YIELD GAP ANALYSIS AMONG RICE GROWERS OF EASTERN UTTAR PRADESH

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Abstract- The present study analyses the total yield gap in Rice crop into three different gaps *viz.* yield gap-I, yield gap-II and total yield gap. The study was conducted in Mirzapur District using primary data collected from 60 sample farmers covering four sample Blocks for the year 2097- 2010. In order to evaluate the objectives of the study, a multistage stratified random sampling technique was adopted Most of the sample farmers were growing vatimansuri variety of rice crop. Yield gap analysis shows that 23 per cent yield gap was estimated between potential and potential farm yield where as yield gap between potential farm yield and actual yield was estimated 23.12 percent. Index of realized potential farm yield was observed 75.20 percent on marginal farms to 80 percent on large farms with an overall average of 76.0 percent. The main causing factors of yield gaps was due to variation in the quantum of resource used and proper timing of the resources use.

Keywords- Yield gap, Costs, & Returns and Constraints.

Introduction

Rice is the most important staple food crop for peoples in developing countries particularly for Asia and for the humid tropics across the world. Almost 96 per cent of rice is produced and consumed by developing countries and 90 per cent in Asia. Rice production has increased faster than population, over the last three decades; in countries with extreme population pressure and limited land resources. Most of the increase in production has come from the increase in yield made possible through the adoption of improved variety developed by National Agriculture Research System (NARS) with support from International Agriculture Research Centre. Rice production increased by 2.3 per cent per year from 1968 to 2001 and 2.4 per cent per year increased in year 2001 to 2008. India is the 2nd largest rice growing country (after china) in the world. The area and production of rice in Asia was 136 mha and 533 million mt. out of the total 152 mha and 582 million mt. of the world during 1990, respectively. Utter Pradesh are the most important rice producing state. During the last forty years, Year 1960-61 to 2001-02, the rice area has increased from 34.1 mha to 44.7 mha. The rice production has increased from 34.5 mt to 93 mt during the same period, while productivity increased from 1013 kg/ha 2086 kg/ha. It is estimated that the rice demand in year 2000 was 100 mt and in year 2025, the demand will be raised 140 mt. Rice is the one of the major cereal crops in the country which is around 45 per cent of India's cereals productions. Keeping above background in the mind, present study was conducted with the following specific objectives.

Objectives

1. To estimate ion the magnitude of yield gap.
2. To study the factors influencing to attain higher yield in paddy.

Methods and Materials

In order to evaluate the objectives of the study, a multistage stratified random sampling technique was adopted. The area of the study was Mirzpur district of eastern Utter Pradesh region of the U.P. State. The Mirzapur district was selected purposively. The study was conducted in Mirzapur District of Eastern Utter Pradesh state by collecting data from the sample farmers. Multistage state Stratified random sampling was adopted for selection of sample farmers. Mirzapur district having highest area under rice were selected. A total of five villages were selected. From each of these villages were selected at random. A minimum of 3 villages per taluk were covered depending on the density of the farmers in the taluk. Primary data were collected from the 120 selected farmers through pretested questionnaire for the agriculture year 2009-2010.

Analytical tools

- **Total Yield Gap (TYG)**
  It is the different between the potential yield (Yp) & the actual yield (Ya)
  $$\text{TYG (in per cent)} = \frac{Y_p - Y_a}{Y_p} \times 100$$
  This total yield gap comprises yield gap – I & yield gap –II.

