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Adoption of remunerative farmers' developed varieties of rice: Case studies from Odisha and Chhattisgarh states of India

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ABSTRACT

Benefit cost ratio is an important factor influencing the decision for adoption of a new variety in any new location. Farmers have been playing an instrumental role in ensuring food security by developing highly productive varieties which are also adapted to various (a)biotic stresses. Promotion and adoption of such varieties in new locations is required to provide profitable livelihood and to meet the growing demand of food crops. In order to determine the adoption of two such farmers' developed varieties- DRK and Indrasan, a study was conducted in nine districts of Odisha and Chhattisgarh states during 2016, using the benefit - cost ratio (BCR) as the key parameter for decision making. Structured questionnaire and cost-benefit analysis approach were used for collecting the data and analysis. The highest benefit-cost ratio (BCR) of 2.26 was recorded in case of farmer's variety DRK followed by Mahamaya (1.30), Swarna (1.12) and Indrasan (0.81). The variety DRK fetched 41.2 percent higher market price in comparison to other varieties due to its superfine quality, better grain recovery and good taste. The highest benefit-cost ratio value ascertained that DRK variety was the most profitable variety for the region. Creating awareness through extensive demonstrations and maximizing its adoption among the farmers is warranted. The alignment of government policies and infrastructural support for the promotion of such economically potential farmers' varieties is advocated for the sustainable solution for increasing the incomes and improving the livelihood of the farming communities.

Key words: Benefit-cost ratio, Farmers' developed varieties, Sustainable livelihood, Technology adoption .

INTRODUCTION

Rice (*Oryza sativa* L.) is the world's most important staple food for more than 50 per cent world population and over 85 per cent Indian population (CRRI 2014). The world acreage and production of rice was 158.8 million hectares (STATISTA 2018) and 490.6 million tonnes in year 2015-16 respectively (FAO 2016). Covering around 24 per cent of the total cultivable land of India and rice contributes 42 per cent of total food grain production and 45 per cent of total cereal production (CRRI 2011). The area and production of rice in India was 43.499 million hectares and 104.408 million tonnes respectively in year 2015-16 (INDIASTAT 2016). The production of rice in Odisha and Chhattisgarh states was 5.88 million and 5.79 million tonnes respectively in year 2015-16 (INDIASTAT 2016) whereas the area under rice cultivation in Odisha and Chhattisgarh was 3.94 million hectares and 3.82 million hectares respectively during 2015-16. The rice production constitutes about 92 per cent of total food grain production in Odisha (Odisha Economy Survey 2017) whereas Chhattisgarh state known as the "Rice Bowl" of central India, rice occupies 77 per cent of net sown area (Economy Survey of Chhattisgarh, 2015). The area of rice cultivation for Jharsuguda, Sundargarh, Sambalpur, Angul and Koraput districts of Odisha was 40.15, 208.56, 140.17, 77.84 and 111.86 '000 hectares, which contributes 1.0, 5.4, 3.6, 2.0 and 2.9 percent respectively to the total area under rice cultivation, whereas the production was 50.58, 406.73, 227.51, 150.12 and 299.14 '000 tonnes, which contributed 0.8, 6.1, 3.5, 2.2 and 4.5 per cent respectively to the total rice production in Odisha during 2013-14 (Odisha Agriculture Statistics 2014). The area of rice cultivation for Dhamtari, Raigarh, Bilaspur and Jashpur districts was 198.15, 228.20, 227.58 and 180.70 '000 hectares, which contributed 4.9, 5.7, 5.6 and 4.4 per cent respectively to the total rice area whereas the production was 620.40, 367.39, 456.49 and 290.40 '000 tonnes, which contributed 7.8, 4.6, 5.7 and 3.6 per cent respectively to the total rice production of Chhattisgarh state during 2014 (Open Government Data Platform India 2014).

