

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

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ABSTRACT

The present study was undertaken to assess the resource use efficiency in the cultivation of rice 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. The results of the study revealed that in the cultivation of Telangana Sona, human labour, machinery, and fertilizers were underutilized and there is a scope for maximizing returns by increasing the use of these inputs. The Marginal Value Product (MVP) was less than one for costs incurred on plant protection chemicals, which means that the resource was over-utilized. *i.e.* decrease in the use of these inputs is suggested. The study recommends the reallocation of resources for profitable rice cultivation.

Comment [a2]: Re-write it, try for one sentence each on motive, method, key results, and its recommended please.

The current abstract is not clear especially with results part, the reader of an abstract has been lured by the title. He or she now wants to know whether to read on. Tell them, in a few sentences as possible, what they will find. No waffle, key details just. Try to exceed 200 words.

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).

Comment [a3]: There is a major aspect that absolutely needs addressing in the Introduction section: Identify a gap in the previous knowledge and provide sufficient evidence to support the direction of your research. And clarify the research component in your work.

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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 (Bandumula Rathod, 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

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 *kharij*2019 and became the 'Rice Bowl' of the country. The total area under paddy in the state reached 2.1million hectares in *kharij*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&Kanth 2021). 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,Loksha& 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

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 160,674 hectares of area in *khariif-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 *khariif-2020* (Table 1).

Table: 1 Area under rice in major rice growing districts of Telanganainkhariif– 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, Thipparthi 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 *khariif-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* 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 <i>Chintu</i> paddy variety
Nidamanooru	Muppalam	10	10
	Errabelli	10	10
Adavidevulapalli	Ushayapalem	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)

The model specified was:

$$\ln Y = \ln A + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5$$

Where,

Y = Gross return (Rs./ha),

X₁ = Cost of seed (Rs. /ha),

X₂ = Cost on fertilizers (Rs./ha),

X₃= Cost on pesticides (Rs./ha)

X₄ = Cost on human labour (Rs./ha),

X₅= Cost on machinery (Rs./ha)

e = Random error

b₁, b₂, b₃, b₄, b₅ 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.*

$$\frac{MVP}{MFC} = 1$$

$$MVP = MPP_i * P_y$$

Where,

MVP = Marginal Value Product

MFC = Marginal factor cost

MPP_i = MPP of ⁱth input

P_y = Price of output

$$MPP_i = b_i \times \frac{Y}{X_i}$$

Where,

b_i = Elasticity coefficient of the ⁱth 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 use efficiency. 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

The Cobb-Douglas production function coefficients were estimated to analyze the relationship between

Comment [a6]: The text and tables were not clearly written, which should be improved, and present your results as tables with statistical tests, to relevant items while discussing the results. This section should highlight significant or interesting findings along with P values for statistical tests in all tables this section. Furthermore, the results and discussion section of your research paper should include: Findings and comparison with prior studies, limitations of your work, casual arguments and deductive arguments

resources and productivity of paddy by using the data from respondents. The gross returns from the paddy was taken as dependent variable, while seed, human labour, machinery cost, fertilizer and pesticides were taken as independent variables. Results were calculated and presented in Table 3. The results revealed that with regard to coefficients of multiple determinations, R^2 were 0.70 and 0.63 for Telangana Sona and *Chintu* respectively, which indicate that in Telangana Sona 70 per cent variation in paddy production is explained due to variation in all explanatory variables. Similarly, in the case of the *Chintu* variety about 63 per cent of the variations have been explained by the explanatory variables, which were included in the model.

Results also revealed that the regression coefficient of seed cost in Telangana Sona was 0.049. In the case of the *Chintu* variety, the regression coefficient of seed cost was 0.018 which was a positive coefficient and non-significant. The regression coefficient of human labour cost in Telangana Sona was 0.225 and significant at 1 per cent level of confidence indicating a one per cent increase in human labour cost would increase gross return by 0.22 per cent. On the other hand, in the *Chintu* variety coefficient of human labour was 0.071 and significant at a 5 per cent level of confidence which means a one per cent increase in human labour would bring the change of 0.071 per cent increase in returns. The coefficient of machinery cost was 0.189 and significant at one per cent level of confidence in Telangana Sona 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 Sona and *Chintu* variety respectively. It means that a one per cent increase in fertilizer cost would increase gross returns by 0.158 and 0.287 per cent in respective varieties. In the Telangana Sona variety, the coefficient of pesticide cost was positive and non-significant but in the case of the *Chintu* variety it was 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.

