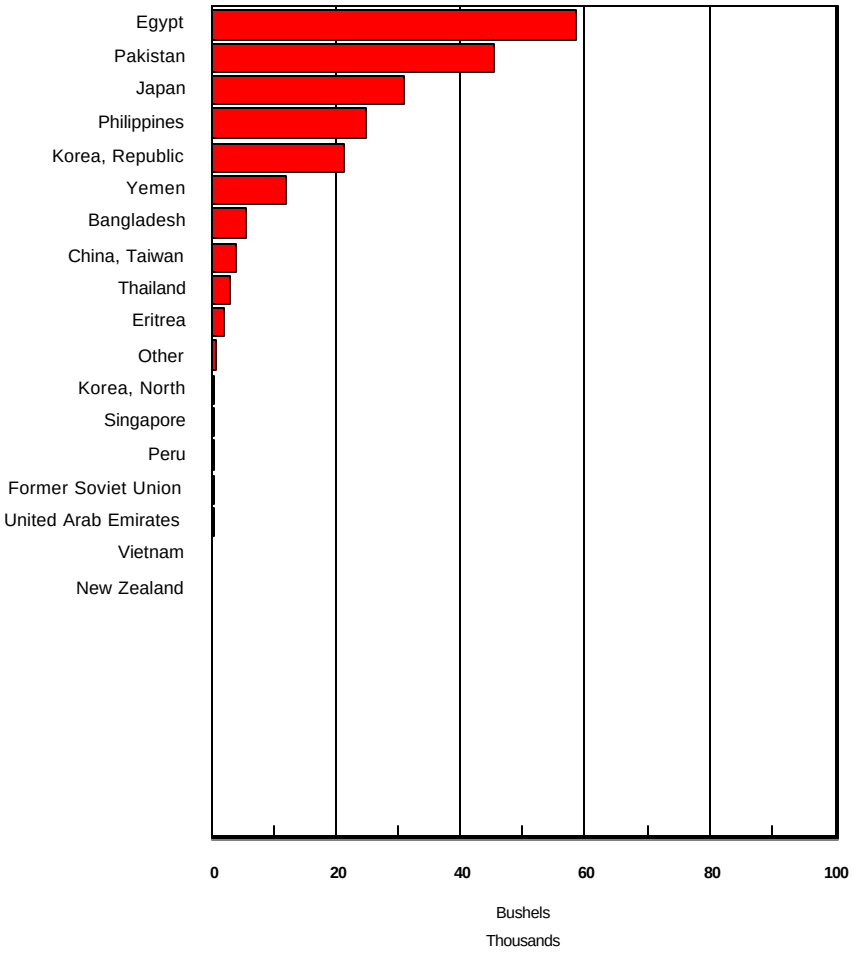


Source: Australian Wheat Board, Annual Report 1998-99

United States *white* wheat exports by destination (1997/98) are shown in Figure 10.a. Primary destinations were Pakistan, Japan, the Philippines, Republic of Korea, and Yemen. U.S. exports of white wheat are of the SW wheat class. The volumes of the HW wheat class produced in the United States are not yet sufficient to develop or support export customers. U.S. *HRS* wheat exports during the same time period are shown in Figure 10.b. Primary destinations were Japan, the Phillippines, Taiwan, and Korea. Pakistan, the largest recipient of SW wheat from the United States in 1997-98, was not a significant recipient of HRS wheat.

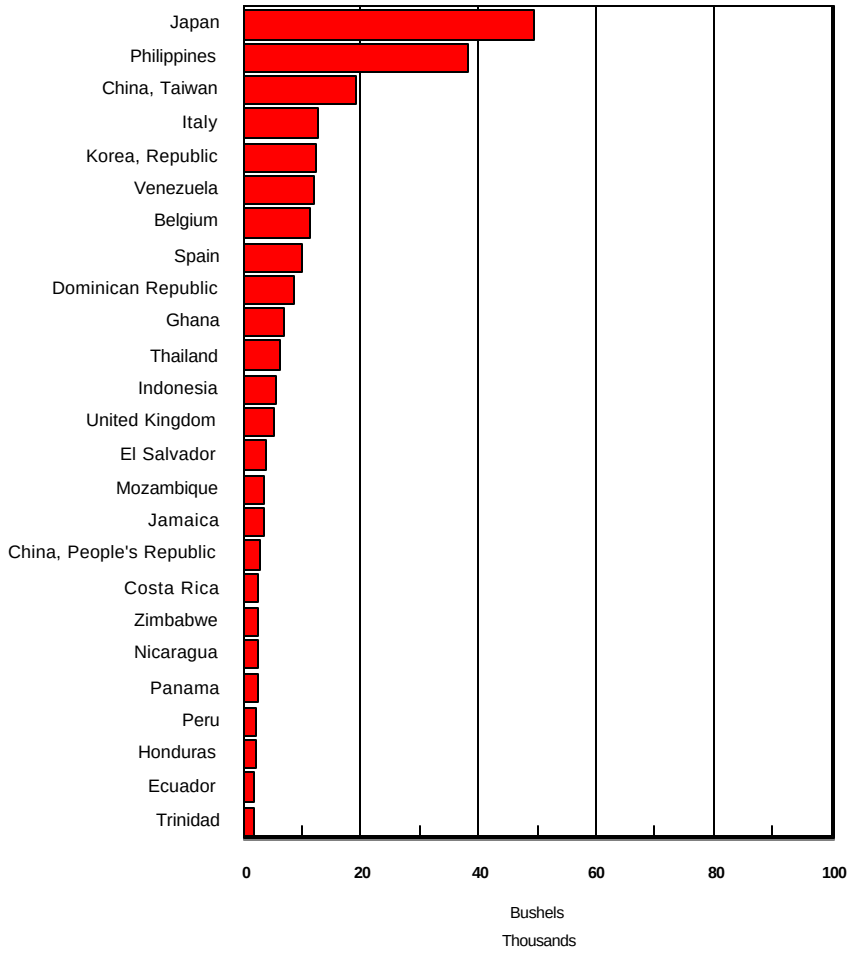
Australia, as the primary exporter of HW wheat, tends to define the import markets for HW wheat. The most likely import markets for HW wheat from a market potential perspective are the oriental Pacific Rim countries (Indonesia, Japan, Korea), the Middle East (Iran, Iraq, Egypt), and India and Pakistan. A quality HW wheat would almost certainly enhance export potential since white wheat is preferred for many markets. Political and trade issues can be a significant influencing factor in determining actual potential for U.S. exports to these markets.