- **Yield Gap – I**
  It is different between the potential yield (Yp) and the potential farm yield (Yd)
  $$\text{Yield gap –I (In per cent)} = \frac{Y_p - Y_d}{Y_p} \times 100$$

- **Yield Gap – II**
  It is different between the potential farm yield (Yd) and actual yield (Ya)
  $$\text{Yield gap (in per cent) – II} = \frac{Y_d - Y_a}{Y_d} \times 100$$

- **Index of Realized Potential Yield (IRPY)**
  It is the ratio of the actual yield (Ya) to the potential yield (Yp) expressed in percentage terms.
  $$\text{IRPY} = \frac{Y_a}{Y_p} \times 100$$

- **Index of Realized Potential Farm Yield (IRPFY)**
  It is the ratio of the actual yield (Ya) to the potential farm yield (Yd) expressed in percentage terms.
  $$\text{IRPFY} = \frac{Y_a}{Y_d} \times 100$$

- **Cost Concepts :-**
   Different cost concept was used as follows - Cost A$_1$/A$_2$, Cost B and Cost C

Results and Discussion
Return over cost for paddy crop
The break-up of input cost according to cost concepts and returns obtained over costs, measures of farms profit, and output–input ratio for paddy crop variety (vanimansuri) has been worked out and displayed in [Table-1].

It reveal from [Table-1] that, on an average cost A, B, and C were estimated Rs. 10937.04, 17763.93 and 18822.04 per ha. respectively. These costs were increased with the increase in size of farm. It was due to highest investment on major farm input by

the large farm categories than smaller farm categories. Table also reflects that the yield as well as gross income per hectare increased with the increase in the size of farm, because of better planning and proper care of production strategies by the larger farm categories. Per hectare measures of farm, profit shows that higher production with the involvement of higher cost on lager farm. Most net income, family labour income and farm business income Marginal and small farms than the larger farms, it shows that all these return were decreasing with the increase in size farms. The average output–input ratio was estimated 1.49. The study also revealed that output – input ratio on the marginal, small and large farms were 1.53, 1.54 and 1.49 respectably. Average per quintal cost of production was estimated Rs., 495.32 and it was ranging between Rs. 480.13 on small farms to Rs. 580.99 large size of farms.

Table-1 *Costs and returns of paddy on sample farms (Rs./ha.)*

Particulars	Size group of farms			Average
	Marginal farms (0-1 ha)	Small farms (1-2 ha)	Large farms (2-above ha)	
Cost – A	10213.37	10677.14	14601.50	10937.04
Cost – B	16728.73	17378.41	23031.02	17763.93
Cost – C	18123.73	18177.61	23239.82	18822.04
Yield (qtl/ha)	**37.60**	**37.86**	**40.00**	**38.00**
Grass valve of output	**27824.00**	**28016.40**	**29600.00**	**28120.00**
Net income (Return over cost – C)	9700.27	9828.79	6360.18	9297.96
Family labour income (Return over cost – B)	11095.27	10637.99	6568.98	10356.07
Farm business Income (Return over cost – A)	17610.62	17339.26	14998.50	17182.96
Cost of Production (Rs./qtl.)	**482.20**	**480.13**	**580.99**	**495.32**

Estimation of yield gap
[Table-2] present the yield performance of paddy (variety vanimansuri) under the different field situations. It could be observed from the table that there existed a sizeable gap in the paddy (variety vanimansuri), productivity on research station (potential yield) ,demonstration yield (potential farm yield) and the sample farmers field (actual yield).

Paddy crop yield–realized on the research station 65 Qtl/ha and on demonstration

plots 50 Qtl/ha were sufficiently higher than on farmers fields 38 Qtl/ha. Higher yield levels on research stations and demonstration plots were attributed to the fact that the experiments are conducted on scientific lines and are equipped with all the resources including the technical input on the research stations, while the demonstration traits are carried out under the Supervision of agricultural extension workers.

