

## WHEAT MANAGEMENT PRACTICES AND FACTORS OF YIELD DECLINE IN THE PUNJAB PROVINCE OF PAKISTAN

Khalid Mahmood Aujla, Sajida Taj\*, Khalid Mahmood\*\* and Nadeem Akmal\*

**ABSTRACT:** Wheat is the main staple diet of the people of Pakistan. There were different views for wheat yield decline and crisis in the country during 2007-08. To assess the wheat situation and compare wheat production practices to identify the major factors of yield decline, a national level field survey was conducted during June 2008 by Social Sciences Division, Pakistan Agricultural Research Council through its satellite institutes in the provinces. Total 238 wheat growers were purposively selected from different cropping zones of the Punjab province as sample of the national survey. The survey results reveal that decline in wheat area, the incidence of frost/cold spells, shortage of irrigation water over normal supplies, imbalanced use of fertilizers particularly of DAP fertilizer below the recommended doses, higher prices of inputs such as seed, fertilizer, diesel, electricity and less wheat prices during 2006-07 and late announcement of the minimum guaranteed wheat price for 2007-08 were the main reasons of lower wheat production in 2007-08. To enhance the wheat yield, farmers were of the view that the timely availability of quality inputs (seed, fertilizers) at reasonable prices, canal water supply at critical stages of plant growth, and affordable diesel and electricity prices should be ensured. Timely availability of credit to the resource poor farmers would also enhance the wheat yield in Punjab.

*Key Words:* Wheat; Fertilizer Use; Canal Water; Inputs Availability; Yield; Punjab; Pakistan.

### INTRODUCTION

Wheat, the most widely used staple food grain of the world occupies an important place as staple food grain of Pakistani diet, therefore, it is grown in almost every part of the country by overall more than 80% of the farmers. It contributes 12.7% to the value added in agriculture and 2.6% to GDP. Wheat is also the most important single product as a source of income in the rural areas of Pakistan. This crop occupies a major area in *rabi* season and grown on more than 8.094 m ha of land (GoP, 2008b). Punjab province occupies 75% of the total wheat area of the country and almost 76% of the total wheat production of the country comes from this province (GoP, 2008a). Area and production target of wheat for 2007-08 were set at 8.578 m ha and 24 mt respectively. While wheat was cultivated on an area 8.414 mha showing 1.9% decrease than last year's area (GoP, 2008b).

The performance of wheat crop affects the overall growth rate of agricultural sec-

tor and import bill of the country. From public perspective, government wants to keep the wheat prices low under the argument of poverty and malnutrition. At the same time, attainment of self-sufficiency in wheat production has always remained one of the major objectives of agricultural policy of the government. Because the low wheat prices have direct implications on wheat production system especially in the rising input prices scenario. Resultantly the area under wheat is declining and the issue of food security is rising in the country. The population is increasing at 2.1% annually but the wheat area and production is not keeping pace with the burgeoning population growth (GoP, 2008b).

The government agencies concerning wheat production continuously monitored the performance of wheat crop throughout the season. Various views/perceptions were offered on the questions about wheat yield decline. More rainfall at maturity stage, aphid/jassid attack, and decrease in

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\*Technology Transfer Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan.

\*\*Pakistan Agricultural Research Council, Islamabad, Pakistan.

wheat area due to low prices in the previous year were considered the main causes of yield decline. But at policy makers' levels, it is very important to investigate the causes of wheat yield decline at farmers/grassroots level to get the real picture of the problem. Therefore, Pakistan Agricultural Research Council initiated a national survey on the performance of wheat crop during *rabi* 2007-08 through its Technology Transfer Institutes (TTIs) located in all provinces. Scientists from TTI, Faisalabad conducted the wheat survey in irrigated Punjab during June 2008. The main objectives of this survey were to examine the yield performance of wheat in the irrigated Punjab and identify differences in wheat production practices as compared with previous year in the major cropping zones of Punjab and causes of decline in wheat yield and production during 2007-08.

#### MATERIALS AND METHODS

A farm level survey was conducted during June 2008 in three cropping zones (rice-wheat, cotton-wheat and mixed) of the irrigated Punjab. Three districts from each zone were selected purposively. In mixed cropping zone, Faisalabad, Jhang and T.T. Singh were the sample districts. Gujranwala, Hafizabad and Sheikhpura districts were selected from rice-wheat zone. Bahawalpur, Khanewal and Rahim Yar Khan from cotton-wheat zone were selected as sample districts for the present study. Total 238 wheat growers (89 from rice-wheat, 81 from cotton-wheat and 68 from the mixed cropping zones) were ran-

domly selected from the Punjab province as sample of the national survey. The data were collected through farmers' interviews using a well-structured questionnaire and analyzed by using simple statistics to estimate various responses and draw conclusions for pertinent recommendations. The respondents were classified into small, medium and large farm categories according to size of their operational land holdings. The farmers operating a farm size of less than 5 ha were termed as small farmers, those with an operational holding between 5-10 ha were placed under medium farmers whereas the farmers having more than 10 ha of land were classified as large farmers (Table 1). Farms level wheat management practices were compared and assessed to identify the factors of yield decline during 2007-08 in the Punjab province.

