Original Research Article

Resource use efficiency in paddy cultivation: A comparative study of Telangana *Sona* and *Chintu* varieties in Nalgonda district of Telangana state of India

ABSTRACT

The present study was undertaken to assess the resource use efficiency inthe cultivation ofrice variety, Telangana Sona. A total sample of 120 farmers from 6 villages of three mandals in Nalgonda district of Telangana was selected. Cobb-Douglas production function analysis was used to study resource use efficiency. Theresults of the study revealed that in the cultivation of Telangana Sona, humanlabour, machinery, and fertilizers were underutilized and there is a scope for maximizingreturns by increasing the use of these inputs. The Marginal Value Product (MVP) wasless than one for costs incurred on plant protection chemicals, which means that the resourcewasover-utilized*i.e.*decreaseintheuseofthisinputis suggested. The study recommends the reallocation of resources for profitable rice cultivation.

Keywords: Rice, Telangana Sona, Resource Use efficiency, Telangana.

INTRODUCTION

In India, rice is the most important and extensively grown food crop, occupying nearly 42.75 million hectares *i.e.*,nearly 44 per cent of the total area under cereals in the country. India has the largest area in the world accounting for nearly 28.2 per cent of the world's area under rice. India is the second-largest producer and consumer of rice in the world. In India rice had a share of 43.5 per cent in the total cereals production in 2019. The growth in rice production with stability has been a matter of concern to achieve food security, especially in developing countries (Bandumula, 2018). The productivity of rice has increased from 1984 kg per hectare in 2004-05 to 3450 kg per hectare in 2020-21 due to improved irrigation facilities and government schemes and initiatives. However, rice production needs to be increased to meet future food requirements amid strong competition for limited resources (Bandumula, Tuti, Mahender, Waris, Muthuraman, Brajendra&Vidhan, 2021).Major paddy growing states in India are West Bengal, Uttar Pradesh, Punjab, Telangana and Andhra Pradesh **(**Directorate of Economics & Statistics, DAC&FW).

Agriculture plays a pivotal role in the economy of Telangana.Besides the fact that the sector helps in ensuring food security, it also provides livelihoods to more than half of the state's workforce(BandumulaRathod, Ondrasek, Pillai& Sundaram,2022). In the state of Telangana, the agricultural households as a percentage of rural households are 54.2% (2,655,700 agricultural households out of 4,899,600 rural households) in 2019.

Rice is the predominant crop in Telangana, accounting for 50.3 percent (4.12 mha) of the total gross cropped area in 2020-21, up from 26.6 percent in 2014-15. Rice production has increased significantly in

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Telangana; it continues to dominate as a major crop produced in the state and has seen a prominent increase in production in recent years. Telangana is one of the national leaders in paddy production (Akula, Nirmala, & Rathod. 2022). Rice is the major food crop and staple food for the state (Amtul& Nirmala 2016). Telangana has achieved a record procurement of 11.2 million tons of paddy, in *kharif*2019 and became the 'Rice Bowl' of the country. The total area under paddy in the state reached 2.1million hectares*in kharif*.2020.Total paddy production in the state increased to 11.88 million tons in 2019-20 from 6.25 million tons in 2017-18. Yield increased to 3450kg per hectare in 2020-21 against 3176 kg per hectare in 2017-18(Directorate of Economics and Statistics,Government of Telangana, 2020).

There is an increasing scarcity of available agricultural land and enhancing the productivity of crops faces a new challenge of ensuring that land becomes more and more productive. This is where resource-use efficiency becomes relevant to our agricultural and food systems (Fayaz,Aadil, Javeed, Shafi&Kanth2021). Rice provides up to 60 per cent of the daily energy requirement and a substantial part of the protein intake, and therefore is crucial for nutritional security (Bandumula,Babu,Neeraja,Waris, Muthuraman&Rao, 2016).The sustainability of rice-based farming systems is threatened by sub-optimal use of inputs, increasing resource scarcity, especially water and labour, climate change, emerging energy crisis and rising fuel prices, the rising cost of cultivation and emerging socio-economic changes such as urbanization, migration of labour, preference for non-agricultural activities etc., (Ladha,Pathak& Gupta,2009 and Thejaswai,Lokesha& Thapa, 2021). In order to achieve optimum production levels, the available resources must be used efficiently. There is a call for an appraisal of the efficiency of the resources in rice production. Hence, the studies on resource use efficiency in rice cultivation, assume importance in the background of depleting resources (Alimi, 2000 and Sani,Yakubu & H.M. Bello,2010).