Figure 10.a. U.S. Inspections for Export, Soft White Wheat
(June 1, 1998 - May 31, 1999)



Source: Wheat Situation and Outlook Yearbook, USDA/ERS, March 2000

Figure 10.b. U.S. Inspections for Export, Hard Red Spring Wheat
(June 1, 1998 - May 31, 1999)



Source: Wheat Situation and Outlook Yearbook, USDA/ERS, March 2000

3. ECONOMIC ISSUES ASSOCIATED with WHITE WHEAT in HRS WHEAT AREAS

3.1. General

Production practices are alike for hard white spring (HWS) wheats and HRS wheats produced for the same markets. The major production problem for HW wheat is susceptibility of the grain to pre-harvest sprouting (Paulsen). Past obstacles to expanded acreage of HW wheat in the United States include tradition, the tendency of white wheat to sprout in the head when subjected to rain at harvest, and lack of a suitable grade classification in the U.S. Grain Standards for Wheat (Bequette and Herrman).

A single class of wheat is an unlikely candidate for product differentiation (Barkley). Red wheat is a ***very close substitute*** for white wheat in both production and consumption; therefore, any premium is likely to be minimal, since there are few true differences between red and white wheat. In spite of the difference in color, hard white winter (HWW) wheat is ***virtually identical*** to HRW wheat. The major attribute desired by bakers is consistent-quality wheat. Given consistent quality they can blend wheats/flours and set up their production systems to meet customer preferences.

Advantages usually attributed to HW wheat include higher milling extraction rates (i.e., more flour per bushel of grain milled to the same color standards), a less bitter aftertaste for whole-wheat bread, and the color qualities preferred by some consumers. In addition to greater extraction rates, bran from white wheat is used in breakfast and snack-type foods and commands a higher price than bran from red wheat (Lin and Vocke 1998). Bran from white wheat may be regarded as a co-product rather than a by-product.

Several variables can be described as strongly influencing the demand for HW wheat relative to hard red wheat (Boland and Howe). These "drivers of change" are changing consumer tastes and preferences, emerging market segments, existence of close substitutes, and segregated storage capability.

There are both agronomic and economic issues that will determine the speed and extent of the adoption of white wheat. For farmers, the most critical questions are how it yields and the level of the price premiums relative to competing classes of wheat. The question of price premiums is a subject of much debate. Without significant price premiums to compensate for the increased handling costs associated with segregation of the white wheat to avoid being classified as mixed wheat, the primary adoption driver would have to be yield advantages.

The purchasing decisions for wheat-based products for both domestic and international consumers are influenced by their tastes and preferences. In the Far East Asian countries, consumption of grain-based foods has increased as consumers switch from rice to wheat-based foods, especially in oriental noodles, making noodles an important use of Asian wheat imports.

Hard red wheat is a close substitute for white wheat. Based on a study done by Barnes and Shields, hard red wheat is almost five times more substitutable for white wheat than white wheat is for hard red wheat. [4] This is likely due to the current broader range of acceptable end uses for hard red wheat.

There is no single measure of wheat quality, but several quality characteristics that are required in various combinations for different markets (Brennan). The value of the characteristics vary with changes in markets and marketing arrangements. Brennan points out that one of the key issues facing wheat breeding programs is how to simultaneously take into account quality improvement and yield components. He cites a previous study that showed that unless the premium for quality was substantial, society would be disadvantaged if the quality improvement was at the expense of yield improvement.

Initial HW wheat utilization will likely be in the domestic bread industry, with the international market for the Asian noodle industry growing as acreage/production of white wheat increases (Lang, et al.). Thus it would be desirable if new HW wheat varieties produced flour suitable for both purposes. The development of HW wheat for dual purposes (bread and noodles) presents the challenge of avoiding negatively impacting bread quality while trying to improve noodle quality.

3.2. Agronomic Issues

Production practices (seeding date, seeding rate, fertilization, and harvesting) are essentially the same for HWS wheats and HRS wheats produced for the same markets. Additional care (seeding, harvesting, storage, transportation, etc.) must be taken at the farm level, however, to avoid potential mixing of red and white wheats, resulting in a "mixed wheat" classification.