Table-2 *Yield level Released and the Estimated Yield Gap Under the different size of holdings*

S. No.	Particular		Yield (qtl./ha.)
1.	Potential yield		65.00
2.	Potential form yield		50.00
3.	Actual yield		
	(i)	Marginal	37.60
	(ii)	Small	37.86
	(iii)	Large	40.00
	(iv)	Overall	**38.00**
4.	Yield Gap- I		15.00 (**23.01 per cent**)
5.	Yield Gap- II		
	(i)	Marginal	12.40 (23.2 per cent)
	(ii)	Small	12.14 (24.24 per cent)
	(iii)	Large	10.00 (20.00 per cent)
	(iv)	Overall Average	12.00 (**23.40 per cent**)
6.	Total yield gap (TYG) – (Yp-Ya)		
	(i)	Marginal	27.40
	(ii)	Small	27.14
	(iii)	Large	25.00
	(iv)	Overall	**27.00**
7.	Index of yield Gap – (in per cent)		
	(i)	Marginal (in percentage)	42.15
	(ii)	Small	41.75
	(iii)	Large	38.46
	(iv)	Overall	**41.54**
8.	Index of Realized potential yield (IRPY) in per cent		
	(i)	Marginal (in percentage)	57.84
	(ii)	Small	58.24
	(iii)	Large	61.53
	(iv)	Overall	**58.46**
9.	Index of Realized potential form yield (IRPFY) in per cent		
	(i)	Marginal	75.20
	(ii)	Small	75.72
	(iii)	Large	80.00
	(iv)	Overall	**76.00**

The magnitude of average total yield gap worked out to be 26.56 Qtl/ha. This comprised of relatively higher magnitude of yield gap-I 23.01 percent, than yield gap-II, on the marginal, small & large farm were 24.28 percent and 20.00 percent respectively.

The average index of yield gap was to the extent of 41.54 percent. That the percentage of index of yield gap ranging between 38.46 percent to 42.15 percent on the large and marginal farms. Index of realized potential yield estimated was, 57.84 percent, 58.24 percent, 61.53 percent and 58.46 percent on the marginal farms, small farms, large farms and overall respectively.

The overall index of realized potential farm yield estimated was 76 percent and on the marginal small & large farms were 72.20 percent, 75.72 percent & 80.00 percent respectively in the study area.

Deviation of Input between Demonstration & Actual Farms

The yield levels obtained by the farmers with the intermediate achievable demonstration plot yield levels. This analysis has been extensively used by the plant and animal breeders but only sparingly by the social scientists. The purpose behind using this technique in the present study was to provide information on the nature of association between the input use gaps & the yield gap.

The analysis was carried out across the different categories of sample farms. To begin with, the input use gaps & output differences at the mean levels were worked out and the results are presented [Table-3].

[Table-3] reveals the demonstration plots used higher quantity of all inputs than on the farmers field. The quantum of difference in the input use levels varied from one input to another. The estimated input gap was the highest for plant nutrients (fertilizers) like Zink, Urea and D.A.P 83.92 percent, 44.57 percent 19.90 percent resistively followed by plant protection seed plunging, irrigation and manure 55.33 recent, 53.30 percent, 33.75 percent, 25.00 percent and 23.25 percent respectively. Human labour (5.48 percent) more used on the actual field compared the demonstration plots. Across the categories of sample farms, input use gaps were higher on marginal and small farms for all the input compared to their large counterparts However, paddy variety vanimansuri all over output obtained 24.00 percent.

Variables	Unit	Demonstration plots	Actual field Situation			Average
			Marginal	Small	Large	
Human labour	Md.	90	(-) 3.91 (4.34)	(-) 5.46 (6.07)	(-) 8.18 (9.08)	(-) 4.94 (5.48)
Seed	Kg.	40	20.36 (50.90)	22.40 (56.00)	22.97 (56.00)	21.32 (53.30)
Tractors	Ploughing	4	1.55 (38.75)	1.53 (38.25)	0.13 (3.25)	1.07 (26.75)
Irrigation	------	4	1.00 (25.00)	1.00 (25.00)	1.00 (25.00)	1.00 (23.00)
Manure	Qtl.	40	12.85 (32.12)	4.00 (10.00)	(-) 18.06 (45.15)	9.30 (23.25)
Fertilizer						
Urea	Kg	120	49.09 (40.90)	62.71 (52.26)	51.48 (42.90)	53.49 (44.57)
DAP		60	14.30 (23.83)	10.32 (17.20)	5.58 (9.30)	11.90 (19.90)
Zink		25.00	21.00 (84.00)	21.00 (84.0)	20.87 (83.48)	20.98 (83.92)
Plant protection	Liter	3	1.94 (64.66)	1.27 (42.33)	1.33 (44.33)	1.66 (55.33)
Yield	Qtl.	50.00	12.40 (24.80)	12.14 (24.28)	10.00 (20.00)	12.00 (24.00)

Table-3 Input Use Gaps in Paddy on various size of holdings (Rs. /ha.)