Telangana Sona (RNR 15048) is a new paddy variety developed by PJTSAU in the year 2015 with special characteristics such as short duration (125 days), water-conserving, fine grain, high yielding and blast resistance. Due to these traits, it is profitable for the farmers to cultivate this variety. Also, it has a low glycemic index, making it ideal for rice-eating diabetics(PJTSAU, Newly Released Crop Varieties, 2015).Rice being the major staple food crop of Telangana state and also by considering the growing importance of the Telangana Sona variety, resource use efficiency of rice production needs to be done. In this context, this study was undertaken to analyze resource use efficiency in the Telangana Sona variety by comparing it with other popular paddy variety*i.e.*,Chintu in Nalgonda district of Telangana.

METHODOLOGY

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In Telangana, Nalgonda, Karimnagar, and Nizamabad are the major paddy growing districts (Table 1). Nalgonda is the highest paddy growing district in the Telangana with 160,674hectares of area in*kharif-2020*(Directorate of Economics and Statistics, Telangana, 2020). Hence, Nalgonda district has been selected purposively to conduct the present study as it had the highest paddy cultivating area in Telangana state during *kharif-2020 (*Table 1*)*.

Table: 1 Area under rice in major rice growing districts of Telangana*inkharif*– 2020

S.No	District	Area (ha)
1	Nalgonda	160,674
2	Suryapet	160,632
3	Nizamabad	154,462
4	Khammam	113,577
5	Jagithyal	113,243
6	Karimnagar	101,183
7	Peddapalli	82,036
8	Yadadri	81,801

Source: Directorate of Economics and Statistics, Telangana, 2020

The Nalgonda district is basically an agrarian district with good irrigation sources and favorable climatic conditions. Approximately 75% of the population depends directly or indirectly on agriculture in the Nalgonda district. The major crops grown are paddy and cotton. Telangana state is considered as seed bowl of India and the contribution of Nalgonda district in this regard is sizeable. Nalgonda district has total 31 mandals and among them Miryalguda, Nidamanoor, Nalgonda, Kanagal, Thripuram, Thipparthy and Vemulapally are major paddy growing mandals.

In Nalgonda district of Telangana state, Telangana Sona (RNR-15048), *Chintu*, MTU-1010, KNM-118, MTU-1156, BPT-5204 and HMT are majorly grown paddy varieties in the category of'fine grain' paddy production. Telangana Sona was the major cultivated variety in the study area, as it covered more than 80 percent of area in *kharif*-2020. To investigate the said objective in Nalgonda district, total three mandals were selected purposively based on the highest area under paddy cultivation and area under Telangana Sona variety. Further, from each mandal two villages were identified purposively based the highest area under paddy cultivation and coverage of Telangana Sona and *Chintu* varieties. Again, from each village, 20 paddy growing farmers were selected using purposive random sampling procedure, 10 each of Telangana Sona and *Chintu* variety cultivating paddy farmers. Thus, total sample size consists of

120 farmers which included 60 Telangana Sona cultivating farmers and ~~60 *Chintu*~~60 Chintu variety cultivating paddy farmers, covering 6 villages. Sampling details are given in Table 2.

Table 2: Sample distribution of paddy farmers

Name of the Mandal	Villages	Sample farmers who cultivated Telangana Sona (RNR-15048) paddy Variety	Sample farmers who cultivated *Chintu* paddy variety
Nidamanooru	Mupparam	10	10
	Errabelli	10	10
Adavidevulapalli	Ulshayapalem	10	10
	Bangarigadda	10	10
Kanagal	Dorepalli	10	10
	Shabdullapuram	10	10
Total		**60**	**60**

Cobb-Douglas production function analysis

Cobb Douglas production function was employed to find out the productivity of inputs in the rice production. By using this function, impact of each input towards paddy production was estimated in both the varieties *i.e.,* Telangana Sona and Chintu Varieties. Cobb-Douglas Production was used by many of researchers to study the resource use efficiency in various crops including paddy (Kadiri, Eze, Orebiyi&Onyeagocha,2014; Sowjanya,Rao, & Kumari, 2017;Thayapara&Jayathilaka, 2020 (All studies at one place only).

