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Quantification of yield gaps and productivity difference in different paddy cultivation methods in Kolhapur district of Maharashtra

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Abstract
The present study is an attempt to analyze the "Quantification of Yield Gaps and Constraints in Different Paddy Cultivation Methods in Kolhapur District of Maharashtra". For present study traditional method, Char-suttri method and Saguna Rice Technology (SRT) method of paddy cultivation are studied. Yield gap III of traditional and SRT was 41.55 qtls and having yield gap per cent 50.59. Yield gap III of traditional and Char-suttri was 45.60 qtls and having yield gap per cent 46.35. The major problems faced by the SRT Sample cultivators are Non-availability of skilled labour ranks first and problems faced by the char-suttri Sample cultivators are Difficult to management practices ranks first.

Keywords: char-suttri method, SRT method, yield gap, constraints

Introduction
Paddy having botanical name *Oryza sativa* L. Family Poaceae. The United Nations General assembly, in a resolution declared in the year of 2004 as the "International Year of Rice", which has tremendous significance to food security. Total paddy production of world in year 2020-2021 is 501.20 million metric tons. India has the largest area under rice crop 44.50 Million hectare and ranks second place in production next to China (Source- Foreign Agricultural Services/ USDA). India accounts for the 20 per cent of total production of Paddy in world. India accounts 120 million metric tons production and china accounts 147 million metric tons. Production-wise, West Bengal stands first rank in India. The study is conducted for analyzing resource use efficiency.

Objectives
1. To estimate yield gap of paddy in different methods of cultivation
2. To study the problems faced by paddy producers in different methods of cultivation

Material and Methodology
For present paper area were selected in the Kolhapur district of Maharashtra. Two tahsils Kagal and Karveer were selected purposively. The three villages selected from Kagal and Kaveer tahsils. Total sample of 90 growers are selected who adopted traditional method, Saguna Rice Technology (SRT) method and char-suttri method. The comparison between 30 growers of SRT and 15 growers of Traditional and 30 growers of Char- Suttri are compared with 15 traditional growers which selected in same area for present study.

Yield Gap
Yield gap was estimated by using the methodology develop by International Rice Research Institute (IRRI), Manila, Philippine for different methods of paddy cultivations.

Yield Gap I= Y_p-Y_d

Where,
Y_p=Potential yield (Maximum yield obtained at farmers level)
Y_d= Potential farm yield (Yield realized on demonstration plot)

Yield Gap II= Y_d-Y_a

Where,
Y_d=Potential farm yield (Yield realized on demonstration plot)
Y_a= Actual yield (Yield realized on traditional sample farm)

Total Yeild GAP= Y_p-Y_a

Where,
Y_p= Potential yield (yield realized at research station)
Y_a= Actual yield (yield realized on sample farm)

Indices of yield gap

a) Index of yield gap refers to the percentage of yield potential unrealized i.e.

$$\text{Index of yield gap (IYG)} = \frac{(Yp - Ya)}{Ya} \times 100$$

b) Index of realized potential yield is defined as the percentage of the yield potential achieved.

$$\text{Index of Realized Potential Yield (IRPY)} = \frac{Ya}{Yp} \times 100$$

c) Index of realized potential farm yield is defined as the ratio of actual yield to potential farm yield, expressed in percentage. Thus,

$$\text{Index of realized demonstration plot yield (IRPDY))} = \frac{Ya}{Yp} \times 100$$

It may not possible for all farmers to raise the crop productivity on their farms to the level of research station. However, it would be realistic to aim at demonstration plot yield (potential farm yield) level. Therefore, emphasis was given on yield gap-II and here in after simply referred 3) Response Priority Index (RPI)

In the quantification of constraints expressed by the farmers, there was a problem, whether emphasis should be given for the number of responses to a particular priority or to the highest number of responses to a constraint in the first priority. But, both lead to different conclusions to resolve this, a Responses-Priority Index (RPI) was constructed as a product of Proportion of Responses (PR) and Priority Estimate (PE), where PR for the i^{th} constraint gave the ratio of number of responses for a particular constraint to the total responses as per Equation

$$(RPI) = \frac{\sum_{j=1}^{k} f_{ij}.X_{[(k+1)-j\}]}}{\sum_{i=1}^{1}\sum_{j=1}^{K} f_{ij}} \quad 0 \leq RPI \geq 5$$

where,
RPI = Response Priority Index for i^{th} constraint,

f ij = Number of responses for the j^{th} priority of the i^{th} constraint (i=1, 2……, l;
j= 1,2,3 …..k),

$\sum_{j=1}^{k} f_{ij}$ = Total number of responses for the i^{th} constraint,

k = Number of priorities, i.e. 5,

X [(k+1)-j] = Scores for the j^{th} priority,

$\sum_{i=1}^{1}\sum_{j=1}^{K} f_{ij}$ = Total number of responses to all constraints, and

$\sum_{i=1}^{1}$ RPI = Summation of RP indices for all constraints.

