International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 8, Issue 12, 2016, pp.-1160-1162.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

# YIELD GAP AND CONSTRAINTS ANALYSIS IN WHEAT PRODUCTION IN HUMID SOUTH EASTERN PART OF RAJASTHAN

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Received: February 25, 2016; Revised: March 05, 2016; Accepted: March 08, 2016

**Abstract-** The south-eastern part of Rajasthan is considered as potential region for wheat production. However, farmers are facing numerous problems in realising the full production potentialities of wheat. Realising the fact a study was conducted to analyse yield gap and constraints in wheat production under field condition. The study was conducted in Bundi district of Rajasthan. To estimate the yield gap in wheat production, 70 full package frontline demonstrations were carried out at farmers field during three consecutive years from 2011-12 to 2013-14. Preferential ranking technique was used to identify the constraints. Stratified random sampling method used to identify the respondents. The selected respondents were interviewed personally using well-structured and pre-tested interview schedule. Results of the study revealed that the yield gap II was 7.55, 5.09 and 4.11 q $ha^{-1}$ in respective consecutive years. The major constraints responsible for yield gap were lack of knowledge, biotic stress, high cost of inputs, Low fertility status of soils and poor extension services. There is further scope to increase productivity on the farms by managing these constraints.

**Keywords**- Analysis, Constraint; Farmer, Productivity; Wheat production; Yield gap.

**Citation:** Dhaka B.L., et al., (2016) Yield Gap and Constraints Analysis in Wheat Production in Humid South Eastern Part of Rajasthan. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 12, pp.-1160-1162.



## Introduction

Wheat is one of the staple food crops in India and grown under diverse production systems and ecological settings. It contributes significantly to nation's food and nutritional security. It has been playing an important role in leveraging the agrarian scenario of India. The country has made tremendous progress in wheat production since introduction of semi-dwarf high yielding varieties during green revolution era. India recorded all time high 95.85 million tonnes of wheat production during 2013-14 [1]. Among wheat producing states in India, Rajasthan is one of the major wheat producing state. The state produced wheat in 2.39 million hectare area with a 3365 kg $ha^{-1}$ during 2014-15 [2]. Major part of wheat producing concerted in South Eastern Humid Plain of Rajasthan. The region comprised of Kota, Bundi, Baran and Jhalawar districts and two tehsils namely Khandar and Sawai Madhopur of Sawai Madhopur district covering geographical area of 26.43 lakh ha. *However,* farmers are facing numerous problems in realising the full production potentialities of wheat. The farmers facing several impediments in wheat production focussing in three important issues *viz*. yield gap between research farm and farmer's field, bio-physical constraints and socio-economic constraints. Analysing the aspects will help to understand the real situation in production, which in turn help in enhancing the wheat production in the region. Therefore, the present study was conducted to analyse the yield gap and constraints in wheat production in south eastern part of Rajasthan.

## MaterialsandMethods

The study was undertaken in South Eastern Humid Plain of Rajasthan. The region comprised of Kota, Bundi, Baran and Jhalawar districts and two tehsils namely Khandar and Sawai Madhopur of Sawai Madhopur district. The present study was based on primary as well as secondary data. The primary data were collected for the year 2013-14 by personal interview method through well-structured and pre-tested interview schedule.

## Estimation of yield gap

The yield gap is defined as the difference between potential yield, which is maximum attainable yield at research station under optimal conditions and actual yield obtained by farmers. In present study the yield gap concept as suggested by Zandstra (1981) [2] was used. The total yield gap can be divided into two parts, *viz*. yield gap I and yield II.

Yield gap I refers to the difference between yield obtained at research station and yield obtained at demonstration plots in a particular region. This gap is caused by differences in climate, soil and other physical environmental factors, which are difficult to manage or estimate at demonstration farmers' fields. Yield gap II is the difference between yield obtained at the nearest demonstration plot and actual yield obtained at farmers' field in a particular region. Yield gap II reflects the effects of biophysical and socio-economic constraints. The yield gap II was the prime concern in the present study.