Deviation of input between potential and actual

Gap of input between potential and actual input and output of the mean levels were worked out and result are present in the [Table-4].

[Table-4] reveals that on an highest overall fertilizer like Zink urea, DAP gap was found 83.92 percent, 42.34 percent and 19.93 percent respectively and manure 76.38 percent followed by plant protection, seed plaguing and irrigation 66.50 percent, 34.12 percent, 34.00 percent respectively. Human labour on the small large more than and on the marginal farms less than used than the potential farms. However, paddy variety vanimansuri output obtained by marginal, small and large farmers was less than potential farms yield by 40.32 percent 39.90 percent respectively with an overall average was 39.68 percent. It was decreasing trend with the increasing in size of farms.

Opinions of sample farmers about problem in Realizing Potential farm yield

It is observed from the study that there are number of constrains, which are responsible for the low productivity or yield gap of paddy variety vanimansuri in the study area. These constraints are broadly classified in to two categories – Crop Management and Infra-Structural organization.

Crop Management

Constraints related to crop management are further divided into constraints related to seed & seed treatment, fertilizer application, irrigation management, weed management, plant protection measures [Table-5.1] and [Table-5.2].

Lack of knowledge of seed treatment was the major constraints as reported by 84 percent of the respondents. Unavailability of desired HYVs seed & lack of knowledge about method of use of fungicide as reported by 73 and 50 percent of the respondents were other constraints.

As regard the constraints related to fertilizer application, the data shows that 75 percent of respondents, lacked in the knowledge about soil testing facilities. The farmer reported high cost of fertilizer, lack of knowledge about recommended doses of fertilizers and micronutrients, lack of capital for purchasing fertilizer and local availability of fertilizers etc. as constraints related to fertilizer application. It is also clear from the table that high cost of weedicide application was not being as effective as hand weeding hack of capital for purchasing weedicides, inadequate knowledge of weed control measure of non availability of desired brand of weedicide were other constraints, as reported by 70,69,18 and 18 percent respectively. Seventeen four per cent paddy growers of the area also reported difficulty in use of insecticides and pesticides due to lack of capital, to purchasing insecticides, high cost insecticides, lock of knowledge about recommended plant protection measures and non availability of desired insecticides reported by 71 , 78 and 30 percent respectively.

Infrastructural organization

Constraints related to institutional infrastructure were also responsible for yield gap. As these institutions provide facilities for loan and impart training effectively.

Regarding to the credit institution, non availability of crop loan at time as reported by 70 percent of the paddy growers followed by poor quality of inputs supplied by co-operative credit societies as reported by 51 percent.