#### RESULTS AND DISCUSSION

##### Farm Size and Area under Wheat

The average size of operational holding was 6.88 ha. The farmers of cotton zone were operating higher farm size in the study area followed by the mixed and rice zones (Table 2). Farmers owned almost 79% of the operational holding. The wheat growers allocated 64% of their farm area to wheat crop in 2007-08 which was almost 4% less than the area in 2006-07. It was 68% and 64% respectively in 2006-07 and 2007-08 in the study area. The farmers of cotton zone were allocating more farm area to wheat crop as compared to rice and mixed zones. The declining trend of wheat area

**Table 1. Sample distribution by farm size and cropping zones**

Farm size group	Cropping zones			
	Rice-wheat	Cotton-wheat	Mixed	All
Small (<5 ha)	50 (58.8)	40 (49.4)	41 (56.9)	131 (55.0)
Medium (5.1-10ha)	24 (28.2)	27 (33.3)	14 (19.4)	65 (27.3)
Large (>10ha)	11 (12.4)	14 (17.3)	17 (25.0)	42 (17.6)
All	89 (100)	81 (100)	68 (100)	238 (100)

*Figures in the parenthesis are percent values*

**WHEAT MANAGEMENT PRACTICES**

**Table 2. Farm characteristics of wheat growers by zones**

Characteristics	Cropping zones			
	Rice-wheat	Cotton-wheat	Mixed	All
<b>Landholding (ha)</b>				
Owned land	5.10	5.63	5.63	5.42
Rented-in land	1.38	2.35	1.34	1.70
Rented-out land	0.49	0.28	0.00	0.28
Total operational land	5.99	7.69	6.96	6.88
Area under wheat in 2006-07	4.33	5.75	3.93	4.69
Area under wheat in 2007-08	4.25	4.41	3.68	4.41
<b>Tenancy status (% farmers)</b>				
Owner	74.2	58.0	70.6	67.6
Owner-cum-tenant	16.8	34.6	29.4	26.5
Tenant	9.0	7.4	0.0	5.9
<b>Power source (% farmers)</b>				
Own tractor	40.5	45.7	47.1	44.1
Rental tractor	59.5	54.3	52.9	55.9
<b>Irrigation source (% farmers)</b>				
Canal	1.4	22.4	5.9	10.2
Tube-well	68.5	27.6	14.7	37.3
Canal+ Tube-well	30.1	50.0	79.4	52.5
<b>Tube-well Ownership (% Farmers)</b>				
Owned	85.5	50.7	67.7	69.1
Rented	14.5	49.3	32.3	30.9

*Survey Information, 2008*

had been still continuing as it was realized in the wheat situation surveys of 2002-03 and 2005-06 (Bashir et al., 2004 and Mahmood et al., 2006). This finding also confirms the MINFAL's report regarding the 2% decrease in wheat area for 2007-08 (GoP, 2007-08b). The main reasons for the decline in wheat area were delayed start of sugar crushing season, late cotton picking by the growers and late announcement of minimum guaranteed price. Majority of the farmers (68%) were owner operated, whereas about 26% of the farmers were owner-cum-tenant. Tractor (owned/rented) was the major source of ploughing. More than 98% of the farmers used tractor as power source. Majority of the farmers (52%) were using mixture of canal and tubewell water for irrigation. The use of canal water as sole source of irrigation prevailed more in the cotton wheat zone only, while majority of the farmers of rice wheat zone were irrigating their lands with tubewells.

Regarding tubewell ownership, majority of the farmers (69%) had their own tubewells (Table 2).