Result and Discussion

1) Estimates of Yield Gap of Paddy in Different Methods of Cultivation

The potential yields were 85.00 qtls. While farm location trial yield of SRT was 65.71 qtl. Yield was obtained in char-suttri method was 59.52 qtl. Yield was obtained in char-suttri method based on adoption of all technology recommended by MPKV, Rahuri. Both yields taken from rice research station, vadagav Maval. These finding confirmed the results reported by Khade (2016) [5] and Deokate (2014) [3].

Table 1: Yield Gap I In Traditional and SRT Method of Paddy Cultivation

	Potential yield gap	
Sr. No.	**Particulars**	**Yield (Qtl.)**
1	Potential yield	85.00
2	Demonstrated yield	65.71
3	Yield gap	19.29
4	Yield gap (%)	22.60

First yield gap was estimated to 19.29 qtl. Potential yield was 85.00 qtl and demonstrated plot yield was 65.71 qtl. Yield gap percentage was 22.60, here need of reduction of yield gap for increasing potential yield.

Table 2: Yield Gap II in Traditional and SRT Method of Paddy Cultivation

Demonstration yield gap		
Sr. No.	**Particulars**	**Yield (Qtl.)**
1	Demonstrated yield	65.71
2	Actual yield	43.45
3	Yield gap	22.26
4	Yield gap (%)	33.38

Yield gap obtained at demonstration level was 22.26 qtl. Demonstrated plot yield was 65.71 qtl and actual yield obtained was 43.45 qtl. This yield gap is more which shows that, at actual level yield of paddy was less. Yield gap per cent was 33.38 which was higher compare to yield gap I.

Table 3: Yield Gap III in Traditional and SRT Method of Paddy Cultivation

	Total yield gap	
Sr. No.	**Particulars**	**Yield (Qtl.)**
1	Potential yield	85.00
2	Actual yield	43.45
3	Yield gap	41.55
4	Yield gap (%)	50.59

Yield gap III is total yield gap i.e. yield gap between potential yield minus actual yield. Yield gap III was 41.55 qtls and having yield gap per cent 50.59. This yield gap indicates that

still yield of traditional Sample cultivators was less compare to SRT Sample cultivators. Yield gap of SRT method and traditional method was varied at different level of production as above mentioned, hence hypothesis was accepted.

Table 4: Yield Gap I in Traditional and Char-Suttri Method of Paddy Cultivation

Potential yield gap		
Sr. No.	**Particulars**	**Yield (Qtl.)**
1	Potential yield	85.00
2	Demonstrated yield	59.52
3	Yield gap	25.48
4	Yield gap (%)	29.98

First yield gap estimated to 25.48 qtls. Potential yield was 85.00 qtl and Demonstrated plot yield was 59.52 qtl. Yield gap percentage was 29.98, here need of reduction of yield gap for increasing potential yield.

Table 5: Yield Gap II in Traditional and Char-Suttri Method of Paddy Cultivation

Demonstration yield gap		
Sr. No.	**Particulars**	**Yield (Qtl.)**
1	Demonstrated yield	59.52
2	Actual yield	39.40
3	Yield gap	20.12
4	Yield gap (%)	33.80

Yield gap obtained at demonstration level was 20.12 qtls. Demonstrated plot yield was 59.52 qtl and actual yield obtained was 39.40 qtl. This yield gap is more which shows that, at actual level yield of paddy was less. Yield gap per cent was 33.80 which was higher compare to yield gap I.

Table 6: Yield Gap III in Traditional and Char-Suttri Method of Paddy Cultivation

Total yield gap		
Sr. No.	**Particulars**	**Yield (Qtl.)**
1	Potential yield	85.00
2	Actual yield	39.40
3	Yield gap	45.60
4	Yield gap (%)	46.35

Yield gap III is total yield gap i.e. yield gap between potential yield minus actual yield. Yield gap III was 45.60 qtls and having yield gap per cent 46.35. This yield gap indicates that still yield of traditional Sample cultivators was less compare to SRT Sample cultivators. Yield gap of char-suttri method and traditional method was varied at different level of production as above mentioned, hence hypothesis was accepted.