New white wheat varieties (or any new wheat variety) must be well-adapted to the climate and soil conditions, high yielding with yield stability, be resistance to pests, diseases, and environmental stresses, produce quality grain, and possess super end use qualities for marketing.

A major problem which must be overcome with white wheat is the tendency of this wheat to sprout when excess rains fall at harvest time. This significantly impacts the quality and desirability of white wheat. Pre-harvest sprouting appears to be a potential problem with current varieties of HW wheat where ever they are being grown.

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[4] "Hard red wheat is a close substitute for white wheat. Barnes and Shields noted that white wheat is the most elastic of all the wheat classes with an own-price elasticity of -0.77 while hard red wheat has an own-price elasticity of -0.42. Thus, if the price of white wheat increased by 10 percent, there would be a 7.7 (4.2) percent decline in the quantity demanded for white wheat (hard red wheat) food use. Barnes and Shields reported that the cross-price elasticity for substituting hard red wheat for white wheat is 1.80 while the cross-price elasticity for substituting white wheat for hard red wheat is 0.36. Thus, hard red wheat is almost five times more substitutable for white wheat than white wheat is for hard red wheat," (Boland and Howe).

Barnes, James N., and Dennis A. Shields, 1998, "The Growth in U.S. Wheat Food Demand," *Wheat Yearbook*/WHS-1998/March 1998. (In this study, by-class demand equations are estimated using Zeller's Seemingly Unrelated Regression (SUR) econometric procedures.)

Rate of expansion in HW wheat acreage will initially be limited by the availability of certified seed. This may put a premium on the seed costs for white wheat until sufficient seed becomes available to meet demands for white wheat acreage.

3.3. Quality Issues

To be acceptable to quality conscious buyers, white wheat, or any wheat, must meet the desired qualities of the end user. HW wheat is preferred in several of the markets.

HW wheats are superior to hard red wheats for noodle making because of their more desirable color. White wheat has a flour extraction rate of 1 to 2 percentage points higher than red wheat when both are milled to the same color standards. Protein content and quality are important factors in noodle quality. Low protein content flours can produce soft, sticky noodles with poor cooking tolerance. Water absorption is also important: too much water absorption results in a sticky dough, while too little water creates a stiff dough (Lang et al.). Protein levels and absorption are key factors influencing the texture of the noodles, an important concern of the consumers. Millers and even bakers, and certainly most noodle manufacturers, would prefer white wheat for most purposes. [5]

Bread flour is usually made from hard wheats of higher (12-15%) protein, while tortillas and flat breads are generally produced from hard wheat flours of intermediate protein content (11-13%). The protein content desired for noodle flour is generally lower than that desired for bread flour.

A major challenge of any breeding program is to identify a target market and determine the quality characteristics of the end users in that market. The wheat characteristics for making good noodles are different than those for good bread baking. High protein and high gluten are generally desired for bread, while a low to mid protein range with less gluten is preferred for a good noodle wheat. While there is considerable discussion of development of a dual purpose (bread and noodles) white wheat it seems unlikely that such a wheat would really satisfy the majority of end users. As illustrated in Table 9, it is difficult to expect one type of HW wheat to serve dual markets (bread and noodles) given the different protein levels required by the various products.

The difference in desirable quality characteristics (including protein levels) between the different target market segments suggests that segregation based on variety type or protein content may be needed to meet the conflicting markets in the most acceptable manner. It would appear to be next to impossible for one class (HW wheat) to optimally serve multiple markets indicating the need to carefully define the target market segment in developing the wheat breeding program.

Variety or protein level segregation pose additional challenges in classification and handling.

[5] Ben Handcock, executive vice-president of the Wheat Quality Council, "Need for Quality Safeguards Seen in Face of Rising White Wheat Tide," *Milling & Baking News*, Sosland Publishing Co., November 30, 1999.

Table 9. Wheat Types and Protein Levels of Different End Uses						
Wheat	Percent Protein in Wheat					
Type	9	10	11	12	13	14
Durum						Pasta
Hard (white/red)				Chinese-style noodles	Loaf Bread	
Mixed		Household flour	Japanese - style noodles	Flat Bread		
Soft (white/red)	Cake, biscuit, pastry					

Source: *Wheat Yearbook*, USDA/ERS, March 1998.
Original Source: Modified from Australian Wheat Board.

3.4. Classification/Grading

Wheat in the United States is divided into six classes - durum, HRS, HRW, SRW, HW, and SW. SW encompasses all soft endosperm white wheat varieties and HW wheat encompasses all hard endosperm white wheat varieties. HW wheat was just identified as a class by the Federal Grain Inspection Service in May, 1990. Neither class of white wheat is divided into subclasses denoting spring or winter as is the case with hard red wheat.

Wheat color is determined on a visual basis. The Federal Grain Inspection Service uses visual classification based on color, length of the kernel, and shape of the germ crease and brush. Determining wheat color on a visual basis poses problems of subjectivity.

It is critical to avoid mixing red and white wheat. Any mixture of wheat that consists of less than 90 percent of one class or more than 10 percent of one other class or a combination of classes that meet the definition of wheat is classified as "mixed wheat" and would be subject to significant price discounts. HW wheat needs to be segregated from conventional hard red wheat varieties in order to avoid a "mixed wheat" grade.

