International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 5, 2023, pp.-12347-12349.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Research Article

IMPACT OF SWARNA (MTU-7029) RICE VARIETY ON YIELD AND INCOME OF FARMERS IN GODAVARI ZONE OF ANDHRA PRADESH

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Received: February 25, 2023; Revised: May 26, 2023; Accepted: May 28, 2023; Published: May 30, 2023

Abstract: The present study was conducted on impact of Swarna (MTU-7029) rice variety on yield and income of farmers in Godavari zone of Andhra Pradesh was analyzed by employing decomposition analysis. Multistage sampling method was adopted for the sample selection. A total of 160 sample were selected for this study. A well-structured questionnaire was used for data collection. The decomposition analysis results showed that per hectare yield and income of Swarna (MTU-7029) rice variety adopter farmers were found that 26.53 and 15.15 per cent, respectively higher than that of non-adopter farmers. The technology component was contributing 18.04 and 9.35 per cent increase in the total yield and income. The total contribution of changes in the levels of input use to the outcome differences between the two groups was 8.48 and 5.80 per cent, respectively.

Keywords: *Decomposition, Swarna (MTU-7029), Yield, Income and Godavari zone*

Citation: S. Prasanthi, *et al*., (2023) Impact of Swarna (MTU-7029) Rice Variety on Yield and Income of Farmers in Godavari Zone of Andhra Pradesh. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 5, pp.- 12347-12349.

Introduction

Rice is the staple food for about 800 million people in India, which constitutes about 65 per cent of its population. Its role is detrimental to the nutrition, economy, employment, culture and history. Rice contributes approximately 40 per cent of India's total food grain production (NRRI, 2020) [1]. India has 439.03 lakh hectares of area with a production of 1158.9 lakh tonnes and with a productivity of 2647 kg ha-1 (TE 2019-20). In India, Andhra Pradesh stands third in rice cultivation with a production of 12 per cent in the country [2]. In Andhra Pradesh rice is the major crop cultivated in gross area of more than 22.61 lakh hectares and production of 129.18 lakh tonnes and with a productivity of 5711 kg ha-1 (TE 2019-20). The districts of West Godavari and East Godavari, which are considered as rice bowl of Andhra Pradesh [3]. In the Godavari zone, rice is grown in 7.81 lakh hectares with a production of 51.17 lakh tonnes with a productivity of 6552 kg ha-1 (TE 2019-20). In Godavari zone, A.N.G.R.A.U released rice varieties like MTU-7029, MTU-1064, MTU-1061, MTU-1121 and RGL-2537 were widely cultivated in kharif season. In that, Swarna (MTU-7029) rice variety is cultivated in around 1.85 lakh ha with a share of 51.65 per cent. The main objective of the study was to analyse the impact of Swarna (MTU-7029) rice variety on yield and income of farmers in Godavari zone of Andhra Pradesh [4-7].

Materials and Methods

Multistage sampling technique was employed for this study. The study was conducted in Godavari zone of Andhra Pradesh. Godavari zone was purposively selected for this study, because it is having 7.81 lakh hectares of area under rice cultivation (TE-2019-20). Godavari zone consists of East and West Godavari districts. From each district two mandals were selected based on the highest area under Swarna (MTU-7029) rice variety. From East Godavari district, Samalkot & Kajuluru mandals and from West Godavari district, Nidadavole & Pentapadu mandals were selected. From each mandal, two villages were selected for this study. Thus, a total of eight villages were selected based on the highest area under Swarna (MTU-7029) rice variety. From each village, 10 adopter and 10 non-adopter farmers were selected randomly, by making a total sample size of 160 farmers comprising 80 adopters and 80 non-adopters. The data pertains to the year 2021-2022. The farmers were interviewed using well-structured questionnaire and the data was analysed by employing decomposition analysis [8-10].

Decomposition Analysis

Impact of Swarna (MTU-7029) rice variety on yield of farmers

The Decomposition analysis model developed by Bisaliah (1977) [11] was used to analyse the impact of Swarna (MTU-7029) rice variety on the yield of farmers. For any two production functions, the total change in the productivity could be brought out by shifts in the production parameters that defined the production function itself and by the changes in the input-use levels. Therefore, the production functions are considered as the convenient econometric models for decomposing the productivity difference. The Cobb-Douglas type of production function used was specified as follows

$$\ln Y = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b4 \ln X4 + b5 \ln X5 + ui \quad (1)$$

were,

Y=Dependent variable, Y1: Adopter of Swarna (MTU-7029) rice variety and Y_2: Non-Adopter of Swarna (MTU-7029) rice variety

Y = Yield (q ha-1)

X_1 = Human labour (Rs. ha ¯1)

X_2 = Machine power (Rs. ha ¯1)

X_3 = Cost of seed (Rs. ha ¯1)

X_4 = Plant protection chemicals (Rs. ha ¯1)

X_5 = Fertilizers (Rs. ha-1)

bj = Regression Co-efficient (j= 0,1,2, -, n)

ui = Error term.