The details of estimated MVP ratios of resources in paddy production are represented in Table 4. The Cobb-Douglas production function estimates and geometric levels of inputs 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. In 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. The MVP value for pesticide was less than one for pesticide cost (0.033) which means pesticide

was overused 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 Production function model

Explanatory variable	Telangana Sona Variety	Chintu Variety
Intercept	5.517	7.752
Seed cost	0.049 (0.23898292)	0.018 (0.6964)
Human labour cost	0.225* (0.00000047)	0.071** (0.0467)
Machinery cost	0.1898* (0.021014441)	0.049 (0.3668)
Fertilizer cost	0.158* (0.000000269)	0.287* (0.0000015)
Pesticide cost	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: 4 Marginal Value Product (MVPs) of inputs in production function

S. No	Telangana Sona Variety				Chintu Variety			
	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: Primary data collected from farmers

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 and support to procure and use of the recommended level of inputs may be considered to realize the potential yield in Telangana Sona variety on farmers' fields. The MVP value for pesticide was less than one for pesticide cost (0.033) which means resource was overused. *i.e.*, a decrease in the use of this input would enhance the returns in Telangana Sona Variety. The study suggests the reallocation of resources with mechanization and reduction in pesticide use for the profitable cultivation of rice.

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REFERENCES

1. Agricultural Statistics at a Glance; Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare, Government of India: New Delhi, India, 2021.
2. Akula, M., Bandumula, N., & Rathod, S. (2022). Rice production in Telangana: growth, instability and decomposition analysis. *ORYZA-An International Journal of Rice*, 59(2), 232–240.
3. Alimi, T. (2000). Resource use efficiency in food crop production in Oyo State of Nigeria. *Journal of Agriculture and Environment*, 1 (1): 1-7.
4. Bandumula, N. (2014). Yield gaps and constraints in low land rice ecology of Eastern Uttar Pradesh. *International Journal of Plant, Animal and Environmental Sciences*. 4(3), 683-687.
5. Bandumula, N., Babu, V.R., Neeraja, C.N., Waris, A., Muthuraman, P. & Rao, D.S. (2016). Linking agriculture and nutrition: an ex-ante analysis of zinc biofortification of rice in India. *Agricultural Economic Research Review*, 29 :171-17
6. Bandumula, N. (2018). Rice Production in Asia: Key to Global Food Security. *Proc. Natl. Acad. Sci., India, Sect. B Biol. Sci.* **88**, 1323–1328 <https://doi.org/10.1007/s40011-017-0867-7>.
7. Bandumula, N., M. D. Tuti, R. Mahender Kumar, Amtul Waris, P. Muthuraman, Brajendra Parmar & T. Vidhan Singh (2021): Integrated assessment of system of rice intensification vs. conventional method of transplanting for economic benefit, energy efficiency and lower global warming potential in India, *Agroecology and Sustainable Food Systems*, 45(5):745-766. <https://doi.org/10.1080/21683565.2020.1868648>
8. Bandumula, N., Rathod, S., Ondrasek, G., Pillai, M.P. & Sundaram, R.M. (2022). An Economic Evaluation of Improved Rice Production Technology in Telangana State, India. *Agriculture*, 12, 1387. <https://doi.org/10.3390/agriculture12091387>
9. Devi, I. S., Suhasini, K & Sunandini, G. P. (2020). Resource Use Efficiency of Groundnut in Anantapur district of Andhra Pradesh. *Current Journal of Applied Science and Technology*. 39(13):1-7.
10. Directorate of Economics & Statistics, DAC&FW, 2020. <https://eands.dacnet.nic.in/> (Accessed on 09/03/2022)
11. Directorate of Economics and Statistics, Telangana, 2020. https://www.ecostat.telangana.gov.in/crop_estimation_survey.html (Accessed on 23/03/2022)
12. Ebele, A.C & Eric, E.C. (2017). Resource use efficiency in rice production in the lower Anambra irrigation project, Nigeria. *Journal of Development and Agricultural Economics*. 9(8): 234-242.
13. Fayaz, A. L., Aadil, M. N., Javeed, A. R., Shafi, M.B., and Kanth, T. A. (2021). Resource use efficiency of rice farming in Jammu and Kashmir, *Indian Agricultural Research Journal*, 58 (3) :

