



Yield gap analysis of Paddy in Tamil Nadu

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ARTICLE INFO	ABSTRACT
<p>Research Article Received on July 27, 2023 Revised on August 26, 2023 Accepted on September 17, 2023 Published on October 22, 2023</p> <p>Article Authors Kanaka, S., Subrahmaniyan, K.</p> <p>Corresponding Author Email kanaka.s@tnau.ac.in</p>	<p>Paddy cultivated in over 45,800 hectares in 24 districts including Tanjavur and Tiruvarur of Cauvery delta zone of Tamil Nadu. India has recorded an average Paddy productivity of 2.4. t/ha and Tamil Nadu has an yield level of over 3.15 t/ha on the year 2021 exceeding national level. Keeping in view of the production and productivity of Paddy at the national and state levels, and an in depth analysis of production and yield gap of ADT 43 at Cauvery delta zone were studied. The productivity ranged from 3638 Kg/ha in Tanjavur district to 5117 Kg/ha in Tiruvarur district with the mean productivity of 4435 Kg/ha in the Cauvery Delta Zone. (S and C report of GoTN) The mean yield gap in Cauvery delta Zone was 26.33%. The constraints to Paddy productivity included non-availability labour, late planting due to delayed water supply from metur dam and incidence of pests and diseases. The research study given that among the different categories of paddy growers, small farmers were found to have an average yield gap of 55.63 percent followed by medium farmers with an average yield gap of 30.35 percent and for large farmers, the average yield gap was found to be 20.25 %. The R-squared value (R²) is provided as 0.524, which indicates the proportion of variance in the yield gap that is explained by the factors included in the regression model. The F-statistic is given as 3.404**, which is a test of overall significance for the regression model. These results suggests that the cost of inputs, using own seeds on multiple years, and chemical pesticide usage are significant factors influencing the yield gap in paddy cultivation, while non-availability of labor and not following soil testing recommendations are not significant factors in this analysis.</p>
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Cauvery delta place of Tamil Nadu is considered as "Nerkalanchiyam" (Land of Paddy cultivation). Paddy cultivation in the Cauvery delta is around 3,61,855 hectares during the current season of Samba-Thaladi-Pishanamr. The overall coverage for the State is around 12.95 lakh hectares this time against about 13.19 lakh hectares in the previous year. As a result, rice production is estimated to be around 78 lakh tonnes, down from about 80 lakh tonnes last year. In view of the unseasonal rainfall in parts of the delta, rice production may dip further. India has recorded an average rice productivity of 2.4 t/ha and Tamil Nadu has a yield level of over 3.0 t/ha exceeding national

level. Keeping in view of the production and productivity of rice at the national and state levels, and an in depth analysis of production and yield gap at Cauvery delta zone were studied. The productivity ranged from 3630 Kg/ ha in Nagappattinam district to 5019 Kg/ ha in Ariyalur district with the mean productivity of 4420 Kg/ ha in the Cauvery Delta Zone. The mean yield gap in Cauvery delta Zone was 26.33 %. The constraints to rice productivity included shrinking labour availability (99.16%), late planting due to delayed water supply from canals (93.75%), water scarcity (91.67%), salinity/ alkalinity and incidence of pests and diseases (76.67%) (Vasanthakumar, 2017).

Introduction of high yielding variety seeds like IR8 and IR20 as a part of green revolution has increased the agricultural production in the district during 1960s. The district consists of 3.39 lakh Hectare geographical area of which the net sown area constitutes 2.69 lakh Hectare. The major sources of irrigation are canals, Tanks and wells Cauvery, Vennar and Grand Anicut prove to be source of canal irrigation in the district. Over the years, the problems of non-availability of water, farmers' suicide and industrial projects have been increasing in the area. Yield gap analysis is an essential tool for improving agricultural productivity and food security. By identifying and addressing the factors limiting paddy yield in Tamil Nadu, we can contribute to the sustainable development of agriculture in the region. A yield gap analysis for paddy crop in Tamil Nadu would involve assessing the difference between the potential or attainable yield and the actual yield of paddy in the region. This analysis helps identify factors that limit crop productivity and can inform strategies to bridge the yield gap.

Objectives

- To estimate the yield gap prevailing on popular rice varieties
- To study the factors influencing yield gap as perceived by the farmers

Methodology

The research was undertaken to study the yield gap analysis among the rice growers of the Cauvery Delta zone of Thanjavur district. Among the 14 blocks of Thanjavur Papanasam block was selected purposively. In Papanasam block Aduthurai village was selected for the study, because Tamil Nadu Rice Research Institute of TNAU is located in the village and the institute is released many varieties and practices improved agronomic and climate resilient technologies in the farmer's field. 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 1 dependent variable namely yield gap, were selected for the study. The independent variables were measured using standardized scoring procedure. The dependent variable yield gap was measured using the formula.

