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Impact of PMKISAN Scheme on Production and Efficiency of Paddy Cultivation in Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors equally shared in the development of the paper. All authors read and approved the final manuscript.

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ABSTRACT

Aims: This study aimed to estimate the impact of Direct Cash Transfer scheme on production and technical efficiency of paddy cultivation.
Study Design: Multi-stage random sampling was used.
Place and Duration of Study: Sample: Three districts namely Dharmapuri, Thoothukudi and Thanjavur were randomly selected for the study during December 2021-March 2022.
Methodology: Both primary and secondary were used in the study. A pre-tested interview schedule was used to collect the information on general characteristics, cost of cultivation and

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resource inputs used were collected from 90 beneficiaries and 90 non-beneficiaries. Thus, a total of 180 sample respondents.

Results: Of the total PMKISAN assistance (Rs. 6000) about 5.16% (Rs. 3300) of the amount has been spent for cultivation purpose. The average cost of cultivation among the beneficiaries was lesser than non-beneficiaries and the net returns were more among the beneficiary than the non-beneficiary. The major share of operational cost incurred in paddy cultivation for beneficiaries and non-beneficiaries was towards human labour followed by machine labour and fertilizer cost. The estimated mean technical efficiency for PMKISAN beneficiaries was 84% and there is a chance of improvement for increase in yield. The difference in yield and technical efficiency may be due to assistance provided to the farmers, through which the cost of cultivation was less and were able to adopt new technologies.

Conclusion: Overall, the PMKISAN beneficiaries were able to use the PMKISAN assistance for procuring seeds, fertilizers and wages for labour. The beneficiaries were technically efficient in paddy production and also the cost of cultivation was lesser when compared to non-beneficiaries.

Keywords: PMKISN; technical efficiency; cost of cultivation; impact; paddy; direct cash transfer.

1. INTRODUCTION

Government of India had implemented various schemes like National Food Security Mission (NFSM), PMKISAN, Pradhan Mantri Fasal Bima Yojana (PMFBY) and National Mission for Sustainable Agriculture (NMSA) for providing inputs, machineries and tools at subsidized rates, insurance cover to reduce loss due to natural calamities. Apart from subsidies, price and income support programmes are also provided to the farmers to overcome the farm distress and to double the farmers income. 76% of the total agriculture budget is proposed towards PMKISAN, PMFBY and interest subsidy on short term credit. The Government spending towards PMKISAN had increased in successive years from Rs. 20,000 crores during 2018-19 to Rs. 65,000 in 2021-22. PMKISAN (PM Kisan Samman Nidhi) a direct cash transfer scheme was implemented by Government of India to supplement income to the farmers, a sum of Rs. 6000 is paid in three installments to the farmers through direct benefit transfer. Over 12 crores registered farmers have been benefiting from PMKISAN scheme. The scheme was intended at providing social security to marginal and small farmers through supplementing financial needs of the farmers in procuring inputs like seeds, fertilizers etc., Rice is one of the important staple food crops providing nutrition for peoples in India as well as for half of the world's population [1]. In India, about 45 million hectares of land was under paddy cultivation with estimated total production of 129.66 million tonnes during 2021-22. Majority of the farmers (86.08%) in India have marginal and small operational land holdings [2]. Based on the Situation Assessment Survey [3] about 56% of agricultural households in India were cultivating paddy crop and the average gross cropped area under paddy crop per household was 0.61 hectares. With emerging food demand, increasing the productivity with limited resource availability is at great concern. Thus, increasing the productivity can be possible through adoption of new technologies [4,5] which are not affordable by marginal and small farmers. The average monthly income of the agricultural households was Rs. 10218 [3]. Swaminathan and Bhavani [6] suggest that factor productivity will have to be doubled, if the cost of production is to be reduced and the prices of farm products are to be made competitive and farming remunerative. Various scheme implemented by Government of India is to provide farmers inputs at subsidized rate, to adopt the technologies which would help in reducing the cost of cultivation and also to increase productivity. For attaining the resource productivity measurement of technical efficiency is important for the simple reason that it is one of the factors that contributes to an increase in productivity. Economics is an important concept in production economics when resources are constrained and opportunities of adopting better technologies are competitive [7]. To achieve the productivity, it is essential to measure technical and resource use efficiency. Efficiency refers to how close a production unit is to best possible frontier of production; the ratio of output to the level of input used is the technical efficiency [8]. Some major efficiency studies on paddy farming in India show the non-profitable status across various states of India. In Rajasthan, the share of operational and fixed costs increases in the same proportion in the total cost of cultivation [9]. The reports of the

Commission of Agriculture Cost and Prices (CACP) accentuated the fact that in some of the major paddy-producing states like Kerala, Tamil Nadu and Odisha, profitability hovered around ten percent in 1999–2000 and 2010–2011; the varying degree of loss was reported in other periods [10]. The main objective of the study is to estimate resource productivity of inputs in rice cultivation among beneficiaries and non-beneficiaries which will help in understanding of use of inputs for rice production and to find whether there is a significant difference among them. Hence, an attempt has been made to study the technical efficiency and cost of cultivation between PMKISAN beneficiaries and non-beneficiaries.