To estimate the yield gap in wheat production, 70 full package frontline demonstrations were carried out at farmers field during three consecutive years from 2011-12 to 2013-14. Wheat varieties Raj 4037 demonstrated at farmers field involving farmers with their resources as active participants. Existing varieties was used as local check. The production performance of frontline demonstration was compared with local checks. Crops were harvested manually at maturity. A net plot area of 25 m2 from each experimental plot was harvested for seed yield as measurable indicators of output and compared with farmers' practices. The yield gaps were estimated as follows:

$$\text{Yield Gap I} = \frac{Y_R - Y_D}{Y_R} \times 100$$

$$\text{Yield Gap II} = \frac{Y_D - Y_F}{Y_D} \times 100$$

Wherein, $Y_R$ - Yield obtained at research station
$Y_D$ - Yield obtained at demonstration plot and
$Y_F$ - Actual yield obtained at farmers' field

**Identification of constraints**

The problems and constraints faced by the farmers in wheat production were worked out. Preferential ranking technique was used to identify the constraints. The main problems and constraints were focused on bio-physical and socio-economic constraints.

Stratified random sampling method used to identify the respondents. Bundi district was selected purposively based on their potential for wheat production and feasibility of study. Ten villages were selected purposively to ensure good representation of the district. From each selected villages farmers were stratified in three categories of small (up to 2.00 hectares), medium (above 2.00–4.00 hectares) and large (more than 4.00 hectares) based on the land holding. Finally, a total of 200 farmers were selected from selected villages in proportion to the population in each selected villages.

The constraints faced by the farmers in production of wheat were identified through a pilot study. Based on the pilot study, in all 12 major constraints were identified. The intensity of these identified constraints under the field situation was measured to prove their validity. The farmers were asked to rank the constraints perceived as limiting wheat production in order of preference. Based on responses obtained from respondent farmers, the Rank Based Quotient (RBQ) [4] for each identified constraints was calculated.

$$\text{Rank Based Quotient} = \frac{\sum f_i(n+1-i)}{N \times n} \times 100$$

Wherein, $f_i$ – Number of farmers reporting a particular constraint under $i^{th}$ rank
N – Number of farmers
n – Number of constraints indentified

**Results and Discussion**

**Yield gap analysis**

The yield gap in wheat crop production was estimated by using the procedure discussed in the methodology and the results presented in [Table-1].

**Table-1** *Yield gap in various years of wheat production*

| Particular | Yield (q ha$^{-1}$) | | |
|---|---|---|---|
| | 2011-12 | 2012-13 | 2013-14 |
| Experimental station (R) | 52.52 | 52.52 | 52.52 |
| Demonstration yield (D) | 47.45 | 47.45 | 46.61 |
| Actual yield at farmer's field (F) | 39.90 | 42.36 | 42.50 |
| Yield gap I | 5.07 (9.65 %) | 5.07 (9.65 %) | 5.91 (11.25 %) |
| Yield gap II | 7.55 (15.91 %) | 5.09 (10.73 %) | 4.11 (8.82 %) |
| Total yield gap | 12.62 (24.03 %) | 10.16 (19.35 %) | 10.02 (19.08 %) |

It is evident from [Table-1] that yield gap I which denotes the difference between yield at research station and yield at demonstration plots was 5.07, 5.07 and 5.91 q ha$^{-1}$ being 9.65, 9.65 and 11.25 percent in respective consecutive (2011-12 to 2013-14) years. The yield gap II, which was calculated on the basis of difference in yield between demonstration farms and actual yield on the farmers' field, was 7.55, 5.09 and 4.11 q ha$^{-1}$ being 15.91, 10.73 and 8.82 percent in respective consecutive years. The yield gap II could be reduced by adopting improved wheat production practices with balanced fertilizer application, judicial use of water and other package of practices. The yield gap is attributed to different factors: bio-physical, socio-economic, and technical factors as well as climatic factors. The most important reason for existing yield gap among different farms might be due to non-adoption of improved farm practices. The other important factors, which affected the yield levels, were largely beyond the control of farmers like climate, irrigation, biophysical and other uncertain happenings. Previous studies [5-7] also reported similar results.

The economics of wheat production at frontline demonstrations plots were estimated and results have been presented in [Table-2]. Economic analysis of the yield performance revealed that front line demonstrations recorded higher net return (Rs. 58682.00, 60165.00 and 61590.00 ha$^{-1}$) with higher benefit ratio (3.95, 4.02 and 4.13) compared to local checks during respective consecutive (2011-12 to 2013-14) years. Similar results were also reported in earlier studies [7-9].

