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A Study on the Yield Gap Analysis in Paddy, in the Erode District of Tamil Nadu

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Rice is the most important food crop for more than two thirds of the Indian population. During the period 1950-51 to 2001-02, the area has increased by one and a half times (31.0 million hectares to 44.6 million hectares), productivity by three times (668Kg/ha to 2086 Kg/ha) and production by four and a half times (20.58 million tons to 90 million) (Mishra, 2005). But the projected demand for rice is 125 million tons by 2020 at the current rate of population growth.

In this context, yield gap in rice i.e. the difference between the potential yield (yield claimed by the research station) and the actual yield (yield obtained by the farmer in his field) stands as a valuable performance indicator for the rice production in the country.

In order to meet the increased demand for rice juxtaposed with an increasing population growth, the adoption of improved crop production technologies in the farmers field emerges as the most important solution, which in turn serves to bridge this yield gap.

Against the backdrop of this situation, it was decided to conduct the following study with the objectives as detailed below.

1. To study the profile characteristics of the rice growers.
2. To estimate the yield gap prevailing on popular rice varieties.
3. To study the constraints faced by the rice growers in adopting the recommended rice technologies.

METHODOLOGY

The research was undertaken to study the yield gap analysis among rice growers of the Western Zone of Erode district. Among the seven taluks of Erode district, Erode taluk having the highest area under rice cultivation was selected. Modakuruchi block having the highest area under rice in Erode taluka was selected. Among the four firkas in Modakuruchi block, two firkas having the highest Paddy area were selected. Two villages namely M.S.Mangalam and Modakuruchi, one each from the two firkas were selected. 20 respondents each from the small, medium and big farmer category were selected to constitute a total sample size of sixty farmers.

A total of 16 independent variables and one dependent variable namely yield gap, were selected for the study. The independent variables were measured using standardized scoring procedure. The dependant variable yield gap was measured using the formula.

$$\text{Average yield gap} = \frac{\text{Potential yield} - \text{Actual yield}}{\text{Potential yield}} \times 100$$

Suitable statistical tools such as Percentage analysis, cumulative frequency, Pearson's correlation coefficient and multiple regression analysis was used for the study.

The extent of adoption was measured by the scale followed by Adhiguru (1991) and the respondents were categorized in to low, medium and high based on cumulative frequency method.

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Table 1. Profile Characteristics of respondents

(n = 60)

Sl. No.	Variable	Number of respondents	Percentage
1.	**Age**		
	Young	8	13.33
	Middle	21	35.00
	Old	31	51.67
2.	**Educational Status**		
	Illiterate	0	0.00
	Can read only	3	5.00
	Can read and Write	3	5.00
	Primary level	5	8.33
	Middle level	12	20.00
	Secondary level	16	26.66
	Higher secondary level	11	18.34
	Collegiate level	10	16.67
3.	**Occupational status**		
	Agriculture as primary	52	86.67
	Agriculture as secondary	8	13.33
4.	**Farm Size**		
	Small	20	33.33
	Marginal	20	33.33
	Big	20	33.33
5.	**Area under rice cultivation**		
	Low	8	13.33
	Medium	9	15.00
	High	43	71.67
6.	**Experience in rice cultivation**		
	Low	3	5.00
	Medium	19	31.70
	High	38	63.30
7.	**Annual income**		
	Low	9	15.00
	Medium	34	56.67
	High	17	28.33

Sl. No.	Variable	Number of respondents	Percentage
8.	**Social Participation**		
	Low	35	58.33
	Medium	16	26.67
	High	9	15.00
9.	**Cropping Pattern**		
	Single season	52	86.67
	More than one season	8	13.33
10.	**Economic motivation**		
	Low	14	23.33
	Medium	20	33.33
	High	26	40.00
11.	**Farm Power Status**		
	Low	29	48.33
	Medium	22	36.67
	High	9	15.00
12.	**Extension Participation**		
	Low	19	31.67
	Medium	26	43.33
	High	15	25.00
13.	**Credit Orientation**		
	Low	14	23.33
	Medium	19	31.67
	High	27	45.00
14.	**Labour availability**		
	Low	24	49.00
	Medium	26	43.00
	High	10	16.67
15.	**Input availability**		
	Low	6	10.00
	Medium	14	23.33
	High	40	66.67
16.	**Information seeking behaviour**		
	Low	16	26.67
	Medium	24	40.00
	High	20	33.33