2. METHODOLOGY

For the study, districts like Dharmapuri, Thoothukudi and Thanjavur were randomly chosen from different zones which represents socio-economic diversities of the state and also to provide an overall picture of the impact of PMKISAN assistance in increasing the efficiency and income of the beneficiaries. From each district, one block and from each block two villages were randomly selected. Separate beneficiaries and non-beneficiaries were selected, of which 90 samples were beneficiaries and 90 other samples were non-beneficiaries. Thus, making a total of 180 sample households. Based on the pre-tested interview schedule the data on cost of cultivation, inputs used were collected and processed.

2.1 Cost Concepts

Cost concepts was used to study the economics of cultivation between beneficiaries and non-beneficiaries.

Cost A1: Value of hired human labour
Value of hired and owned bullock labour
Value of hired and owned machine labour
Value of owned and purchased seed
Value of fertilizers, manures and Chemicals
Value of pesticides and insecticide
Expenditure on irrigation
Land revenue and taxes
Interest paid on crop loan if taken
Depreciation on farm assets excluding land
Interest on working capital
Miscellaneous expenses

Cost A2: Cost A1 + rent paid for leased in land

Cost B1: Cost A2 + interest on value of owned fixed capital assets

Cost B2: Cost B1 + rental value of owned land

Cost C1: Cost B1 + imputed value of family labour

Cost C2: Cost B2 + imputed value of family labour

Cost C3: Cost C2 + 10% of cost on account of managerial function performed by farmer

Income measure:

Gross income = (quantity of main product * price of main product) + (quantity of by product * price of by product)

Net income = Gross income – Cost C

Benefit Cost Ratio = Gross income / cost of cultivation

2.2 Technical Efficiency

The technical efficiency among beneficiaries and non-beneficiaries was estimated using the stochastic frontier production function. The Cobb-Douglas production function was used with the inclusion of dummy variable to represent the beneficiaries and non-beneficiaries. The Cobb-Douglas production function was used employed to measure the resource productivity. However, Cobb-Douglas production function does not distinguish between the technical and allocative efficiency. Technical efficiency is the maximum possible output that one can attain from a given use of inputs. Frontier production function represents the maximum possible output from given set of inputs. Deviation of a farm from the frontier indicates the farm's degree of technical efficiency [11]. Denis et al. [12] developed stochastic frontier model from which one can estimate both the technical and allocative efficiency [13]. Trimmer [14] developed a concept of imposing the Cobb-Douglas production function into a frontier which give an output-based efficiency measure. For the current study stochastic frontier production function approach proposed by Battese and Coelli [15] was used in which the specific parameters are estimated in maximum likelihood (ML). The function is

$$\ln y = \ln a + b1 \ln X1 + b2 \ln X2 + b3 \ln X3 + b4 \ln X4 + b5 \ln X5 + b6 \ln X6 + b7 \ln X7 + \ln U$$

Where,

Y	=	Yield (Kg/ha)
X1	=	Seed rate (Kg/ha)
X2	=	Farm Yard Manure (tonnes/ha)
X3	=	Nitrogenous fertilizers (Kg/ha)
X4	=	Phosphatic fertilizers (Kg/ha)
X5	=	Potassic fertilizers (Kg/ha)
X6	=	Plant Protection Chemicals (Kg/ha)
X7	=	Human labour (man days/ha)
X8	=	Machine labour
ε	=	Error term
bi	=	Output elasticity

The error term is composed of two parts one being symmetric normally distributed and another random errors.

$$\varepsilon_i = v_i - s u_i$$

The farm specific technical efficiency (TE) are computed by taking the exponential of the negative of u_i that is

$$TE = \exp(-u_i)$$

As u_i is non-negative, the technical efficiency can take a maximum value of one and minimum value of zero. The sample respondents were categorised into low, medium and high efficiency group based on the mean and standard deviation [16].