**Table-2** *Economics of frontline demonstrations*

| Year | Cost of Cultivation (Rs/ha) | | Gross Return (Rs/ha) | | Net Return (Rs/ha) | | B:C Ratio | |
|---|---|---|---|---|---|---|---|---|
| | FLD | Local check | FLD | Local check | FLD | Local check | FLD | Local check |
| 2011-12 | 19865.00 | 17895.00 | 78547.00 | 66451.00 | 58682.00 | 48556.00 | 3.95 | 3.71 |
| 2012-13 | 19950.00 | 18735.00 | 80115.00 | 70422.00 | 60165.00 | 51687.00 | 4.02 | 3.76 |
| 2013-14 | 19655.00 | 18450.00 | 81245.00 | 74875.00 | 61590.00 | 56425.00 | 4.13 | 4.05 |

**Constraints analysis**

In order to take advantage of promising opportunities of wheat production, the farmers need to overcome a number of impediments related to wheat production. The constraints faced by farmers in wheat production were worked out and they are discussed under two broad categories *viz*., bio-physical constraints and socio-economic constraints. In addition to some general constraints, farmers are being faced an array of specific constraints.

**Bio-physical constraints**

The constraints related to bio-physical aspect of wheat production have been analyzed and presented in the [Table-3] along with their Rank Based Quotient (RBQ) for each constraint. These constraints were arranged according to their seriousness as perceived by the farmers. It is quite clear from [Table-3] that farmers were vulnerable to insufficient knowledge about various aspects of wheat production practices, value addition and post harvest management, product standards and quality parameters and marketing opportunities. Based on RBQ value (76.58) lack of knowledge was given first rank. It was found that majority of the farmers were also vulnerable to biotic stress. Based on RBQ value (69.78) biotic stress was given second rank among bio-physical constraints perceived by respondent farmers. Farmers revealed that insect pests and diseases caused more cost on control and reduced productivity and quality of wheat produce. Low fertility status of soils (RBQ value, 63.01) was another major. Weed infestation, late sowing and terminal heat were perceived as the next most serious bio-physical constraints were ranked at subsequent positions. It was observed that farmers' production system not sufficient for wheat production. Similar constraints in wheat production were also identified by scholars [5, 6, 10, 11].

**Table-3** *Bio-physical constraints*

| Constraints | R.B.Q | Overall Rank |
|---|---|---|
| Lack of knowledge | 76.58 | I |
| Biotic stress | 69.78 | II |
| Low fertility status of soils | 63.01 | III |
| Weed infestation | 62.46 | VI |
| Late sowing | 56.42 | V |
| Small and fragmented holdings | 45.12 | VII |
| Terminal heat | 23.40 | IV |

**Socio-economic constraints**

Socio-economic constrains faced by the farmers in the study are presented in [Table-4] show that high cost of agricultural inputs (RBQ value, 72. 63) was the most important constraint. During the course of the study, it was revealed by respondents that the price of agricultural inputs including seeds, fertilizers, pesticides, fuels, etc. was increasing day by day, which led to high cost of production which in turn resulted in reduced profits. Poor extension services (RBQ value, 64.53) was the second most important constraint as perceived by farmers. Respondents revealed that extension services were not available as and when needed. Most of the farmers were dependent on agri-input dealers and fellow farmers for information related to wheat production. Poor infrastructure (RBQ value, 53.21) was the next most important constraint as perceived by farmers. Respondents revealed about the problems of poor road, lack of transport facilities, lack of electricity, lack of storage facilities and lack of processing facilities.

Further, inadequate and untimely inputs supply and poor credit support to the farmers were another constraints as perceived by the respondents. Similar constraints were also reported in previous studies [12-14].

**Table-4** *Socio economic constraints*

| Constraints | R.B.Q | Overall Rank |
|---|---|---|
| Poor credit facilities | 39.74 | IV |
| Poor infrastructures | 53.21 | III |
| Inadequate input supply | 47.54 | V |
| High cost of inputs | 72.63 | I |
| Poor extension services | 64.53 | II |

**Conclusion**

It may be concluded that there is a wide gap between yield of wheat at research station and actual yield obtained by farmers. This gap could be contributed to lack of knowledge about improved wheat production technologies to farmers, poor extension support, biotic stress, high cost and inadequate supply of agri-inputs. The yield gap I could be minimised through development of appropriate wheat production technologies suitable to biophysical and socio-economic situation of the farmers. The yield gap II could be minimized by adopting improved wheat production practices with balance use of fertilizers, judicial use of irrigation water and other package of practices. There is scope to further increase productivity on the farms. By managing these constraints, the wheat productivity could be increased.

**Conflict of Interest: None declared**

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