FINDINGS

A perusal of Table 1 revealed that majority of the respondents (51.67 per cent) were old, followed by 26.66 per cent in the secondary level of education and 86.67 per cent had agriculture as primary occupation. With respect to the area under rice cultivation, majority of the respondents (71.67 per cent) had higher area under rice cultivation. As far as the experience in rice cultivation was concerned, it could be observed from the table that most of the respondents (63.30 per cent) had high level of experience in rice cultivation, and with respect to the level of annual income, it was observed that a little more than half the total number of respondents (56.67 per cent) had medium level of annual income. An observed of the social participation of the respondents revealed that 58.33 per cent of the respondents had low level of social participation.

Further perusal of the table showed that 86.67 per cent practiced a single season of cropping pattern, 40.00 per cent had high level of economic motivation, 48.33 per cent had a low level of farm power status, 43.33 per cent had a medium level of extension participation, and 45.00 per cent had a high level of credit orientation.

The high level of credit orientation has been attributed to the presence of Primary Agricultural credit societies and Banking institutions which facilitated easy and timely disposal of crop loans. With respect to labour availability it was observed that 49.00 per cent of the respondents had a low level of labour availability. Further it could be observed from the table that 66.67 per cent of the respondents had a high level of input availability and 40.00 per cent of the respondents had a

Table 2. Adoption behaviour of farmers on recommended practices of Paddy cultivation

(n=60)

Sl. No.	Specific recommended practices in paddy cultivation	Adoption	
		Number	%
1.	Variety	60	100.00
2.	Optimum seed rate	60	100.00
3.	Seed treatment	60	100.00
4.	Plant population	40	66.67
5.	Soil testing	20	33.33
6.	Diammonium Phosphate to nursery	32	53.33
7.	Application of fertilizer based on soil testing	15	25.00
8.	Bio-fertilizer application	46	76.67
9.	Micro nutrient application (ZnSo4)	29	48.33
10.	Split application of fertilizer	52	86.67
11.	Integrated pest management	28	46.67
12.	Integrated nutrient management	31	51.67
13.	Integrated weed management	34	56.67
14.	Integrated water management	48	80.00
15.	Timely harvest	60	100.00

medium level of information seeking behaviour.

A perusal of Table 2 shows the adoption behaviour of farmers on recommended practices of paddy cultivation. It is evident from the table that there is a differential adoption of individual recommended practices i.e, cent per cent of the respondents had adopted the practices like improved variety, optimum seed rate, seed treatment and timely harvest. Most of the farmers had adopted the practices like split application of fertilizer (86.67%), integrated water management (80%) and bio-fertilizer application (76.67%). This may be due to the fact that more awareness on the high cost of fertilizers and less cost of bio-fertilizers and limited quantity of water for irrigation are the determining factors for adoption. The possible explanation may be put in terms of the fact that, the public extension system in the study area is distributing the required quantity of certified and foundation seed.

A great majority of the farmers had not adopted, fertilizers based on soil test, IPM and micro-nutrient application for lack of technical know-how, complexity of the practices, non-realization of

Table 3. Distribution of the respondents based on extent of adoption

Sl. No.	Specific recommended practices in paddy cultivation	Adoption	
		Number	%
1.	Low	14	23.33
2.	Medium	30	50.00
3.	High	16	26.67

importance of these practices. The findings of the study were in agreement with the findings of Rajasekhar (1986).

A perusal of Table 3 revealed that half of the total number of respondents studied (50.00 per cent) had a medium level of adoption followed by 26.27 per cent in the high adoption category, and

Table 4. Yield gap prevalent among various categories of farmers during Samba season

Sl. No.	Category	Yield gap (%)
1.	Marginal farmers	34.33
2.	Small farmers	24.20
3.	Big farmers	19.10
	Average Yield Gap (%)	25.88

23.33 per cent in the low adoption category.

An observation of Table 4 revealed the yield gap prevalent among various categories of farmers during the samba season. For the present study, the yield gap was computed for ADT-39, which had the maximum acreage in the study area during samba season. The table revealed that the yield gaps in the different categories of farmers varied from 19.10 per cent to 34.33 per cent. The yield gap per cent analysis revealed that a maximum gap of 34.33 per cent was found among marginal farmers while 24.21 per cent gap was noticed among big farmers. Overall it revealed that, an average yield gap of 25.88 per cent existed among all the respondents.