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The model specified was:

$$\text{Ln } Y = \text{Ln } A + b_1 \text{Ln} X_1 + b_2 \text{Ln } X_2 + b_3 \text{Ln } X_3 + b_4 \text{ Ln } X_4 + b_5 \text{ Ln } X_5$$

Where,

Y = Gross return (Rs./ha),

X_1 = Cost of seed (Rs. /ha),

X_2 = Cost on fertilizers (Rs./ha),

X_3= Cost on pesticides (Rs./ha)

X_4 = Cost on human labour (Rs./ha),

X_5= Cost on machinery (Rs./ha)

e = Random error

b_1, b_2, b_3, b_4, b_5 elasticity coefficients

A = Constant (intercept)

Paul,2020; DeviSuhasini&Sunandini, 2020 and Phuge,Deorukhakar, Meshram, Thorat, Dhekale, &Wadkar, 2021 employed studied resource use efficiency using cobb-douglas production function.

In order to test the efficiency, the ratio of Marginal Value Product (MVP) to marginal factor cost (MFC) for each input is computed and tested for its equality to 1 *i.e.*

$$\frac{MVP}{MFC} = 1 \quad (1)$$

$MVP = MPP_i * P_y$

Where,

MVP = Marginal Value Product

MFC = Marginal factor cost

MPP_i = MPP of i^{th}input

P_y = Price of output

$$MPPi = bi \times \frac{Y}{Xi} \quad (2)$$

Where,

b_i = Elasticity coefficient of the i^{th}independent variable

Y = Geometric mean of the output

X_i = Geometric mean of the input

The marginal value product was compared with their MFC for evaluating resource useefficiency.MFC is the price per unit of input. If the MFCs of all the inputs expressed in terms of an additional rupee in calculating the ratio of MVP to MFC, the denominator will always be one and the ratios will be equal to their respective MVP.

The prevailing market price of inputs was used as the Marginal Factor Cost (MFC) since the farmers were assumed to be operating under purely competitive input markets. On the basis of the economic theory, a firm maximizes profits with respect to resource use when the ratio of the marginal return to opportunity cost is one. The values were thus interpreted as;

a) If r <1, it means the resource in question was over-utilized, hence decreasing the quantity used of that resource increases profit.

b) If r > 1, it shows that the resource was being under-utilized and increasing the rate of use will raise the profit level.

c) If r = 1 it means the resource was being efficiently utilized.

RESULTS AND DISCUSSION

TheCobb-Douglasproductionfunctioncoefficientswereestimatedto analyze the relationship between

resources and productivity of paddy by using thedata from respondents. The gross returns from the paddy was taken as dependentvariable,whileseed,humanlabour,machinerycost,fertilizerandpesticideswereta kenas independent variables. Results were calculated and presented in Table 3. Theresultsrevealedthatwithregardtocoefficientsofmultipledeterminations,R^2were0.70and0.63forTelangana SonaandChinturespectively,whichindicatesthatinTelanganaSona 70per centvariationinpaddy productionisexplaineddue tovariation in all explanatory variables. Similarly, in the case of the *Chintu* variety about 63per cent of the variations have been explained by the explanatoryvariables,whichwereincluded in the model.

Results also revealed that the regression coefficient of seed cost in TelanganaSona was 0.049. In the case of the *Chintu* variety,the regression coefficient of seed cost was 0.018which was a positive coefficient and non-significant. The regression coefficient of humanlabourcostinTelanganaSonawas0.225andsignificant at 1 per centlevelofconfidenceindicatinga oneper centincreaseinhumanlabourcostwouldincreasegrossreturnby0.22percent.Ontheotherhand, inthe *Chintu*varietycoefficient ofhumanlabourwas0.071 andsignificant at a 5 per cent level of confidence which means a one per cent increase in humanlabour would bring the change of 0.071 per cent increase in returns. The coefficient ofmachinerycostwas0.189andsignificantatoneper centlevelofconfidenceinTelanganaSona and 0.049 and non-significant in *Chintu* variety. The regression coefficient for fertilizer cost was 0.158 and 0.287 and significant at one per cent level of confidence for Telangana SonaandChintuvarietyrespectively.Itmeansthata oneper centincreaseinfertilizercostwouldincrease gross returns by 0.158 and 0.287 per cent in respective varieties. In the TelanganaSona variety, the coefficient of pesticide cost was positive and non-significant but in the case of the *Chintu* variety itwas negative(-0.0163)and non-significant.Naipunya& Rajeswari (2017) studied resource use efficiency in different rice based cropping Systems of Andhra Pradesh and found that the regression coefficient of machine power (x_2), and fertilizers (x_4) were positively significant at 10 per cent level. Naik,Jalikatti, Chourad& Ashok (2018) analyzed the resource use efficiency of Soybean crop and found that the seed, FYM, human labour, bullock labour, and fertilizer were over utilized and machine labour and plant protection chemicals were underutilized by the farmers.