3.5. Segregation and Handling Costs

Grain industry leaders note that the industry must focus on identity preservation (IP) or segregation methods to deliver HW wheat. Identity preservation is more stringent (and expensive) than segregation and requires strict separation be maintained at all times. Crop segregation requires that

crops be kept separate to avoid commingling from production points (farm level), loading and unloading, storage, transportation, all the way through to the end users.

In a Kansas State University study, the average cost for segregating wheat ranged from $.0188 to $.0838 per bushel, depending on model chosen and assumptions relative to size of harvest and percent burden on the operation. The simulation models were developed using engineering, receiving, and quality data collected from 50 country grain elevators in the state. [6] Another base point is the recent survey funded by the Illinois Council on Food & Agricultural Research where the average additional costs incurred by grain elevators when handling specialty corn was $.08 per bushel (Bender, et al.).

A factor which does enter into the handling/segregation equation is on-farm storage. Only 14 percent of Kansas wheat is farm-stored, while 80 percent is stored on the farm in North Dakota (*Grainnet*, posted February 26, 1998).

In the case of white wheat and competing markets (bread baking and noodle making), the issue may come down to variety specific segregation, putting even more stress on the segregation/handling system.

Relative logistical costs are another key factor. The cost of shipping is important when comparing exports between various countries such as the United States and Australia. Buyers will typically obtain their desired blends of wheats from countries which are geographically closer to their countries to reduce shipping costs. Until critical volumes are achieved, shippers may not be able to take advantage of the transportation savings realized through unit train shipments.

While Identity Preservation is a deviation from the current norm, there are indications that several field crops are also likely to require segregation in the near future. Ron Olson of General Mills has identified three pendulums of change as shifting the basic orientation of the U.S. commercial grain industry. These changes include: the move away from traditional commodity orientation, the industry's interdependence with consumers, and technology's role in producing food products. Up to 15 percent of General Mills' 1999 total grain consumption was estimated to consist of identity preserved or proprietary varieties.[7] Identity preservation of crops may become the accepted practice and may be regarded as a cost of doing business rather than an additional cost.

3.6. Markets and Market Development

Emerging markets for white wheat are three principal product market segments: whole-wheat breads, tortillas, and oriental noodles (Lin and Vocke 1998). These include both domestic and international customers.

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[6] Hermann, Timothy J., Michael Boland, and Adam Heishman, "Economic Feasibility of Wheat Segregation at Country Elevators," *Proceedings of the Annual Meeting of the National Association of Wheat Growers*, February 1999.

[7] Ron Olson, vice president of General Mills, at a National Grain and Feed Association Country Elevator Council Meeting (http://www.kswheat.com/wheatscp/1999/01_21_99_hww.html, accessed 09/02/99).

Whole-wheat breads are becoming increasingly popular in the United States. Bread made from white wheat flour is lighter in color and less bitter than bread made from red wheat. Tortillas made from wheat are finding increased use in "wraps" in fast food restaurants in the United States where consumers generally prefer bright white tortillas giving an edge to white wheat. White wheat flour for making oriental noodles is generally favored in East and Southeast Asia. The color and texture offered by white wheat flours are preferred over red wheats for most oriental noodles.

A big factor of interest in white wheat development is the export market, particularly the Asian noodle market. Asia is the fastest growing market in the world and the fastest growing segment of the Asian market is the noodle market. This market is currently primarily served by Australia, which exports exclusively white wheat (primarily hard) and enjoys logistics/shipping cost advantages due to their proximity to that market. Other potential export markets are Mexico for making tortillas and pan bread and the Middle East and Indian Subcontinent for flat bread.

The other big hurdle with respect to market development is lack of sufficient quantities of white wheat to supply customer needs. Acreage is slow to develop because of uncertainties in market development, but the market cannot be developed without sufficient quantities of quality wheat to ship.

Political considerations are another factor that can have significant impact on export market development and stability. The use of economic sanctions (as the recent case with Pakistan) can seriously disrupt market relationships.

3.7. Price Premiums

In U.S. markets a premium for HW wheat *could* develop once sufficient quantities are available to processors. However, due to the newness of the HW wheat market, there is limited information and data on market values. This section provides a summary of available observations on the potential for price premiums.

In late April (1999), Farmland Industries announced it would pay at least 10 cents more per bushel for HW wheat, and higher premiums still for increasing quality attributes (test weight, foreign material, and protein). [8] In July 2000, Farmland again offered producers a guaranteed premium of 10 cents per bushel if they sign up to plant white wheat this fall. Additional quality premiums of up to 15 cents a bushel are also being offered in an effort to increase the number of HW wheat acres planted and the volume of white wheat available for millers. [9] Premiums of 25 to 35 cents per bushel were offered contract growers in Colorado and Idaho in exchange for their efforts to preserve grain identity (Lin and Vocke 1998).

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[8] "Farmland Offers Marketing Option for White Wheat Grain Producers," *Grainnet* Article Library, posted April 22, 1999, (http://www.grainnet.com/ArticleLibrary/articles.html?ID=3620, accessed 09/01/99).

[9] Griekspoor, Phyllis Jacobs, "Farmers offered incentives to produce white winter wheat," *AGWEEK*, July 17, 2000.

It is unlikely that producers will receive more than a modest premium due to marketing expenses associated with keeping white wheat segregated from hard red wheat. The substitutability of hard red wheat for HW wheat and related elasticities (discussed in Section 3.1) precludes the sustainability of any substantial premiums. In reality, domestic millers are unlikely to pay more than about 6 cents per bushel, the value that may be realized through higher extraction rates (assuming all other factors are the same). Domestic millers may realize a benefit through higher extraction rates (more flour from a given amount of wheat), but there is no assurance of how much of that benefit will be passed back to the wheat producer.