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

A suitable statistical tool such as Percentage analysis, Cumulative frequency, Pearson's correlation coefficient and multiple regression analysis was used for the study. The average yield gap was assessed for kuruvai season, for ADT - 43 varieties, separately for marginal, small and big farmer category and the total average yield gap were found out.

Results and Discussion

Profile Characteristics of Sample Farmers

This table 1 provides a comprehensive overview of the characteristics of paddy cultivators, including their demographics, farming related factors and access to resources. As could be observed from table 1, were old (42 %), large number of respondents had completed school level education (65 %) and having the primary occupation is farming (91.67%). It could be further observed from the table, that farm size, small, medium and large farmers were selected 20 numbers in each category purposively. As per the farming experience of the paddy, growers were concerned, it could be seen from the table, that 42 % of farmers had an more than 30 years of experience. With respect to cropping pattern, it could be observed that cent percent of the paddy growers practiced a single crop of paddy in kuruvai season at Cauvery delta zone and 53 % of farmers who are practiced a double crop of paddy.

As per as the input availability were concerned, it could be see that 41.67 % of the paddy growers had a medium level of input availability, followed by 33.33 % in the high level and only 25 % fell in low level of input availability. This would attribute to the active involvement of rice research institute in district. When we could be seen from the table the information seeking behavior was concerned 36.67 % of the respondents belonged to both high and medium level of information seeking behavior followed by 26.66 % in low level. With respect to the credit, orientation behaviors 48.33 % of the respondents belonged to the medium category of credit orientation followed by 38.33 % in the high category of the credit orientation and only 13.34 % had a low level of credit orientation.

Table 1. Profile characteristics of Paddy Cultivators

S. N.	Variable/ Categories	Paddy Cultivators	
		Number	Percentage
1	Age		
	Young	16	28
	Middle	18	30
	Old	26	42
2	Education		
	Illiterate	9	15
	School Level	39	65
	Graduate Level	12	20
3	Occupation		
	Farming is Primary	55	91.67
	Farming and Business/Employee	5	8.33
4	Farm Size		
	Small	20	33.34
	Medium	20	33.33
	Large	20	33.33
5	Farming Experience		
	More than 30 years	26	42
	30 to 15 years	18	30
	Less than 15 years	16	28
6	Cropping Pattern		
	Paddy	60	100
	Paddy-Paddy	32	53.33
7	Input Availability		
	Low	15	25.00
	Medium	25	41.67
	High	20	33.33
8	Information seeking behaviour		
	Low	16	26.66
	Medium	22	36.67
	High	22	36.67
9	Credit Orientation		
	Low	8	13.34
	Medium	29	48.33
	High	23	38.33
10	Labour Availability		
	Low	15	25.00
	Medium	41	68.33
	High	4	6.67

As far as the labour availability was concerned, it could be observed that most of the respondents (68.33%) had medium level of labour availability, followed by level 25 % and 6.67 % fell in the high level of labour availability.

Yield Gap Assessment for Kuruvai Season Paddy

The average yield gap for the kuruvai season paddy was studied with the popular paddy variety of ADT 43 and the results were presented in table 2. From the table could be observed that among the different categories of paddy growers.

The small farmers were found to have an average yield gap of 55.63 % followed by medium farmers with an average yield gap of 30.35 % and for large farmers, the average yield gap was found to be 20.25 %. This might be, because of small farmers by virtue of their economic status, could not adopt the advanced technologies in paddy cultivation. Besides it was found, during the study that large and medium farmers had access to irrigation facilities like bore wells, small farmers could not afford the that type of resources and this could have contributed to the existence of a wide yield gap among this category.

S. N.	Category	Season	Variety	Average Yield Gap in %
1	Small	Kuruvai	ADT-	55.63
2	Medium		43	30.35
3	Large			20.25

Table 3. Factors influencing for Yield Gap

S. N.	Factors	Correlation Coefficient
1	Delayed opening of dam water for kuruvai season	0.563**
2	Non Availability of Labour	-0.301*
3	Using Own seeds on multiple years	0.142
4	Aged seedlings	0.130
5	Not followed soil testing recommendation for fertilizer application	0.142
6	Cost of Inputs	0.296*
7	Chemical pesticide Usage	0.154

Note: **-Correlation is significant at 0.01 levels,*Correlation is significant at 0.05 levels

Delayed Opening of Dam Water for Kuruvai Season

This factor has a correlation coefficient of 0.563**, which indicates a significant positive correlation with the yield gap. In other words, a delayed opening of dam water is associated with a higher yield gap.

Non-Availability of Labour

This factor has a correlation coefficient of -0.301*, indicating a significant negative correlation with the yield gap. Non-availability of labor is associated with a lower yield gap.

Using Own Seeds on Multiple Years

This factor has a correlation coefficient of 0.142, which suggests a positive but not very strong correlation with the yield gap.