#### **Wheat Planting Schedule and Methods**

In Punjab wheat sowing is normally delayed. The sowing time for wheat is recommended up to November 15 while most of the sowing is accomplished during late November and first fortnight of December (Abdullah et al., 2006). It is scientifically proved that planting time has important implications on wheat yields. It not only significantly affects the germination but also the number of tillers, number of grains per spike and eventually the grain yield. Therefore, the information regarding the wheat planting schedule was obtained to see the trend of wheat planting in the area. It was observed that most of the wheat area was planted up to November 30 in both years (Table 3). But still a significant percentage of wheat area i.e. 35 and 37 per-

**Table 3. Wheat area distribution by planting time and sowing methods (%)**

Parameter	Rice-wheat		Cotton-wheat		Mixed		All	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
<b>Planting period</b>								
Before Nov 15	32.5	32.0	2.5	2.9	8.3	9.9	14.4	15.1
Between								
Nov 15-30	52.0	52.8	35.5	27.0	72.0	73.2	50.0	47.3
After Nov 30	15.5	15.2	62.0	70.1	19.7	16.9	35.6	37.6
<b>Sowing methods</b>								
Drill Sown Area	1.7	1.6	5.7	5.5	14.5	14.1	6.4	6.2

cent for 2006-07 and 2007-08 respectively was planted after November 30. The late wheat sowing was more in cotton wheat zone where most of the wheat area i.e. 70 % was sown after November 30 and increasing trend of late sowing was found in this zone as it was 62% in 2006-07 and it increased up to 70 % in 2007-08. The major reason was the late harvesting of cotton crop and it took some time for land preparation that's why the wheat sowing was done late. While in other two zones of the Punjab most of the wheat area was planted up to November 30. The drill/line sowing of wheat was not encouraging in the area as only 6.4% and 6.2% respectively of the total wheat areas were planted with drill in 2006-07 and 2007-08. However, the drill/line sowing was more in the mixed cropping zone as compared to other two zones.

### Seed Sources and Treatment

Effective use of improved seed can result in higher agricultural production and increase in net incomes of farming families, which has a positive impact on rural

poverty as well. The information regarding the seed source, seed treatment and seed rate was collected to draw attention to overcome the flaws in this most important component of agriculture. Majority of the farmers (57%) were using their own seed. Input dealers were the second major source of seed in the area. Most of the wheat seed (96%) is used without any seed treatment.

The recommended seed rate for timely wheat sowing is 123.55 kg ha<sup>-1</sup>. If the sowing is to be done in December, then the recommended seed rate is 173 kg ha<sup>-1</sup> (Mahmood et al., 2006). Most of the farmers were practicing the seed rate as per extension department recommendations. However, in cotton-wheat zone, the seed rate applied was a little higher 129 kg ha<sup>-1</sup> and 154 kg ha<sup>-1</sup> than the recommended seed rates for both early and late sowing respectively as compared to other zones of Punjab (Table 4).

### Fertilizer Application

Balanced usage of fertilizer helps in increasing crop yield from 30% to 60% in

**Table 4. Zone-wise seed sources, seed treatment and seed rate of wheat (%)**

Parameter	Rice-wheat		Cotton-wheat		Mixed		Total	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
<b>Seed sources</b>								
Own	74.7	66.7	68.8	67.5	42.6	33.8	62.9	57.0
Input dealers	16.5	15.5	24.7	25.0	30.9	43.7	23.7	27.2
Fellow farmers	6.3	14.3	5.2	5.0	23.5	21.1	11.2	13.2
Others	2.5	3.6	1.3	2.5	2.9	1.4	2.2	2.6
<b>Seed treatment</b>								
Yes	5.1	4.9	4.1	5.3	1.5	1.5	3.7	4.0
No	94.9	95.1	95.9	94.7	98.5	98.5	96.3	96.0
<b>Seed rates (kg ha<sup>-1</sup>)</b>								
Early planted	113.42	113.18	128.74	128.99	123.06	123.56	120.84	121.08
Late planted	118.12	118.12	153.70	153.46	132.20	130.72	138.13	137.39

## WHEAT MANAGEMENT PRACTICES

different regions of the country (GoP, 2008b). However, the main impediment in exploring the full potential of the soil has remained below due to imbalances in fertilizer usage especially, in terms of over application of nitrogenous fertilizer compared to phosphatic fertilizer.

The average application of fertilizer was far below from the recommended doses. The recommended dose of DAP fertilizer is 3.71 bags ha<sup>-1</sup> while its application is below i.e. 2.27 bags ha<sup>-1</sup> during 2007-08 and it is also less than the DAP used in the previous year (2.44 bags ha<sup>-1</sup>) application. The main cause of low usage than recommendation was the higher prices and non-availability of DAP fertilizer at the sowing time. While in urea fertilizer, the use is more than the recommendation as the farmers applied 5.96 bags ha<sup>-1</sup> and it was more in cotton wheat zone (8.43 bags ha<sup>-1</sup>) as compared to rice and mixed zones. The Urea application was higher (5.96 bags ha<sup>-1</sup>) than the previous year application (4.94 bags ha<sup>-1</sup>). Use of other fertilizers was nominal in the area in both years (Table 5).