Further it could be observed that the yield obtained by the farmers varied from 39.00 q/ha to 78.00 q/ha. The highest percentage (30.00%) of the farmers obtained a yield of 58.50 q/ha. About 7.00 per cent of the respondents had obtained lowest yield of 39.00 q/ha, where as only 5.00 per cent of them had highest yield of 78.00 q/ha. Yield gap per cent was found to vary from 1.18 per cent to 50.59 per cent. However an average yield gap was found be 25.88 per cent.

A perusal of Table 6 revealed that out of the seventeen factors studied with respect to the yield gap in Paddy, critical factors such as low fertility of soil, high cost of agricultural inputs, contract system for transplanting, weeding and harvesting

Table 5. Distribution of the farmers based on yield gaps and paddy yield

Sl. No.	Yield obtained q/ha	No. of farmers	Percentage	Yield percentage
1.	39.00	4	6.67	50.59
2.	45.50	6	10.00	42.35
3.	52.00	7	11.67	34.12
4.	58.50	18	30.00	25.88
5.	65.00	14	23.33	17.65
6.	71.50	8	13.33	9.41
7.	78.00	3	5.00	1.18
Total	409.50	60	100.00	25.88

Average yield = 59.37 q/ha
Average yield gaps = 25.88%
Highest yield obtained by the cultivator = 78 q/ha
Lowest yield obtained by the cultivator = 39 q/ha
Potential yield of ADT-39 in western zone = 78.83 q/ha

Table 6. Relationship and influence of factors on yield gap of Paddy crop

Sl. No.	Variable / Factors	'r' value	Regression analysis		
			'B'	Standard error	't' value
1.	Inadequate irrigation water	0.615NS	13.715	11.357	1.316 NS
2.	Low fertility of soil	0.564**	15.695	7.630	2.003 NS
3.	Saline and alkaline problem soil	0.201NS	-12.354	9.994	-2.007 NS
4.	High cost of Agril. Inputs	0.600**	4.650	8.542	0.676 NS
5.	High rate of interest for credit	0.090NS	-0.304	1.726	-0.495 NS
6.	High cost of labour	0.030NS	-1.905	1.810	-1.567 NS
7.	Non-availability of human labour during peak season of planting and harvesting	0.072NS	3.807	8.167	0.436 NS
8.	Lack of proper and assured supply of electricity / fuel to oil enquire	0.096NS	2.909	20.002	0.376*
9.	Non-availability of high yielding variety for Samba	-0.091NS	1.502	17.780	0.127*
10.	Using own seeds for a number of years	0.017NS	0.964	9.363	0.207*
11.	Using of aged seedlings	0.153NS	12.651	5.572	2.884 NS
12.	Low plant population	0.156NS	-7.603	10.004	-0.947 NS
13.	Micro nutrient deficiency in soil	0.294*	23.667	12.605	2.224 NS
14.	Contract system for transplanting, weeding and harvesting operations	0.608**	-7.786	17.623	-0.745 NS
15.	Application of fertilizers not based on soil testing recommendation	0.493**	-8.345	6.346	2.348 NS
16.	Insecticide resistances in paddy pest	0.673**	13.846	32.758	-0.743NS
17.	Lack of adequate demonstration in paddy technologies	0.054	-19.557	26.779	-1.8047 NS

R^2 = 0.613 F = 3.867**
* = Significant at 0.05 level ** = Significant at 0.01 level
NS = Non significant

operation, application of fertilizers not based on soil testing recommendation and insecticide resistance in Paddy pests maintained positively and highly significant relationship with the yield gap in Paddy. Thus it could be inferred than low soil fertility, high cost of agricultural inputs, micronutrient deficiency in soil, contract system for transplanting, weeding and harvesting operation, application of fertilizers not based on soil testing recommendations and insecticide resistance in paddy pests increased the yield gap in paddy.