- 521-526.
14. Kadiri, F.A., Eze, C.C., Orebiyi, J.S. & Onyeagocha, S.U.O. (2014). Resource use and allocative efficiency of paddy rice production in Niger delta region of Nigeria. *Global Journal of Agricultural Research*, 2(4): 11-18.
 15. Ladha, J.K., Pathak, H. & Gupta, R.K. (2009). Sustainability of the rice-wheat cropping system: issues, constraints and remedial options. *Journal of Crop Improvement*, 19(2): 125-136.
 16. Naik K.V., Jalikatti V., Chourad R & Ashok N. (2018). Resource use efficiency of Soybean in Belagavi District of Karnataka, India. *International Journal of Current Microbiology and Applied Sciences*, 7(1): 2319-7706.
 17. Naipunya, J., & Rajeswari, S. (2017). Resource use efficiency in different rice based cropping systems of Andhra Pradesh. *International Journal of Pure Applied Biosci*, 5(6), 1316-1322.
 18. Paul, K. (2020). Farm level technical efficiency of paddy production in Andhra Pradesh: An empirical evidence from the cost of cultivation survey data. *Economic Affairs*. 65(4):335212.
 19. Phuge, S.C., Deorukhakar, A.C., Meshram, A.V., Thorat, V.A., Dhekale, J. S & Wadkar, S.S. (2021). Resource use efficiency in farming systems in North Konkan Coastal Zone region of Maharashtra. *International Journal of Current Microbiology and Applied*
 20. Professor Jayashankar Telangana State Agricultural University (PJTSAU), Newly released crop varieties. 2015. Printed and Published by Professor Jayashankar Telangana State Agricultural University. <https://www.pjtsau.edu.in/files/Newlycrop2015.pdf>
 21. Sani A., A.A. Yakubu & H.M. Bello (2010). Bello Resource-Use Efficiency in Rice Production Under Small Scale Irrigation in Bunkure Local Government Area of Kano State Nigerian Journal of Basic and Applied Science, 18(2): 292-296 Available online at <http://ajol.info/index.php/njbas/index>
 22. Sowjanya, B., Rao, D. S & Kumari, R.V. (2017). Resource productivity and price spread analysis of paddy marketing in Andhra Pradesh. *Journal of Research PJTSAU*. 45(1/2):55-61.
 23. Thayaparan, A & Jayathilaka, D.M.P.I.L. (2020). Technical efficiency of paddy farmers and its determinants: application of translog frontier analysis. Paper presented at International Conference on Business Research University of Moratuwa, Moratuwa, Sri Lanka October 27, 2020, 199-218. <http://dl.lib.uom.lk/handle/123/16142> (Accessed on 11/05/2022)
 24. Thejaswi Kumar, J., Lokesha, H. & Thapa, S. (2021). Resource Use Efficiency Among Aerobic and Conventional Rice Farms in Eastern Dry Zone of Karnataka: A Comparative Analysis. *Economic Affairs*, 66(3): 439-446.
 25. Waris, A., Nirmala, B., & Kumar, S.A. (2016). Gender gap and female workforce participation in agriculture in Andhra Pradesh, India. *African Journal of Agricultural Research*, 11(9), 769-778. <http://dx.doi.org/10.5897/AJAR2013.7683>