The output decomposition model used in this study was,

$\ln Y_1 = \ln b_{01} + b_{11} \ln X_{11} + b_{21} \ln X_{21} + b_{31} \ln X_{31} + b_{41} \ln X_{41} + b5_1 \ln X5_1 + u_1$ (2)

$\ln Y_2 = \ln b_{02} + b_{12} \ln X_{12} + b_{22} \ln X_{22} + b_{32} \ln X_{32} + b_{42} \ln X_{42} + b5_2 \ln X5_2 + u_2$ (3)

where, Y, X_1, X_2, X_3, X_4, X5, bj and ui are denoted in Equation (1). However, Equations (2) and (3) represents adopter and non-adopter of Swarna (MTU-7029) rice variety farmers regression functions, respectively. The differences between the above two equations (2) and (3) gives the technology impact, as follows.,

$(\ln Y_1 - \ln Y_2) = \ln (Y_1/Y_2) = \ln (b_{01}/ b_{02}) + \{(b_{11} - b_{12}) \ln X_{12} + (b_{21} - b_{22}) \ln X_{22} + (b_{31} - b_{32}) \ln X_{32} + (b_{41} - b_{42}) \ln X_{42} + (b_{51} - b_{52}) \ln X_{52}\} + \{b_{11} \ln(X_{11}/X_{12}) + b_{21} \ln(X_{21}/X_{22}) + b3_1 \ln(X_{31}/X_{32}) + b_{41} \ln(X_{41}/X_{42}) + b_{51} \ln(X_{51}/X_{52})\} + u_1 - u_2$ (4)

The decomposition equation (4) gives an approximate measure of the percentage change in per hectare output between Swarna (MTU-7029) rice variety adopters and non- adopters. The first bracketed equation on the right-hand side is a measure of percentage change in output due to shift in scale parameter of the production function. The second bracketed expression, the sum of the arithmetic changes in output elasticities each weighed by the logarithm of that input used, is a measure of change in output due to shifts in the slope parameters of the production function. The third bracketed term refers to the gap caused by differences in input use, which is weighted by the slope coefficients of the productivity function fitted for technology. This expression is a measure of change in the yield due to change in per hectare quantities of inputs.

Impact of Swarna (MTU-7029) rice variety on income of farmers

Swarna (MTU-7029) rice variety was the leading A.N.G.R.A.U released variety in Godavari zone. In order to identify the effects of inputs impact on income of Swarna (MTU-7029) rice variety adopter and non-adopter farmers, decomposition analysis was undertaken.

The output decomposition model developed by Bisaliah (1977) was employed to analyze the impact of Swarna (MTU-7029) rice variety on income of the farmers. The total change in the income could be brought out by shifts in the production parameters that defined the production function itself and by the changes in the input-use levels. Therefore, the production functions are considered as the convenient econometric models for decomposing the income difference. The Cobb-Douglas type of production function used was specified as follows

$\ln Y = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + ui$ (1)

were,

Y=Dependent variable, Y1: Adopter of Swarna (MTU-7029) rice variety and

Y_2: Non-adopter of Swarna (MTU-7029) rice variety

Y = Gross returns (Rs. ha ¯1)

X_1 = Yield (q ha-1)

X_2 = Human labour (Rs. ha ¯1)

X_3 = Machine power (Rs. ha ¯1)

X_4 = Cost of seed (Rs. ha ¯1)

X_5 = Plant protection chemicals (Rs. ha ¯1)

X_6 = Fertilizers (Rs. ha-1)

bj = Regression Co-efficient (j= 0,1,2, -, n)

ui = Error term.