With respect to the influence of factors on the yield gap of paddy crop, it was observed that factors such as lack of proper and assured supply of electricity / fuel to oil engine, non-availability of high yielding variety for samba and sowing of own seeds for a number of years had positive and significant influence on the yield gap of paddy. This it could be explained that an increase in factors such as lack of proper and assured supply of electricity / fuel to oil engine, non-availability of high yielding variety for samba, and using own seeds for a number of years, were found to result in an increase of 0.376, 0.127 and 0.207 units respectively in the yield gap of paddy.

Table 7. Constraints faced by paddy farmers

(n=60)

Sl. No.	Constraints	No.	%	Rank
I.	**Biophysical Constraints**			
1.	Availability of improved variety	20	33.33	III
2.	Poor quality of seed	15	25.00	IV
3.	Adopting correct spacing	35	58.33	II
4.	Adopting specific fertilizer application	48	80.00	I
II.	**Biological Constraints**			
1.	Inadequate irrigation water	35	58.33	V
2.	Low population	38	63.33	IV
3.	Occurrence of weeds	45	75.00	II
4.	Higher pest incidence	39	65.00	III
5.	Inadequate organic matter	48	80.00	I
III.	**Socio-Economic constraints**			
1.	High cost of Labour	57	95.00	I
2.	Non-availability of credit	40	66.67	IV
3.	High rate of credit	42	70.00	III
4.	High cost of credit	56	93.33	II
5.	Non-availability of soil testing centre	20	33.33	VIII
6.	Non-availability of farming implements	30	50.00	
7.	Improper harvesting	25	41.67	VII
8.	Scattered land holding	32	53.33	V
9.	Lack of transport facilities	18	30.00	IX
IV.	**Other Constraints**			
1.	Absence of demonstration	34	56.67	II
2.	Lack of training facilities	36	60.00	I
3.	Lack of union	15	25.00	III

The constraints faced by the paddy farmers are enumerated in Table 7.

The major Bio-physical problems of farmers in the production of paddy were adopting specific fertilizer application, adopting correct spacing and non-availability of improved seeds and poor quality of seed. Majority of the farmers applied fertilizers on blanket recommendation due to their lack of awareness and knowledge about recommended fertilizers. Due to demand for labour, during peak period of crop, the major work like transplanting was carried out on contract basis. Hence maintaining the optimum plant population was perceived as a difficult task.

Major Biological constraints perceived by the farmers were inadequate organic matter, occurrence of weeds, higher pest incidence, low plant population and inadequate irrigation water. Due to lack of farm yard manure and green manuring farmers depend heavily on the indiscriminate application of inorganic fertilizers to maintain productivity of crop which leads to heavy occurrence of pests and diseases and also to deteriorating soil health.

Among the major socio-economic constraints perceived by the farmers were high cost of labour, high cost of inputs, high rate of credit, non-availability of credit and scattered land holding.

The problems like high cost of labour and input may be reduced by increasing the productivity. The high rate and non-availability of credit are to be tackled properly by the co-ordinated efforts of public extension personnel with the bankers, and by way of organizing workshop and seminar before the cropping season. Other constraints perceived by the farmers were absence of demonstration and lack of training facilities. These constraints were found to affect the dissemination of innovation and adoption of improved practices in paddy cultivation. The extension personnel can increase the number of training and demonstration programmes and seek to encourage and motivate farmers to participate and get the benefits out of them. The use of village knowledge centres and e-chaupals for speedy and effective dissemination of information among the farming community should be made use of.

CONCLUSIONS

Rice occupies a pivotal place in India's food security and livelihood system. The country has to produce about 135-140 million tons of rice by 2020 to meet its ever-increasing food requirements. The achievement of this target is no doubt a challenging task, but it is not unachievable keeping in mind the potential opportunities and avenues yet to be exploited in crop improvement research; and the utilization of the services of a well knit extension system for the speedy and effective dissemination of these improved technologies.

Consolidation of yield by correction of factors influencing of yield gap of paddy is however considered as the more promising short-term strategy.The study has clearly brought out the factors influencing the yield gap of paddy.

Ensuring free and assured supply of electricity to farmers, undertaking massive production and supply of good quality seeds for samba season, educating the farmers on the ill effects of using own seeds for a number of years successively, through the use of result demonstrations, and multimedia presentations are effective measures for narrowing this yield gap.

A number of factors were observed to have a positive and significant relationship with the yield gap of paddy. Problem of low fertility of soil could be solved by resorting to effective use of organic manure application. It was also observed that application of fertilizers not based on soil testing