Climate change has negatively affected India's hundreds of millions of rice producers and consumers (Auffhammer *et al*., 2011). In this context, the knowledge regarding good varieties of rice in terms of yield and market price is highly essential for farmers. Economic factor is one of the key factor that plays an important role in affecting selection of a new technology (Carboni and Napier, 1993; Fuglie and Kascak, 2001). It is expected that the adoption level will increase when the adopters attained the greater

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profit (Jeon *et al*., 2006). Cost of cultivation is an important factor and it is the basis on which marketing choices are made. In general, farmer prefers to sell his agriculture produce in the market only when the market price covers the cost of production. The benefit cost ratio (BCR) i.e. the ratio of net value of crop produced to cost of input that show total financial return for each rupee invested in the crop production process (IGNOU 2007) and BCR is an important technique to evaluate economics of farming. Farmers consider varietal characteristics in choosing which variety or varieties will suit farm-specific production conditions, consumption preferences and marketing requirements (Bellon, 1996).

Many studies have been conducted in different fields to determine and understand the factors that influence adoption of new technologies among farmers (Li *et al*., 2010; Pannell *et al*., 2006). The participatory varietal selection approach is a rapid and cost-effective tool for identifying suitable crop varieties (Witcombe *et al*., 1996). Earlier supportive research was carried out at different farmers' field in Gandhinagar district of Gujarat by Chodvadiya *et al*. (2016) and the technology was adopted by the farmers with positive impact through farmers' participation. Farmers' varieties are adaptable in new area without any significant deterioration in production (Choudhary *et al*., 2016). A few on-farm studies comparing cost benefit ratio of improved rice varieties in comparison to local cultivated varieties are reported (Nirmala and Muthuraman, 2009) but, no studies were found related to adoption of farmers' developed varieties in new areas based on benefit cost ratio, this prompted the authors to undertake the present work. The objective of the study was to evaluate the performance of two farmers' developed rice varieties - DRK and Indrasan developed by innovators – Late Shri Dadaji Ramaji Khobragade (Maharashtra) and Late Shri Indrasan (Uttarakhand) respectively, to determine the economics using BCR ratio and adoption of farmers' varieties in the states of Odisha and Chhattisgarh.

MATERIALS AND METHODS

The study was carried out in the states of Odisha and Chhattisgarh during *kharif* 2016 the main rice growing season. Five districts of Odisha (Jharsuguda, Sundargarh, Sambalpur, Angul and Koraput) and four districts of Chhattisgarh (Dhamtari, Raigarh, Bilaspur andJashpur) were selected based on rice cropping pattern. 10 villages from each states were randomly selected and a total of fifty-one farmers participated in the study voluntarily based upon the initial survey and rapport building interventions in the area. Two farmers' developed rice varieties – DRK (developed by Late Shri Dadaji Ramji Khobragade, Maharashtra) and Indrasan (developed by Late Shri Indrasan Singh, Uttarakhand) were sown with the locally cultivated popular varieties- Mahamaya and Swarna according to the standard recommended package of practices. The essential observations to calculate cost of production and revenues of tested varieties were collected through structured questionnaire from farmers' field. The BCR of tested rice varieties was studied for identifying the most lucrative rice variety in terms of net revenue. Simple percentage analysis was used to analyze the structural changes in the cost of cultivation of paddy. Cost structure of the crop was analyzed by working out the share of each item in the total cost of cultivation. The cost of production was also worked out. The gainfulness of rice production was measured by calculating BCR using Nurunnaher *et al*. (2003) formula as follows:

BCR = Net Profit/Gross Cost

Where,

Net profit is the gross farm income minus the total farm expenditures and

Gross cost is the sum of all expenses incurred on the cultivation.

RESULTS AND DISCUSSION

In Chhattisgarh and Odisha, the most prominent rice varieties cultivated by farmers in the study area were Swarna and Mahamaya. During the study, farmers' developed rice varieties DRK and Indrasan were cultivated along with Swarna and Mahamaya in the 51 farmers' field. The major costs parameters of rice cultivation in the study area for calculating cost benefit ratios were land preparation, nursery management, seed material, fertilizers, irrigation, insecticides and fungicides, harvesting and threshing, cleaning and packing, transportation and field care taker. In both the states, the use of manual labours was prominent in agricultural activities during various stages of rice cultivation contributing to more than 45 percent of total cost of cultivation while the share of rest of the major activities were as follows -land preparation (11.5%), nursery management (12.3%), fertilizers (7.2%) insecticides and fungicides (11.5%), harvesting and threshing (12.3%) (Table 1).