The income decomposition model used in this study was,

$\ln Y_1 = \ln b_{01} + b_{11} \ln X_{11} + b_{21} \ln X_{21} + b_{31} \ln X_{31} + b_{41} \ln X_{41} + b_{51} \ln X_{51} + b_{61} \ln X_{61} + u_1$ (2)

$\ln Y_2 = \ln b_{02} + b_{12} \ln X_{12} + b_{22} \ln X_{22} + b_{32} \ln X_{32} + b_{42} \ln X_{42} + b_{52} \ln X_{52} + b_{62} \ln X_{62} + u_2$ (3)

where, Y, X_1, X_2, X_3, X_4, X5, X_6, bj and ui are as denoted in Equation (1). However, Equations (2) and (3) represents Swarna (MTU-7029) rice variety adopter and non-adopter farmers regression functions, respectively. The differences between the above two equations (2) and (3) gives the technology impact, as follows.,

$(\ln Y_1 - \ln Y_2) = \ln (Y_1/Y_2) = \ln (b_{01}/ b_{02}) + \{(b_{11} - b_{12}) \ln X_{12} + (b_{21} - b_{22}) \ln X_{22} + (b_{31} - b_{32}) \ln X_{32} + (b_{41} - b_{42}) \ln X_{42} + (b_{51} - b_{52}) \ln X_{52} + (b_{61} - b_{62}) \ln X_{62}\} + \{b_{11} \ln(X_{11}/X_{12}) + b_{21} \ln(X_{21}/X_{22}) + b_{31} \ln(X_{31}/X_{32}) + b_{41} \ln(X_{41}/X_{42}) + b_{51} \ln(X_{51}/X_{52}) + b_{61} \ln(X_{61}/X_{62})\} + u_1 - u_2$ (4)

The decomposition equation (4) gives an approximate measure of the percentage change in per hectare income between Swarna (MTU-7029) rice variety adopters and non- adopters. The first bracketed equation on the right-hand side is a measure of percentage change in income due to shift in scale parameter of the production function. The second bracketed expression, the sum of the arithmetic changes in output elasticities each weighed by the logarithm of that input used, is a measure of change in income due to shifts in the slope parameters of the production function. The third bracketed term refers to the gap caused by differences in input use, which is weighted by the slope coefficients of the productivity function fitted for technology. This expression is a measure of change in the income due to change in per hectare quantities of inputs.

Results and Discussion

Impact of Swarna (MTU-7029) rice variety on yield of farmers

The decomposition analysis was used to estimate the contribution of various resources to the yield difference between the Swarna (MTU-7029) rice variety adopter and non-adopter farmers and the results were presented in Table 1. The decomposition analysis showed that the adopters of Swarna (MTU-7029) rice variety had a per-hectare yield which was 26.53 per cent higher than non-adopter farmers. The technology component was contributing 18.04 per cent to the total increase in output. This implied that with no further input application, Swarna (MTU-7029) variety yield could be increased by 18.04 per cent. Technical change affects the yield by shifting either intercept or the slope coefficients or both. Technical modifications were divided into neutral changes and non-neutral changes. Scale parameter's (neutral change) contribution was -388.84 per cent and slope parameter's (non-neutral change) contribution was 406.88 per cent.

Table-1 Results of decomposition analysis on yield of farmers

SN	Particulars	Percentage
	The total observed difference in yield	26.53
1)	Source of output growth	
a.	Neutral component	-388.84
b.	Non-neutral component	406.88
	The total estimated difference in output due to technology	18.04
2)	Input contribution	
a.	Human labour (Rs. ha^{-1})	0.01
b.	Machine power (Rs. ha^{-1})	0.03
c.	Value of seed (Rs. ha^{-1})	-0.01
d.	Plant protection chemicals (Rs. ha^{-1})	0.008
e.	Fertilizers (Rs. ha^{-1})	0.03
	The total estimated difference in output due to input difference	8.48

The total contribution of change in the levels of input use to the yield difference between the two groups was 8.48 per cent. This indicated that the yield of the adopter farmer could increase by 8.48 per cent if the input use leads to increase in the same level as that of the non-adopter farmers. The adoption of Swarna (MTU-7029) rice variety enhanced the yield, which in turn increased production in the study area.

The major contributor amongst all the inputs to the yield difference was the cost incurred by the farmers for using of machine power and fertilisers contributed 0.03 and 0.03 per cent of higher yield to the adopters when compared to the non-adopter farmers, followed by human labour (0.01 per cent). Plant protection chemicals was found to be positively contributing but at a lower level i.e., 0.008 per cent. This implied that the adopter farmers gained a higher income by investing more on machine power, fertilisers, human labour and plant protection chemicals. The cost incurred on seed was negatively contributing to the adopter farmers (-0.01). This means that the more seed used in non-adopter farms had helped to increases the yield of farmers by 0.01 percent in non-adopter farms.