Initial premiums for white wheat may reflect more of an incentive for producers to plant white wheat than a continuing premium for perceived quality attributes. Since there are few true differences between red wheat and white wheat, the premium, if any, is likely to be minimal.

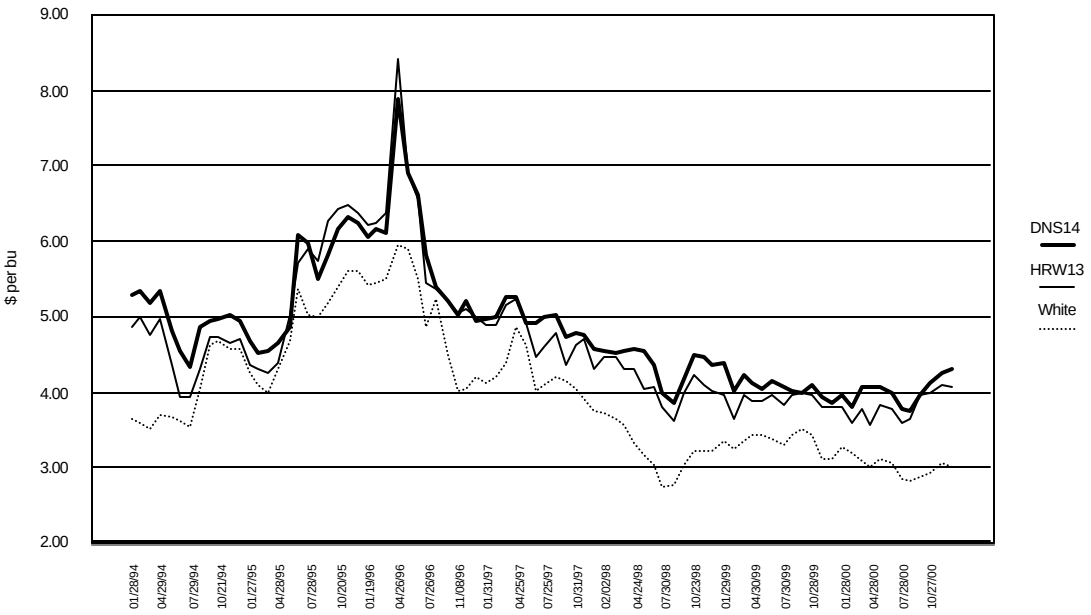
As more producers get into white wheat, economies "dictate" that any premium will likely diminish and white wheat could be the norm. If white wheat becomes the norm then red wheat may be subjected to "discounts." As one industry executive stated, "no offers for certain hard red wheats is the harshest kind of discount." [10] Given preferences for white wheat in many of the international markets, producers would still benefit from the marketing advantages of white wheat, even without a premium (Paulsen). Rollie Sears, while still at Kansas State University stated, "My expectation is there will not be a premium at all, white wheat will just replace red wheat as what we grow in Kansas." [11]

A comparison of historical wheat prices for the past five years at the Pacific Northwest export region is shown in Figure 11. Dark northern spring (HRS) has consistently commanded a premium over HRW wheat and a significant premium over white wheat. Over the period 1994-2000, average prices for these wheat classes (DNS14, HRW13, and White) were $4.82, $4.65, and $3.95, respectively. These reflect premiums for DNS of $0.17 over HRW wheat and $0.87 over white wheat at PNW markets. As HW wheat becomes a larger part of the white wheat class this premium may narrow, but it does raise a question as to the premium required for HW wheat to become an economically viable alternative to HRS wheat in North Dakota.

[10] Personal conversation with Cargill Grain Division executive.

[11] Barkley, Andrew P., *The Economics of Introducing Hard White Wheat in Kansas*. A Report submitted to the College of Agriculture, Kansas State University, July 20, 1998.

Figure 11. Wheat Prices, Pacific Northwest



Source: U.S. Wheat Associates, Weekly Wheat Price Report
(Last Friday of each month or nearest available report)

4. ECONOMIC ANALYSIS: YIELD vs. PRICE PREMIUM

4.1. Introduction

The two most discussed economic variables in relation to the introduction of HW wheat on a commercial scale are premium and yield. Before adopting white wheat into production, the wheat producer expects its return per acre must exceed that of competing alternatives. In North Dakota, the primary competitor to the introduction of white wheat would be HRS wheat.

The impacts of potential price premiums and yield differentials were examined, assuming that the production costs are the same for HWS wheat in North Dakota as for HRS wheat. This relationship was examined first by looking at gross returns in a discrete scenario, i.e., the uncertainties surrounding these key variables is not a factor in looking at the price premium/yield differential relationship.

Next a stochastic simulation model was developed to study the impact of uncertainties in price premiums, yields differential, and the special handling costs. Given the lack of consensus noted in the various studies reviewed and the uncertainty of the changes in these key variables, it is important to understand the impact of these key variables on potential revenues when comparing HWS and HRS wheats. A spreadsheet model was developed using the *@RISK* program to analyze the stochastic scenario.