The rice grain yield for all the four varieties tested ranged between 47-59 q/ha while the straw yield ranged between 74-111 q/ha (Fig 1). The average paddy yield calculated was 55.5 q/ha and fetched an average market price of Rs. 1727.50 per quintal and the total production of grain was Rs. 95876.25 (Table 2). Straw – a leading by-product of rice crop that is produced in bulk quantum in Asia (Kumar *et al*., 2015) also contributes to farmers' incomes and being primarily utilised as animal feed (Sarnklong *et al*., 2010). The average straw yield for the varieties was 86 q/ha and it fetched a price of Rs 300 per quintal and contributing Rs. 25800.00 in the total sum of production. The net production for the varieties was Rs. 70260.25 (Table 2). The total rice grain production of varieties DRK, Indrasan, Swarna and Mahamaya were Rs. 142000, 69069, 86730 and 86730 respectively, whereas straw production was Rs. 25800,

Table 1: Average per hectare cost and revenue for all varieties in the tested regions in the states of Odisha and Chhatisgarh.

Cost parameters	Work unit	Quantity	Prices (Rs.) per single quantity	Amount (Rs.) per hectare	Percentage share in total cost of cultivation
Land Preparation					
Cultivation using tractor	hour	3	581	4305	8.4
Stirring of mud flat using bullocks	hour	1	653	1613	3.1
Nursery management					
Paddy seed material	kilogram	25	51.12	3157	6.1
Nursery bed preparation for 1500 square feet area	hour	1	890	2198	4.2
Maintenance of nursery bed	day	1	423	1045	2.0
Uprooting and transport of seedling from nursery to field	hour	2	167.5	827	1.6
Transplanting of seedling into main field per day	labour	25	190.6	11770	22.9
Fertilizers requirement					
DAP	kilogram	43.83	24	2598	5.0
Urea (2 times)	kilogram	39.66	6	588	1.3
Potash	kilogram	11.41	17	479	0.9
Application of DAP fertilizer	day	1	213	526	1.0
Application of Urea fertilizer (18 DAT & 60-65 DAT)	day	2	256	1265	2.4
Application of potash fertilizer	day	2	152	751	1.4
Irrigation	day	1	463	1141	2.2
E. Insecticides & fungicides	-	-	-	5888	11.5
Application of insecticides& fungicides (2 times)	day	2	309.5	1529	2.9
F. Harvesting and threshing with combined harvesting machine	labour	10	256.9	6345	12.3
G. Cleaning and packing	labour	3	179	1326	2.6
H. Transportation of paddy from field to home using tractor	-	-	-	1168	2.3
Fields care taker at the time of crop maturity period	day	15	78.20	2897	5.6
Total cost of production				51416	

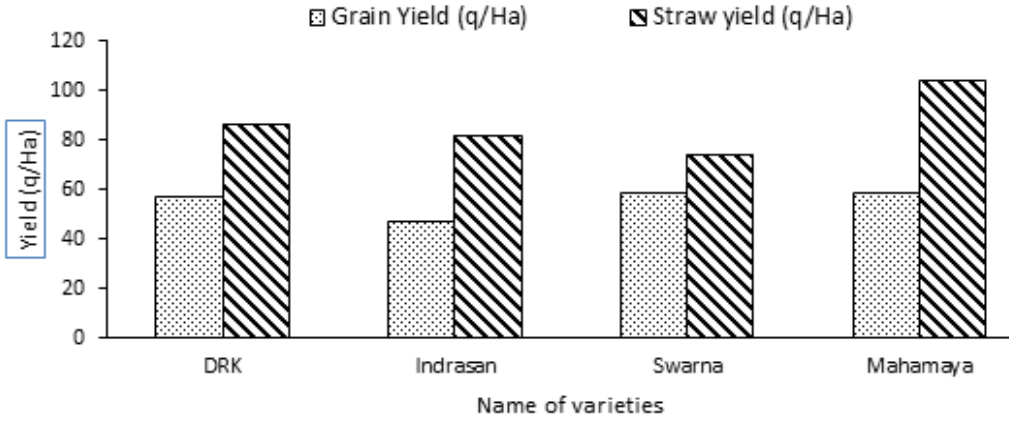

Fig 1: Yield of rice grain and straw of different varieties tested in Odisha and Chhattisgarh during *kharif* 2016.