### Irrigation Management

Water is a vital input needed for an efficient utilization of plant nutrients and

consequently better crop growth and yield. Shortage of water supply particularly at critical stages of crop growth severely affects the yield. The farmers having access to tube wells are in a relatively better position to manage timely irrigation provided the ground water is fit for irrigation.

Only 12.7% of the farmers were getting normal canal water in 2007-08 as compared to 16% in the previous wheat crop. Majority of the farmers (more than 80%) reported that they got below normal canal water (Table 6) in both years. Due to the less availability of canal water both in *rabi* 2006-07 and 2007-08, only one irrigation could be applied from canal water (Table 7). Canal water irrigation was comparatively more in cotton wheat and mixed zones of Punjab whereas reliance on underground water has been increasing rapidly that has been causing underground water stress.

### Appropriateness of Rainfall and Temperature for Wheat Season

Timely rainfall plays an important role in crops production and increases the production potential. The rainfall at the critical crop conditions is not beneficial but it also damages the crop and decreases the yield potential of the crop. According to the

**Table 5. Fertilizer use by cropping zones** (Bags ha<sup>-1</sup>)

Fertilizer	Rice-wheat		Cotton-wheat		Mixed cropping		Total	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
DAP	2.45	1.90	2.27	2.35	2.72	2.64	2.45	2.27
Urea	5.29	4.57	5.19	8.43	4.05	3.73	4.94	5.96
NP	0.17	0.00	0.15	0.10	0.02	0.02	0.12	0.05
SSP	0.47	0.37	0.07	0.05	0.22	0.15	0.25	0.20
AN	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.02
TSP	0.00	0.00	2.59	0.02	0.00	0.00	1.04	0.00
AS	0.00	0.07	0.00	0.15	0.00	0.02	0.00	0.10
Other	0.02	1.90	0.22	2.35	0.07	2.64	0.12	2.27

DAP: Diammonium phosphate; NP: Nitrogen phosphate; SSP: Single super phosphate ; AN: Ammonium nitrate; TSP: Triple super phosphate; AS: Ammonium sulphate

**Table 6. Availability of canal water** (%)

Availability	Rice-wheat		Cotton-wheat		Mixed		Total	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Normal	3.1	8.8	34.3	21.7	3.2	4.8	16.0	12.7
Less than Normal	96.9	91.2	65.7	78.3	96.8	95.2	84.0	87.3

farmers' perception the rainfall was generally not favorable for 2007-08 as compared to previous year. Therefore, the percentage of farmers who consider rainfall as favorable decreased as compared to last year (Table 8). The inter-zone comparison shows that satisfaction level of rainfall was higher in mixed zone as compared to other zones of the Punjab. Regarding the appropriateness of temperature, majority of the farmers (64%) reported it unfavorable for 2007-08 (Table 8).

### Yield

Overall wheat yield decreased by about 11-23% during *rabi* 2007-08 as compared to *rabi* 2006-07 with an average decline of 17%. The overall average wheat yield during *rabi* 2007-08 obtained by the sample farmers was 3183 kg ha<sup>-1</sup> as compared to last year average i.e. 3776 kg ha<sup>-1</sup>. The in-

ter-zone comparison shows that percent decrease in wheat yield was relatively higher in cotton wheat zone as compared to rice and mixed zones (Table 9).

### Prices

The support prices of wheat announced by the government were Rs. 425 and Rs. 625 per 40 kg for 2006-07 and 2007-08, respectively. The average wheat prices received by the growers were Rs. 430 and Rs. 633 per 40 kg from village dealers for 2006-07 and 2007-08, respectively. While from village consumers, the farmers received Rs. 435 and Rs. 608 per 40 kg for 2006-07 and 2007-08 respectively. The inter-zone comparison shows that average prices of wheat received were higher for both years in rice wheat zone as compared to other zones (Table 10).