The other key agronomic factor, pre-harvest sprouting, is not explicitly taken into consideration but can be considered in the price premium (or discount). Pre-harvest sprouting of white wheat is a potential problem in all parts of North Dakota; however, conditions that favor pre-harvest sprouting occur more frequently in eastern and east central than in western North Dakota. This would suggest that HW wheat might be better suited for the western part of the state.

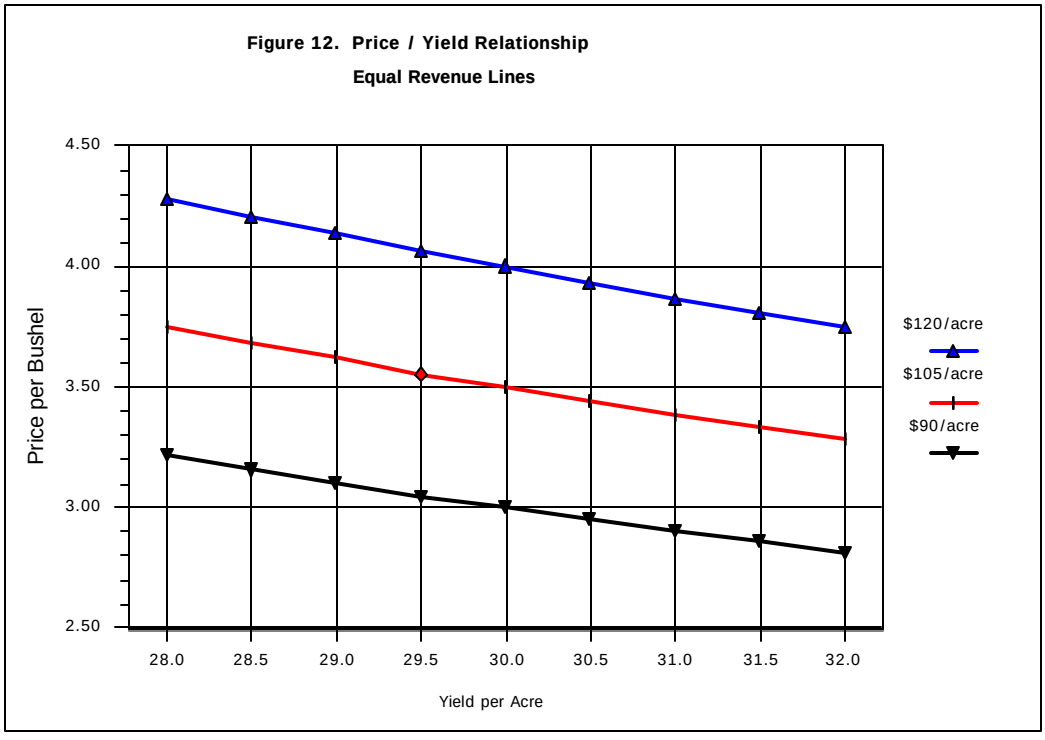
4.2. Yield and Premium Tradeoffs (Discrete)

Adoption of HW wheat depends on whether the producer's net revenue per acre is equal to or greater than the net revenue that would be expected to be realized in planting HRS wheat. Starting with a base case with expected yields of 30 bushels per acre, the prices (reflecting HRS wheat price plus premium for HW wheat) that would need to be realized to maintain an equal revenue level at three different price levels ($3.00, $3.50, and $4.00 per bushel) as yield varies are summarized in Table 10.

With a yield standard of 30 bushels per acre and the HRS wheat price at $3.00 per bushel ($90 gross revenue per acre) a reduction in yield to 29 bushels per acre for HW wheat would require just over a 10-cent premium just to maintain the same gross revenue level. In addition to this "break-even" premium, an additional premium is required to cover the special handling costs that will most likely be associated with handling HW wheat. On the other side, if the HW wheat yield was one bushel per acre better than the HRS wheat yield, the average increase in gross revenue of 10 to12 cents per bushel should more than cover the special handling costs expected to be associated with the HW wheat.

Table 10. Price / Yield Relationship			
Gross Revenue	$90 per acre	$105 per acre	$120 per acre
Yield	Price Required		
28.0	3.214	3.750	4.286
28.5	3.158	3.684	4.211
29.0	3.103	3.621	4.138
29.5	3.051	3.559	4.068
30.0	3.000	3.500	4.000
30.5	2.951	3.443	3.934
31.0	2.903	3.387	3.871
31.5	2.857	3.333	3.810
32.0	2.813	3.281	3.750

These price/yield relationships are displayed graphically in Figure 12. Equal revenue lines for $90, $105, and $120 per acre point out the price and yield combinations that must be met to maintain or exceed the respective revenue targets. The less likely that premiums might be realized for HW wheat, the more important it is to realize increased HW wheat yields just to ensure that the special handling costs do not erode the producer's net revenue. As an example, a yield of 28 bushels per acre at a price of $3.75 per bushel generates a gross return of $105 per acre. If there is no price premium for HW wheat to cover the additional handling costs, in effect reducing the realized price, the yield for HW wheat must be higher than that to produce the same return of $105 per acre.



4.3. Yield and Premium Tradeoffs (Under Uncertainty)

Development of HW wheat is still in its infancy and there are limited historical statistics on which to base values for the key variables. It is evident from the previous studies reviewed that there is no clear consensus on the likely values of the key variables discussed in this report.