Table 2: The average net production of rice per hectare for all varieties in the tested regions in the states of Odisha and Chhatisgarh.

Yield and Production	Yield(quintals/hectare)	Price/quintals(Rs.)	Total amount/hectare (Rs.)
i) Grain yield	55.5	1727.50	95876.25
ii) Straw yield	86.00	300.00	25800.00
Average gross with return (a)			121676.25
Cost of cultivation(b)			51416
Net with return (c) = (a) – (b)			70260.25

Table 3: The net and gross returns and cost benefit ratios of four tested rice varieties in the states of Odisha and Chhatisgarh.

Returns	Rice varieties			
	DRK	Indrasan	Swarna	Mahamaya
Gross Returns (Rs.) per hectare	167800	93543	108960	117852
Cost of cultivation (Rs.) per hectare	51416	51416	51416	51416
Net Returns (Rs.) per hectare	116384	42127	57544	66436
Benefit cost ratio	2.26	0.81	1.12	1.3

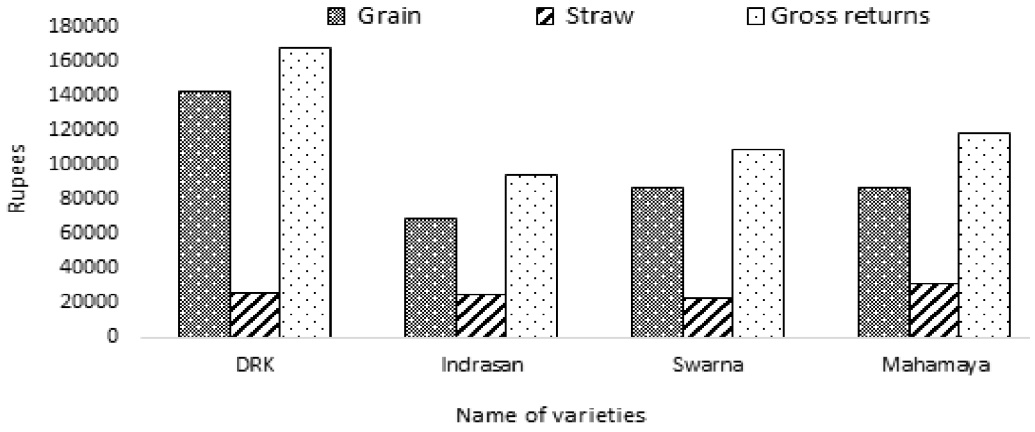

Fig 2: Total returns of grain and straw and gross returns of different varieties tested in Odisha and Chhattisgarh during *kharif* 2016.

24453, 22230 and 31122 respectively (Fig 2). Rice variety DRK gave a higher gross return of Rs. 116384.00 which is 44.3%, 34.9% and 29.6 % higher than the gross returns of varieties Indrasan, Swarna and Mahamaya respectively(Fig 2).

The highest benefit cost ratio of 2.26 was recorded for the variety DRK followed by Mahamaya (1.30), Swarna (1.12) and Indrasan (0.80). As shown in (Fig 1), the production of grain in the variety DRK was 56.8 q/ha, but it fetched good market price of Rs. 2500 /quintal as compared to other varieties tested, due to its superfine quality, better grain recovery of more than 80% and good taste. Similar results were reported by Samant *et al*. (2015) who tested two different varieties of rice- Sahabhagi and Khandagiri through on-farm trials with a higher benefit-cost ratio of 1.38 for Sahabhagi variety. The advantages of growing newly introduced varieties with higher returns as compared to traditional varieties have also been reported in the studies of Mitra *et al*., 2014; Nirmala *et al*., 2012; Nirmala and Muthuraman (2009) where they attribute the variation in net returns and benefit cost ratio to the variations in the prices of various agricultural inputs and produces.