ThedetailsofestimatedMVPratiosofresourcesinpaddyproductionarepresented in Table 4. The Cobb-Douglas production function estimates and geometric levels ofinputs and outputs were used to estimate the Marginal Value Product (MVP) of the inputs. Ebele & Eric, 2017, estimated MVP in their study on the resource use efficiency in rice. InTelanganaSona,MVP valuesofhumanlabourcost(1.15),machinery cost (1.56), and fertilizer cost (2.2) were more than one. It indicates thatresources were underutilized and there is a scope for maximizing returns by increasingthe use of human labour, machinery and fertilizer. The MVP value for pesticidewas less than one for pesticide cost (0.033) which means pesticide

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wasoverused*i.e.*,a decrease in the use of this input would enhance the returns.Similar results were reported by Fayaz,Aadil, Javeed,Shafi&Kanth, 2021.

In the case of the *Chintu*variety, MVP values of seed cost (0.44), human labour cost (0.30), machinery cost (0.28), and pesticide cost (-0.28) were less than one which indicates overutilization of these resources. Hence, if we reduce these resources in *Chintu* we can increase the returns. In *Chintu*variety, only fertilizer cost (3.1) MVP value was greater than one which indicates underutilization of fertilizer and there is a scope to enhance the returns by increasing the application of fertilizers.The study is supported by earlier research (Bandumula, 2014).

Table: 3. Estimated values of co-efficient and related statistics of Douglas Productionfunction model

Explanatoryvariable	**TelanganaSona Variety**	**Chintu Variety**
Intercept	5.517	7.752
Seedcost	0.049 (0.23898292)	0.018 (0.6964)
Humanlabourcost	0.225* (0.00000047)	0.071** (0.0467)
Machinerycost	0.1898* (0.021014441)	0.049 (0.3668)
Fertilizercost	0.158* (0.000000269)	0.287* (0.0000015)
Pesticidecost	0.0330 (0.364500894)	-0.0163 (0.541783)
R^2	0.70	0.63
F-Value	25.54	18.84

, and ** Significant at the 1 and 10 levels.

Table:4MarginalValueProduct(MVPs)of inputs inproductionfunction

	Telangana Sona Variety				***Chintu* Variety**			
S. No	Input Variables	Co-efficient	MVP		Input Variables	Co-efficient	MVP	
1	Seed	0.049	1.0	Optimum Utilized	Seed	0.018	0.44	Excess Utilized
2	Human Labor	0.225	1.15	Under utilized	Human Labor	0.071	0.30	Excess utilized
3	Machinery	0.189	1.56	Under utilized	Machinery	0.049	0.28	Excess utilized
4	Fertilizer	0.158	2.2	Under utilized	Fertilizer	0.287	3.1	Under utilized
5	Pesticide	0.033	0.96	Excess utilized	Pesticide	-0.016	-0.28	Excess utilized

Source:Primarydata collectedfromfarmers

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CONCLUSIONS

The results revealed that in the case of Telangana Sona, MVP values of human labour cost (1.15), machinery cost (1.56), and fertilizer cost (2.2) were more than one. It indicates that resources were underutilized and there is a scope for maximizing returns by increasing the use of human labour, machinery and fertilizer. Hence, institutional support in the form of provision of labour support by way of linking MGNREG program with the agriculture labour work, promotion of mechanization andsupport to procure and use of the recommended level ofinputs may be considered to realize the potential yield in Telangana Sona variety on farmers' fields.The MVP value forpesticide was less than one for pesticide cost (0.033) which means resource was overused*i.e.*,a decreasein theuseof this input would enhancethe returns in Telangana Sona Variety.The study suggests the reallocation of resources with mechanization andreduction in pesticide use for the profitable cultivation of rice.

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