A spreadsheet model using *@RISK* was developed to analyze the likely impact of the uncertainty on the key economic variables in the development and introduction of HW wheat. This model was used to review four different scenarios related to price "premium," yield "advantage," and special handling costs expected to be associated with the segregation of HW wheat. The parameters for these economic variables under the different scenarios are summarized in Table 11. Triangular distributions with values for Low (LO), Most Likely (ML), and High (HI) parameters are used in the model. The distributions are considered to be independent of each other, an assumption that seems reasonable given the nature of the variables.

Table 11. Parameters for Key Economic Variables, *@RISK*

Scenario	Price "Premium" cents/bu			Yield "Advantage" bu/acre			Special Handling cents/bu		
(*)	LO	ML	HI	LO	ML	HI	LO	ML	HI
1 - Base Case	0	6	12	-2	0	2	2	6	8
2a - Premium Only	0	6	12	0	0	0	2	6	8
2b - Premium Only	6	10	20	0	0	0	2	6	8
3 - Yield Only	0	0	0	0	3	5	2	6	8
4 - Premium + Yield	0	6	12	0	3	5	2	6	8

(*) LO = Low, ML = Most Likely, HI= High

Other key variables in the model for each of the Crop Reporting Districts in North Dakota and considered as "fixed" for the analysis of yield and premium, include farm prices for hard spring wheat based on 5-year averages, hard spring wheat yields based on 5-year historical averages, and projected 2000 crop budgets for spring wheat in North Dakota. The spreadsheet model is shown in Table 12.

Scenario 1. The base case scenario reflects the initial "best" assessment of values for the parameters for the key variables.

Price Premium: The low value of 0 (zero) reflects the views of several industry leaders that there will not be a premium offered for white wheat, the most likely value of 6 cents per bushel relates to the higher extraction rate that millers should be able to realize, and the high parameter of 12 cents per bushel takes into account views of the optimistic promoters of white wheat.

Table 12. Price / Yield Model Under Uncertainty

CRD >	ND 1	ND 2	ND 3	ND 4	ND 5	ND 6	ND 7	ND 8	ND 9
WHEAT PRICES (1)									
HRS	3.830	3.890	4.030	3.850	4.070	4.090	3.880	3.850	4.240
Price "Premium" (White Wheat)									
$/bu	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
"HWS"	3.890	3.950	4.090	3.910	4.130	4.150	3.940	3.910	4.300
YIELDS (2)									
HRS (5-yr, 94-98)	28.3	28.0	31.2	28.7	27.9	33.3	28.7	25.0	31.7
Yield "Advantage" (White Wheat)									
bu/acre	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
"HWS"	28.3	28.0	31.2	28.7	27.9	33.3	28.7	25.0	31.7
PRODUCTION COSTS (3)									
Direct ($/acre)	50.69	51.85	58.83	47.56	51.83	56.41	44.43	44.43	54.82
Indirect ($/acre)	52.57	55.64	67.10	49.46	55.91	69.97	45.80	45.80	65.10
	103.26	107.49	125.93	97.02	107.74	126.38	90.23	90.23	
Special Handling Costs (White Wheat)									
$/bushel	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
NET RETURNS									
HRS									
$/acre	5.129	1.430	-0.194	13.475	5.813	9.817	21.126	6.020	14.4888
$/bu	0.181	0.051	-0.006	0.470	0.208	0.295	0.736	0.241	0.457
"HWS"									
$/acre	5.318	1.617	0.014	13.666	5.999	10.039	21.317	6.187	14.699
$/bu	0.188	0.058	0.000	0.476	0.215	0.301	0.743	0.247	0.464
"HWS" Advantage									
$/acre	0.189	0.187	0.208	0.191	0.186	0.222	0.191	0.167	0.211
$/bu	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007

(1) Based on 5-year averages of Minneapolis Prices
Futures 3.91
Basis (14%) 0.80
- Rail Shipping Costs (current tariffs)
- Handling Costs 0.11

(2) *North Dakota Agricultural Statistics* (5-yr. average, 1994-98).

(3) *Farm Management Planning Guide* , "Projected 2000 Crop Budgets," NDSU Extension Service.

Yield Advantage: The yield advantage parameters initially center around 0, with an equal likelihood that the white wheat yield differential in early wheat breeding efforts might range as much as +/- 2 bushels per acre. From a variety release point of view; however, it is unlikely that a new variety would be released unless a 3 to 5 bushel per acre yield advantage over existing varieties was evident in the breeding trials.

Special Handling Costs: The special handling costs parameters, based on Herrman's study, are initially a low value of 2 cents per bushel, a most likely value early on of 6 cents per bushel, and a high value of 8 cents per bushel.

Scenario 2. In this scenario, the same price premium distribution as in the base case is included, but with the assumption that HW wheat yields will match the yields of HRS wheat and no yield advantage will be realized. In Scenario 2a ,the conservative price premium distribution parameters (0,6,12) of the base case are used, while in Scenario 2b, more optimistic parameters (6,10,20) are used in the price premium distribution.

Scenario 3. No price premiums are considered in this scenario, but yield advantage parameters are increased to a low value of 0, a most likely value of 3, and a high value of 5 bushels per acre. This more closely represents the yield increase that might be expected for release of a new variety.

Scenario 4. This scenario includes the conservative price premium parameters and the more optimistic yield parameters used in the previous scenario.

Results: *@RISK* was used to conduct the stochastic simulation using the above distributions. The results are based on 2,500 iterations.