3. RESULTS AND DISCUSSION

3.1 Benefit Cost Analysis of PMKISAN Beneficiaries and Non-beneficiaries

The cost of cultivation was calculated for the beneficiary and non-beneficiary farmers (Table 1). The cost meet out from PMKISAN assistance is excluded while calculating cost of cultivation for beneficiaries. The results indicate that the paddy yield was higher for beneficiaries (47.50 quintal/ha) when compared to non-beneficiaries (46.50 quintal/ha). The average cost of cultivation among the beneficiaries was Rs. 64594/ha which was lesser than non-beneficiaries (Rs. 67924/ha). The average net returns were more among the beneficiary (Rs. 23281/ha) than the non-beneficiary (Rs. 18101) and the benefit cost ratio was also found higher for beneficiaries (1.36) than the non-beneficiaries (1.27). The share of human labour was highest in total cost which accounted 39.40% for beneficiaries and 37.67% for non-beneficiaries followed by machine labour which accounts for 11.35% for beneficiaries and 11.78% for non-beneficiaries. The major share of operational cost incurred in paddy cultivation for beneficiaries and non-beneficiaries was towards human labour followed by machine labour and fertilizer cost.

The expenditure made through the PMKISAN assistance is presented in Table 2. Of the total PMKISAN assistance (Rs. 6000) about 5.16% (Rs. 3300) of the amount has been spent for cultivation purpose. Most of the beneficiaries had spent the cash transfer amount towards procuring seeds, fertilizers and for paying wages incurred during intercultural operations. About Rs. 1100 (18.33 %) was spent towards buying of seeds followed by Rs. 950 (15.83 %) was spent for human labour wages, 12.50% was spent for purchase of fertilizers (Rs. 750) and 8.83% for machine labour wages (Rs. 530). Overall, the results indicate that due to cash transfer the cost of cultivation was lesser (Rs. 3330/ha) for beneficiaries than the non-beneficiaries in paddy cultivation which had an increase in net returns of Rs. 5180 per hectare.

3.2 Technical Efficiency

The production function analysis for PMKISAN beneficiaries and non-beneficiaries has been estimated and are presented in Table 3. The variables like machine labour, human labour and plant protection chemicals are positively significant on yield. Whereas, nitrogenous fertilizer and seed are negatively significant on yield. For increase in inputs like seed and nitrogenous fertilizers would reduce the yield by 0.15 and 0.43 per cent. Whereas increase in use of inputs like plant protection chemicals, machine labour and human labour would increase the yield by 0.2, 0.53 and 0.37 per cent respectively. The dummy variable has been included in the function so as to represent whether the respondent is beneficiary or non-beneficiary. The dummy variable is significant indicating that there is a difference in the efficiency between the beneficiaries and non-beneficiaries. The value of $\square^2_u$ was found to be greater than $\square^2_v$ and variance ratio greater than one indicating that the difference between observed and frontier yield were also due to technical inefficiency of the farmers. The estimated mean technical efficiency for PMKISAN beneficiaries was 84% indicating that the beneficiaries had realized 84% of their technical ability. There is a chance of

improvement for increase in yield by 16 per cent. The mean technical efficiency of the non-beneficiaries was 72% indicating that there is 28% chance of increasing the yield. The results indicate that the beneficiaries are more technical efficient than the non-beneficiaries.

3.2.1 Distribution of technical efficiency

The technical efficiency was categorized into three categories viz., low (< 70), medium (70-86) and high technical efficiency (>86). About 63.33% of the beneficiaries fall under medium level of technical efficiency and 33.67% fall under high level of technical efficiency. Whereas, majority of non-beneficiaries fall under the category of medium efficiency group (70%) and 30% under low efficiency group. The results indicate that there is a greater chance to increase the yield by increasing the efficiency level among the non-beneficiaries.

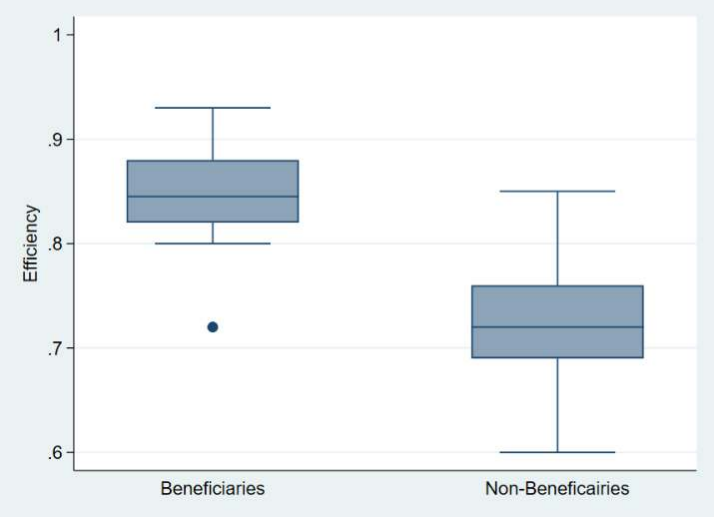

Fig. 1. Technical efficiency distribution of beneficiaries and non-beneficiaries

Table 1. Cost of cultivation of paddy (Rs/ha)