2) Estimates of Indices of Yield Gap for Different Paddy Cultivation Methods

At overall level estimated index of yield gap worked out 105.68 per cent. It was highest for the char-suttri method 115.74 per cent, followed by SRT 95.62 per cent. It indicates that there existed a tremendous scope to improve the paddy production in the study area.

At overall level, the index of realized potential yield was 48.74 per cent. The index of realized potential yield of SRT and char-suttri were 51.12 per cent and 46.35 per cent. It may not possible for the growers to adopt certain components as such new technology developed on the research station due to differences in environmental factors and the other related constraints operating at the farm level.

Table 7: Indices of Yield Gap for SRT and Char-Suttri Method of Cultivation

Sr. No.	Particulars	SRT	Char-suttri	Overall
1	Index of Yield Gap (IYG)	95.62	115.74	105.68
2	Index of Realized Potential Yield (IRPY)	51.12	46.35	48.74
3	Index of realized demonstration plot yield (IRPDY)	77.31	70.02	73.66

Thus, all the recommended package of practices and production technology used on the demonstration plots if they are adopted as such on the sample farms by the sample paddy growers could raise the yield by 27 per cent at overall level. Char-suttri paddy growers can increase yield by 30.00 per cent and SRT Sample cultivators can increase yield by 12.00 per cent. These finding confirmed the results reported by Deokate (2014) [3].

3) Constraints Faced by Farmers

Regarding the problems of paddy production, problems were ranked according to Response Priority Index (RPI).

The major problems faced by the traditional growers are difficult management practises ranks first, followed by lack of water availability, Non-availability of skilled labours, High cost of fertilizers & pesticides, Non-availability of machine & tools, less use of green manuring, Non-availability of cash & credit, Lack of confidence in taking new technology and Lack of guidance from department officials.

The major problems faced by the SRT Sample cultivators are Non-availability of skilled labour ranks first, followed by Non-availability of machine & tools, Lack of confidence in taking new technology, Lack of guidance from department officials, High cost of fertilizers & pesticides, Difficult to management practises, Lack of water availability, Less use of green manuring, Non-availability of cash & credit.

The major problems faced by the char-suttri Sample cultivators are Difficult to management practises ranks first, followed by Lack of water availability, Non-availability of skilled labour, less use of green manuring, High cost of fertilizers & pesticides, Non-availability of machine & tools, Lack of confidence in taking new technology, etc.

Table 8: Constraints faced by traditional, SRT and char-suttri Sample cultivators

Sr. No.	Constraints	RPI	Traditional	RPI	SRT	RPI	Char-suttri
1	Difficult to management practices	0.58	1	0.55	6	0.25	1
2	Lack of water availability	0.47	2	0.47	7	0.18	2
3	Non-availability of skilled labour	0.35	3	0.41	1	0.57	3
4	Non-availability of machine & tools	0.29	5	0.31	2	0.55	6
5	Lack of confidence in taking new technology	0.25	8	0.23	3	0.44	7
6	Lack of guidance from department officials	0.19	9	0.17	4	0.40	8
7	High cost of fertilizers & pesticides	0.33	4	0.34	5	0.35	5
8	Less use of green manuring	0.28	6	0.38	8	0.14	4
9	Non-availability of cash & credit	0.26	7	0.15	9	0.13	9

Conclusion

First yield gap percentage for SRT was 22.60, here need of reduction of yield gap for increasing potential yield. Second yield gap per cent was 33.38 which was higher compare to yield gap I. Third yield gap percentage was 50.59, this yield gap indicates that still yield of traditional Sample cultivators was less compare to SRT Sample cultivators.

First yield gap percentage for char-suttri was 29.98, here need of reduction of yield gap for increasing potential yield. Second yield gap per cent was 33.80 which was higher compare to yield gap I. Third yield gap percentage was 46.35, this yield gap indicates that still yield of traditional Sample cultivators was less compare to char-suttri Sample cultivators.

The major problems faced by the traditional growers are difficult management practises ranks first, followed by lack of water availability.

The major problems faced by the SRT Sample cultivators are Non-availability of skilled labour ranks first, followed by Non-availability of machine & tools.

The major problems faced by the char-suttri Sample cultivators are Difficult to management practises ranks first, followed by Lack of water availability.

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