The numbers reported represent the HW wheat "Advantage" for North Dakota CRD 1. Similar results are evident for the other CRDs (Crop Reporting Districts). The range and average values expected in each of the scenarios are summarized in Table 13 for each CRD. The mean additional return in Scenarios 1 and 2a are essentially zero on a per acre basis while with the higher premium in Scenario 2b the mean additional return is still less than $2.00 per acre. Only in Scenarios 3 and 4 which reflect higher yield expectations is the average additional return worth taking on the additional risk of considering switching to production of HW wheat.

Table 13. Summary Statistics			
HW Wheat "Advantage" ($/acre)			
Scenario	Min	Mean	Max
1	-7.88	0.21	8.31
2a	-1.99	0.23	2.55
2b	-0.32	1.93	4.77
3	-1.46	8.60	8.50
4	-0.16	10.49	19.79

Selected outcomes of cumulative probabilities are summarized in Table 14 and discussed below. The probability of the additional returns that might be realized with HW wheat production are noted for several positive return levels. The probability of positive additional returns are greater than .57 for all of the scenarios. The probability of additional returns greater than $5.00 per acre are only .07 in Scenario 1 (Base Case) and are zero in Scenario 2 where little or no yield increases are expected. In Scenarios 4 and 5 which reflect expected yield increases for HW wheat, positive additional returns are expected nearly 100 percent of the time while the probability of the additional returns exceeding $5.00 per acre are .81 and .90 for Scenarios 4 and 5, respectively.

Clearly the importance of yields comparable to or greater than current wheat varieties is evident if there is any expectation that HW wheat will be adopted in North Dakota.

Table 14. Probabilities Related to Potential HW Wheat "Advantage"					
HW Advantage ($/acre)	1 Base Case	2a Premium Only	2b Premium+ Only	3 Yield Adv Only	4 Yield & Premium
>$0.00	0.570	0.607	0.993	0.989	0.998
>$1.00	0.399	0.166	0.833	0.975	0.994
>$3.00	0.201	0.000	0.138	0.911	0.965
>$5.00	0.071	0.000	0.000	0.809	0.899

5. SUMMARY

The level and even realization of price premiums for HW wheat is very uncertain. Proponents of HW wheat expound on a number of positive attributes that suggest it has numerous advantages over hard red white and can meet the requirements of a number of growing markets, suggesting that HW wheat should benefit from a price premium over hard red wheat. To date the supply of HW wheat in the United States, however, is not sufficient to establish a true commercial market and any premiums offered are primarily incentives to producers to grow HW wheat. There is no strong indication that processors are willing to pay a premium for the quality attributes that they indicate are desirable for the end user product or processing attributes that would benefit them.

It is critical that mixing of red and white wheat be avoided to prevent the wheat from being classed as "mixed wheat," subject to significant price discounts. Until the grain handling industry evolves to a point where segregation/identity preservation becomes the norm special handling costs will continue to exist. Price premiums or increased yields must be realized to offset these additional costs of handling white wheat.

Identifying the target markets and focusing on the quality attributes desired by those markets is important to the wheat breeding programs. While there is much discussion about the development of a "dual purpose" HW wheat the quality characteristics of the two primary markets (bread baking and noodle making) are considerably different. It does not seem likely that a single focus would serve either market well.

The Asian market is viewed as a potentially large market for HW wheat because of its favorable characteristics for making noodles, a rapidly growing market segment in Asia. The size and extent of this export market, however, is uncertain. Australia has the edge in quality, critical volumes, and logistics costs in this market. It is not clear whether the market is larger than what Australia currently supplies or whether they are adequately meeting the current needs of the Asian markets.

Without question, increasing per acre yield is critical to acceptance of HW wheat by producers. The uncertainty of premiums for HW wheat and the additional segregation and handling costs associated with maintaining the integrity of HW wheat must be offset by increased yields to ensure the producer has a chance of realizing acceptable returns associated with the risks and unknowns of switching to a new class of wheat.

The production practices for HW wheat are much like the practices for hard red wheat, but an agronomic issue still to be overcome is the tendency for pre-harvest sprouting of HW wheat when weather conditions are less than ideal. The development of a robust HW wheat is essential if it is to compete with hard red wheat.

While the jury is still out on the acceptance of HW wheat in HRS wheat areas, largely due to the uncertainty of the realization of price premiums, it would seem to be in the best interests of North Dakota producers that wheat breeding programs continue to include some development efforts on HW

wheat. At present, the primary focus needs to be on yield improvements and the development of a robust wheat adaptable to climatic conditions in North Dakota to reduce the risks of switching to HW wheat as an alternative crop. With the premium position of HRS wheat, the push for development of HW wheat in North Dakota is not nearly as strong as in other states. There is always merit; however, in keeping alternatives alive so as not to be left too far behind should consumer patterns and preferences shift significantly.

The focus for HW wheat breeding programs must include maintaining or improving yields and developing resistance to pre-harvest sprouting without reducing quality. To enhance any likelihood of price premiums, the focus must be on continued improvement of quality characteristics for bread baking, primarily for the growing domestic specialty bread market (such as artisan and hearth breads). Alternatively, one could focus on developing improved noodle quality characteristics for the growing, but uncertain, Asian market in an effort to compete with Australia. If or when the HW wheat market develops, it is unlikely that a "dual purpose" focus will satisfy the more discerning consumers domestically or internationally.

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