The results were consistent with Hile *et al.* (2016) [12], who found that technical development in paddy production was resulted in a productivity differential of 19.07 per cent in which the productivity gap was due to different cultural practices of adopter and non-adopter farmers, which accounted for 11.24 per cent and 7.83 percent of the output gap was caused by differences in the inputs used.

Impact of Swarna (MTU-7029) rice variety on income of farmers

The decomposition analysis was used to estimate the contribution of various resources to the income difference between the Swarna (MTU-7029) rice variety adopter and non-adopter farmers and the results were presented in [Table-2].

The income difference between the adopter and non-adopter farms was decomposed into its constituent sources. The decomposition analysis results revealed that per hectare income of adopter farmers was 15.15 per cent higher than the non-adopter farmers. Technical change affects the income by altering either intercept or the slope coefficients or both. Technical changes were partitioned into neutral technical changes and non-neutral technical changes. The contribution of scale parameter (neutral technical change) and slope parameter (non-neutral technical change) was -396.43 per cent and 405.79 per cent, respectively. It means that by adopting Swarna (MTU-7029) rice variety, income could be increased by 9.35 per cent. This implied that with no further input application, income could be increased by 9.35 per cent.

The total contribution of change in the levels of input use to the income difference between the two groups was 5.80 per cent. The major contributor amongst all the inputs to the difference in income was the yield of the farmer (0.13 per cent) followed by plant protection chemicals (0.01 per cent) and fertilisers (0.01 per cent). Human labour was found to be positively contributing but at a lower level i.e., 0.005 per cent. This implied that the adopter farmers gained a higher income by investing more on human labour, fertilisers, yield and plant protection chemicals than the non-adopter farmers. The income gain from the machine power and seed were found to be negative *i.e.*, -0.07 per cent and -0.04 per cent, respectively. The more machine power and seed used in non-adopter farms helped to increase the income of farmers by 0.07 percent and 0.04 per cent in non-adopter farms respectively. The increased income was due to adoption of high yielding varieties which resulted in higher production along with the optimum usage of inputs, and reduced pest & disease infestation.

Table-2 Results of decomposition analysis on income of farmers

SN	Particulars	Percentage
	The total observed difference in income	15.15
1)	Source of income growth	
a.	Neutral component	-396.43
b.	Non-neutral component	405.79
	The total estimated difference in income due to technology	9.35
2)	Input contribution	
a.	Yield (q ha^{-1})	0.13
b.	Human labour (Rs. ha^{-1})	0.005
c.	Machine power (Rs. ha^{-1})	-0.07
d.	Value of seed (Rs. ha^{-1})	-0.04
e.	Plant protection chemicals (Rs. ha^{-1})	0.01
f.	Fertilizers (Rs. ha^{-1})	0.01
	The total estimated difference in output due to input difference	5.80

The results were similar in line with Ketema and Kassa (2015) [13] reported that the technological change in smallholder wheat production has brought about 55.60 per cent productivity difference between new variety plot and old variety plot. The productivity difference was due to the difference in quantities of inputs used, which contributed to 30.65 per cent and the remaining difference in output was due to difference in technology, which contributed to 24.07 per cent.

Conclusion

The decomposition analysis for yield showed that per hectare yield of Swarna (MTU-7029) rice variety adopter farmers was 26.53 per cent higher than that of non-adopter farmers. The technology component was contributing 18.04 per cent to the total increase in yield. The total contribution of changes in the levels of input use to the yield difference between the two groups was 8.48 per cent. The major contributor amongst all the inputs to the difference in yield were machine power (0.03 per cent) and fertilisers (0.03 per cent) followed by human labour (0.01 per cent). Plant protection chemicals was found to be positively contributing but at a lower level i.e., 0.008 per cent. The seed cost (-0.01 per cent) was negatively contributing for adopter farmers.

Application of research: The study suggested that the extension networks of A.N.G.R.A.U should penetrate much deeper into the farming societies and increase the awareness on adoption of Swarna (MTU-7029) rice variety through high promotion at digital and print media.

Research Category: Agricultural Economics

Acknowledgement / Funding: Authors are thankful to Department of Agricultural Economics, Agricultural College, Bapatla, 522101, Acharya N. G. Ranga Agricultural University, Lam, Guntur, 522034, Andhra Pradesh, India and ICAR-Indian Institute of Rice Research, Rajendranagar, 500030, Hyderabad, Andhra Pradesh, India

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Research project name or number: MSc Thesis

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Godavari zone of Andhra Pradesh

Cultivar / Variety / Breed name: Swarna (MTU-7029) Rice

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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