Table-4 *Mean levels and input use gaps in paddy on various size of holdings*

Variables	Unit	Potential plats (Yp)	Actual field situation			
			Marginal (yp-m)	Small (yp-m)	Large (yp-l)	Average (yp-a)
Human labour	Hd	95	1.09 (11.47)	(-) 0.46 (0.48)	(-) 3.18 (3.35)	0.06 (0.06)
Seed	Kg	33	13.36 (40.49)	15.40 (46.66)	15.97 (48.39)	11.26 (34.12)
Tractor	Ploughing	5	2.55 (51.00)	2.53 (50.60)	1.13 (22.60)	1.70 (34.00)
Irrigation	------	4	1.00 (25.00)	1.00 (25.00)	1.00 (25.00)	1.00 (25.00)
Manure	Qtl.	130	102.85 (79.11)	94.00 (72.30)	96.10 (73.92)	99.29 (76.38)
Fertilizer						
Urea	Kg	120	4.08 (40.90)	53.76 (44.80)	51.48 (42.90)	50.81 (42.34)
DAP		60	4.30 (23.82)	10.38 (17.3)	5.58 (9.30)	11.96 (19.93)
Zink		25	21.00 (84.00)	21.00 (84.00)	20.87 (83.48)	20.98 (83.92)
Plant protection	Litter	4	2.94 (73.50)	2.27 (56.75)	2.33 (58.25)	2.66 (60.50)
Yield	Qtl.	63	25.40 (40.32)	25.14 (39.90)	23.00 (36.50)	25.00 (39.68)

Seventy-five percent of paddy variety vanimansuri growers reported that improved production practices were not demonstrated in their fields and lack of contact with extension workers and improper training information at the sowing time.

Table-5.1 *Constraints related to crop management and institutional infrastructure*

S.N.	Constraints	Percentage of respondents
	Crop Management	
A.	**Seed and seed treatment-**	
1.	Lack of knowledge of seed treatment	84
2.	Unavailability of desired HYV'S seed	73
3.	Lack of knowledge of use of fungicide, pesticide	50
B.	**Fertilizer Application**	
1.	Lack of knowledge about recommended dose of fertilizers	92
2.	High cost of fertilizer	80
3.	Lack of knowledge about sail testing facilities	76
4.	Lock of capital for purchasing fertilizer	65
5.	Lack of local availability of fertilizers	50
C.	**Weed management**	
1.	High cost of herbicide	70
2.	Lack of capital for purchasing herbicide	69
3.	The adequate knowledge of weed control measures	18
4.	Net availability of desired brand of herbicide	18
D.	**Plant protection measures**	
1.	Lack of knowledge about recommended plant protection measure	78
2.	Lack of capital for purchasing insecticide	74
3.	High cost of insecticides	71
4.	Non availability of desired insecticides	30

Table-5.2 *Constraints related to crop management and institutional infrastructure*

S.N.	Constraints	Percentage of respondents
	Infrastructural Organizations	
A.	**Credit institution -**	
1.	Non availability of crop loan in time	70
2.	Poor quality of input supplied by co-operative credit society	51
B.	**Extension institutions**	
1.	Improved production techniques not demonstrated at formers field	75
2.	Training facilities not available or available at distant place	72

Conclusion

Cost on the basis of cost concept shows that on an average cost A, cost B and cost C were estimated Rs. 10937, Rs. 17769, and Rs. 18822 and these cost increased with the increase in size of farms. The average yield of paddy was found 38.00 qtls. This was varied between 37.60 qtls. on marginal forms to 40 qtls. on large farms. Return are the cost A, cast B, and cost C were observed Rs. 17182.96, Rs. 10356 and Rs. 9297.5 respectively. Output input ratio was estimated 1.49 and it varied between 1.49 on large farms to 1.54 on small farms. Average cost of production was observed Rs. 495.30 per qtls.

Yield gap analysis shows that 23 per cent yield gap was estimated between potential and potential farm yield where as yield gap between potential farm yield and actual yield was estimated 23.12 percent. Index if yield gap was estimated 41.54 percent and ranging between 38.46 percent on large farms to 42.15 percent on marginal farm. Index of realized potential farm yield was observed 75.20

percent on marginal farms to 80 percent on large farms with an overall average of 76.0 percent Despite uncontrolled factors of production, the main causing factors of yield gaps was due to variation in the quantum of resource used and proper timing of the resources use. Mean level input use gap between demonstration plot and actual field level shows that on an averaged use of input at demonstration plot was higher than the actual field situation by 83.90 percent in plant protection, 53.30 percent in seed, 23.35 percent in the fertilizers use, resulted in the yield gap by 55.33 percent

Conflict of Interest: None declared

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