The table 3 appears to provide information about factors that influence the yield gap in paddy cultivation, along with their correlation coefficients. Here's a breakdown of the information in the table 3 as factors influencing yield gap. Factors column lists the factors that are believed to influence the yield gap in paddy cultivation. Correlation coefficient column indicates the correlation coefficient for each factor, which measures the strength and direction of the relationship between that factor and the yield gap. The correlation coefficient ranges from 1 to 1, with -1 indicating a perfect negative correlation, 1 indicating a perfect positive correlation, and 0 indicating no correlation. Asterisks, with more asterisks indicating higher significance, often denote the significance of the correlation.

The Summary of the Factors and their Correlation Coefficients:

Aged Seedlings

This factor has a correlation coefficient of 0.130, indicating a positive correlation with the yield gap.

Not Following Soil Testing Recommendations for Fertilizer Application

This factor has a correlation coefficient of 0.142, similar to factor 3. It suggests a positive correlation with the yield gap.

Cost of Inputs

This factor has a correlation coefficient of 0.296*, indicating a significant positive correlation with the yield gap. Higher input costs are associated with a higher yield gap.

Chemical Pesticide Usage

This factor has a correlation coefficient of 0.154, indicating a positive correlation with the yield gap, but it is not highly significant. This table provides valuable insights into the factors that may be contributing to the yield gap in paddy cultivation and the strength of their relationships.

Multiple Regression Analysis of Factors Influencing the Yield Gap of Paddy

Table 4 appears to present the results of a multiple regression analysis that aims to identify factors influencing the yield gap in paddy cultivation. The table provides information about the factors, their partial coefficients, standard errors, 't' values and significance levels. Here is a breakdown of the information in the table. Factors column lists the factors that were considered in the analysis. Partial Coefficient column represents the partial regression coefficients for each factor.

These coefficients indicate the strength and direction of the relationship between each factor and the yield gap while controlling for other factors. Standard Error (SE) column provides the standard error associated with each partial coefficient. It helps assess the precision of the coefficient estimates. The 't' Value column shows the 't' values associated with each partial coefficient. The 't' value is used to test the significance of each coefficient in the regression model. The R-squared value (R²) is provided as 0.524, which indicates the proportion of variance in the yield gap that is explained by the factors included in the regression model. The F-statistic is given as 3.404**, which is a test of overall significance for the regression model. These results suggests that the cost of inputs, using own seeds on multiple years, and chemical pesticide usage are significant factors influencing the yield gap in paddy cultivation, while non-availability of labor and not following soil testing recommendations are not significant factors in this analysis.

Table 4. Multiple Regression Analysis of factors influencing the yield gap of Paddy

S. N.	Factors	Partial Coefficient (b)	SE (b)	't' value
1	Cost of inputs	0.560	0.195	2.92**
2	Non Availability of Labour	-0.092	13.20	0.007
3	Using Own seeds on multiple years	0.304	0.113	2.65**
4	Not followed soil testing recommendation for fertilizer application	0.063	7.25	0.0087
5	Chemical pesticide Usage	0.0320	0.104	3.03**

Note: *- Significant at 5 percent level, **-Significant at 1 percent level, R² - 0.524, F-3.404**

Conclusion

Understanding the factors contributing to the yield gap in paddy cultivation in a specific region like Cauvery delta zone is crucial for agricultural planning and improvement. By conducting a multiple regression analysis like the one presented in the table, researchers and policymakers can identify which factors have the most significant impact on paddy yields in that particular region. Here's why this analysis might be conducted for the yield gap of paddy in Tamil Nadu:

Regional Variation

Agricultural conditions, practices and challenges are varying significantly from one region to another.

What affects paddy yields in Tamil Nadu may not be the same as in other regions. Therefore, it's important to conduct a region-specific analysis to understand the unique factors at play.

Policy Planning

Identifying the factors that influence the yield gap allows policymakers and agricultural authorities to design targeted interventions and policies to address these factors. For example, if the cost of inputs is a significant factor, measures to reduce input costs or provide subsidies may be considered.

Improving Farming Practices

Farmers can benefit from this analysis by understanding which practices are positively or negatively associated with yield gaps.

They can then make informed decisions about their farming practices to improve yields and profitability.

Resource Allocation

Limited resources, such as labor, water, and fertilizer, need to be allocated efficiently. Knowing which factors have the most significant impact helps in prioritizing resource allocation for maximum yield improvement.

Research and Extension Services

Agricultural research institutions and extension services can focus their efforts on providing information, technology and training related to the most critical factors identified in the analysis.

In summary, conducting a multiple regression analysis to determine the factors influencing the yield gap of paddy in Cauvery Delta zone (or any specific region) is a valuable step toward improving agricultural productivity, sustainability, and the livelihoods of farmers in that area. It helps stakeholders make data driven decisions and implement targeted strategies for agricultural development.

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