S. No.	Particulars	PMKISAN	
		Beneficiary	Non-beneficiary
1.	**Operational cost**		
	Seed	1450 (2.24)	1880 (2.77)
	FYM	3200 (4.95)	3630 (5.34)
	Cost of fertilizers	6600 (10.22)	7060 (10.39)
	Plant protection chemicals	2900 (4.49)	3507 (5.16)
	Human labour	24850 (38.47)	25587 (37.67)
	Machine labour	7500 (11.61)	8000 (11.78)
	Interest on working capital	3487 (5.40)	3759 (5.53)
Total operational cost		**49987 (77.39)**	**53879 (78.65)**
2.	**Fixed cost**		
	Land tax	12 (0.02)	12 (0.02)
	Rental value of land	13000 (20.13)	13000 (19.14)
	Depreciation	513 (0.79)	415 (0.61)
	Interest on fixed capital	1082 (1.68)	1041 (1.58)
Total fixed cost		**14607 (22.61)**	**14501 (21.35)**
3.	**Total cost**	**64594 (100.00)**	**67924 (100.0)**
4.	Yield (q/ha)	47.50	46.50
5.	Gross income	87875	86025
6.	**Net returns**	**23281**	**18101**
7.	**Benefit and cost ratio**	**1.36**	**1.27**

(Figures in the parenthesis indicate percentage to total cost)

Table 2. Share of cash transfer in total cost of cultivation

S. No	Particulars	Amount (Rs.)
1.	Purchase of Seeds	1100 (18.30)
2.	Purchase of Fertilizer	750 (12.50)
3.	Human labour wages	950 (15.83)
4.	Machine labour wages	530 (8.83)
Total cash transfer spending (Rs.)		**3330 (55.60)**
Total cash transfer (Rs.)		**6000 (100.00)**

(Figures in the parenthesis indicate percentage to total cost)

Table 3. Maximum likelihood estimates in stochastic frontier production function for paddy

S. No	Particulars	Coefficient	z-value	*P*-value
1.	Intercept	4.22*	0.96*	0.034
2.	Seed rate (Kg/ha)	-0.15***	-2.97***	0.003
3.	Farm Yard Manure (tonnes/ha)	0.03	0.96NS	0.605
4.	Nitrogenous fertilizers (Kg/ha)	-0.43***	-3.09***	0.000
5.	Phosphatic fertilizers (Kg/ha)	-0.02	-0.49NS	0.901
6.	Potassic fertilizers (Kg/ha)	-0.03	-0.20NS	0.819
7.	Plant Protection Chemicals (Kg/ha)	0.200*	3.35*	0.038
8.	Human labour (man days/ha)	0.37***	4.77***	0.006
9.	Machine hours	0.53***	5.63***	0.000
	Dummy	0.28***		
	Lambda	1.40		
	$Sigma^2v$	0.12		
	$Sigma^2u$	0.16		
	$Sigma^2$	0.04		
	Log likelihood	20.00		
	Technical efficiency (beneficiaries)	**0.84**		
	Technical efficiency (non-beneficiaries)	**0.72**		

*Note NS= Insignificant; ***=Significant at 0.001; **= Significant at 0.01; *= Significant at 0.05 level of probability*

Table 4. Distribution of technical efficiency among beneficiaries and non-beneficiaries

S. No.	Technical Efficiency	Beneficiaries	Non-Beneficiaries
1.	Low efficiency (<70)	0	27 (30.00)
2.	Medium efficiency (70-86)	57 (63.33)	63 (70.00)
3.	High efficiency (>86)	33 (36.67)	0
Total		**90 (100.00)**	**90 (100.00)**

(Figures in parenthesis indicates percentage to the total)

4. CONCLUSION

PMKISAN scheme was implemented to supplement the income to the farmers in procuring the seeds, fertilizers etc. The results indicate that the PMKISAN beneficiaries had utilized the money assistance for production and the yield was higher for beneficiaries (47.50 quintal/ha) when compared to non-beneficiaries (46.50 quintal/ha). The average cost of cultivation among the beneficiaries (Rs. 64594/ha) was lesser compared to non-beneficiaries (Rs. 67924/ha). The average net returns obtained by beneficiaries are higher (Rs. 23281/ha) than the non-beneficiary (Rs. 18101). The estimated mean technical efficiency for PMKISAN beneficiaries (84%) was found higher than the non-beneficiaries (72%) indicating that the beneficiaries had realized 86% of their technical ability. It concludes that PMKISAN assistance had reduced the cost of cultivation of farmers and also adoption of technologies had significantly increased the yield among the beneficiaries.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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