**Table 7. Number of irrigation from different sources by cropping zones**

Irrigation sources	Rice-wheat		Cotton-wheat		Mixed		Total	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Canal	0.39	0.36	2.05	1.67	1.50	1.32	1.29	1.10
Tube well	2.55	2.67	1.94	2.49	2.31	2.47	2.27	2.55
Mixed	0.27	0.31	0.41	0.44	1.50	1.51	0.69	0.72

**Table 8. Appropriate of rainfall and temperatures for wheat season** (%)

Parameter	Rice zone		Cotton zone		Mixed zone		All	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
<b>Rainfall</b>								
Favorable	81.4	61.8	74.2	27.7	90.6	81.3	82.0	57.1
Unfavorable	18.6	38.2	25.8	72.3	9.4	18.7	18.0	42.9
<b>Temperature</b>								
Favorable	91.4	40.0	80.0	38.2	87.7	27.9	86.3	35.6
Unfavorable	8.6	60.0	20.0	61.8	12.3	72.1	13.7	64.4

**Table 9. Average wheat yield by cropping zone** (%)

Year	Rice-wheat	Cotton wheat	Mixed	All
2006-07	3904.3	3637.5	3775.8	3775.8
2007-08	3489.2	2817.1	3242.1	3182.8
Percent change	- 11.0	- 23.0	- 14.0	- 17.0

**Table 10. Price received for wheat by cropping zones** (Rs 40 kg<sup>-1</sup>)

Procurement agencies	Rice zone		Cotton zone		Mixed zone		All	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Village dealer	496.0	670.0	417.8	617.4	417.4	639.5	430.4	633.3
Village consumer	425.0	622.1	417.2	611.9	474.3	585.6	435.0	607.9
Commission agent	-	611.7	-	619.2	-	-	-	612.7
Procurement center	412.5	625.0	432.8	624.4	425.0	625.0	426.0	625.0

## WHEAT MANAGEMENT PRACTICES

### Factors Responsible for Yield Decline

There are several reasons for the decline in wheat production during 2007-08. The area sown under wheat crop declined by 4% in the survey area as a result of delayed start of sugar crushing season, late cotton picking by the growers and the late announcement of minimum guaranteed price of wheat by the government. To explore the wheat yield decline reasons, farmers' perceptions were also recorded. Ranking analysis was performed to highlight the major causes of yield decline. The results reveal that cold spell of *rabi* 2007-08 followed by the shortage of irrigation water over normal supplies during *rabi* season were the major responsible factors of the wheat yield decline in Punjab. Less prices of wheat during 2006-07, non-availability of quality fertilizers, seeds and pesticides were also the major contributors in the wheat yield decline in 2007-08. Cost of wheat production was much higher owing to high cost of inputs that discouraged the farmers to use balanced amounts of inputs. Relatively unfavourable rainfall and temperature and aphid/jassid attacks, were the other causes of yield decline in Punjab (Table 11).

**Table 11. Farmers ranking about reason of wheat yield decline**

Parameter	Ranking
Cold spell	I
Canal water shortage	II
Low price of wheat in the last year	III
Non-availability of quality fertilizers	IV
high input prices	V
rainfall	VI
Aphid+Jassid	VII
Non-availability of quality seed	VIII

### Conclusions and Recommendations

During assessment year (i.e. 2007-08), average area under wheat was 4% less than the area in the previous year (i.e. 2006-07) in the survey area. This finding is in line with the 2% decrease in wheat area reported by MINFAL for 2007-08. Decline in wheat area, the incidence of frost/cold spells, shortage of irrigation water, and low wheat price in the previous year and

late (after planting time) announcement of minimum guaranteed price were the main reasons of less wheat production. The wheat growers allocated 64% of their farm area to wheat crop instead of 68% in the previous year. Most of the wheat area was planted up to November 30 in both years. But still a significant percentage of wheat area i.e. 35% and 37% for 2006-07 and 2007-08 respectively was planted after November 30. The late wheat sowing was more in cotton-wheat zone where most of the wheat area i.e. 70% was sown after November 30 and increasing trend of late sowing was found in this zone. The average application of DAP fertilizer was below from the recommended doses and declining trend in DAP fertilizer was observed than the previous year. In urea fertilizer, the use is more than the recommendation as the farmers applied 5.96 bags ha<sup>-1</sup>. Majority of the farmers (more than 80%) reported that canal water supply was below normal supply whereas reliance on underground water has been increasing. According to the farmers' perception, rainfall and temperature in 2007-08 were generally not favorable for the wheat crop as compared to previous year. Wheat yield decreased by about 10-15% during *rabi* 2007-08 as compared to *rabi* 2006-07. Cold spell of *rabi* 2007-08 was the major responsible factor of the yield decline followed by the canal water shortage. To enhance the wheat yield, farmers were of the view that timely announcement of wheat price and the availability of quality inputs including diesel and electricity on reasonable prices should be ensured. Well before planting time announcement of wheat price would provide incentives to producers to increase area under wheat as well as make efforts to enhance its yield. The canal water availability is another major cause of yield decline and its availability particularly at critical stages of plant growth should be ensured. Timely availability of credit to resource poor farmers would improve the financing capacity for agricultural equipments and implements and facilitate farmers to purchase inputs in time.

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