In India, rice cultivation depends mainly on uncontrollable factors such as weather and market as fluctuations in market price can hugely affect the production costs and income. Due to the small landholdings of the farmers, the willingness of famers to take risks becomes limited. Variations in labour cost and interest rates are also the main constraint obstructing a farmer to adopt new technologies. The economics of rice production and BCR ratio helps the farmers to make the right decision involving any new variety. As seen in the present study, the cost of labour is highest and location specific integrated approaches and technologies are needed to bridge this huge gap and reduce the cost of cultivation that will further motivate the farmers to adopt new varieties. Higher the BCR ratio for a variety, easier becomes the adoption of the variety by the farmers considering the better performances and better gains as demonstrated by DRK in the present study. The new introduced technologies will eventually lead to the farmers to discontinue the old varieties and to adopt new varieties for cultivation (Sharma *et al*., 2011).

CONCLUSION

The cost benefit analysis of two farmers' varieties DRK and Indrasan in comparison to popular local varieties Swarna and Mahamaya reported the highest BCR value for variety DRK indicting it as the most profitable rice variety over other cultivated varieties in the study area. It is also reflected that the decision of adopting any variety among the farming community is mainly dependent upon the profitability and sustainability of the variety. The study also revealed that the labour costs contribute to the major chunk of cost of cultivation of rice making it a labour intensive process. It is suggested that suitable technologies in rice cultivation to reduce drudgery along with high performing farmers' varieties be introduced in the region to minimize the cost of production and increasing the benefits to maximum. These varieties not only help to improve the livelihood but also prove to be resilient to the changing climate of the rice growing regions as they are producing good returns under the standard recommended cultivation practices of the region. Such interventions are in alignment with the national and global concerns regarding the introduction of location specific technologies to improve the income and provide sustainable livelihood to the farming community. The need of the hour is awareness creation about such profitable varieties among the farmers through extension programs and augmented front line demonstrations to cover the other untouched areas. A successful dissemination of such potential varieties will not only ensure increase in the income but will also provide sustainable livelihood to the farming community.

REFERENCES

Auffhammer M, Ramanathan, V and Vincent J R. (2011). Climate change, the monsoon, and rice yield in India. Climate Change. Department of Agricultural and Resource Economics, University of California at Berkeley, Berkeley, CA 94720, USA (DOI 10.1007/s10584-011-0208-4).

Bellon M R. (1996). The Dynamics of Crop Infra-specific Diversity: A conceptual framework at the farmer level. *Economic Botany* **50**: 26–39.

Carboni S M and Napier T L. (1993). Factors affecting use of conservation farming practices in East Central Ohio. *Agriculture Ecosystems and Environment* **45**(1): 79-94.

Chodvadiya M B, Singh S, Choudhary H, Parvez N, Ravikumar R K and Khobragade D R. (2016). On-farm trials of farmer's variety: tool for performance evaluation and adoption of variety in new areas. *International Journal of Advanced Research* **4**(11): 1703-1712.

Choudhary H, Singh S, Parvez, N, Rathore, R and Raghuvasnhi P S. (2016). Performance of Farmers' Pigeon Pea [*Cajanus cajan* L. Millsp.] Varieties: Opportunities for Sustained Productivity and Dissemination of Varieties. *International Journal of Agriculture Sciences* **8**(61): 3471-3474.

CRRI (2011). Vision 2030. Central Rice Research Institute, Indian Council of Agricultural Research, Cuttack, Odisha. Available at: http://www.crri.nic.in/crri_vision2030_2011.pdf.

CRRI (2014).CRRI Annual Report 2013-14. Central Rice Research Institute, Indian Council of Agricultural Research, Cuttack, Odisha. Available at: http://www.crri.nic.in/CRRI_annualreport/CRAR_13_14_web.pdf.

Economy Survey of Chhattisgarh (2015). Economic Survey of Chhattisgarh, 2014-15. Directorate of Economics and Statistics, Raipur, Government of Chhattisgarh. Available at:http://descg.gov.in/pdf/publications/latest/EconomicSurvey2014-15_E.pdf.

FAO (2016). Food and Agriculture Organization of the United Nations. *Rice Market Monitor*, **21**(2): 1-37. Available at: http://www.fao.org/fileadmin/templates/est/COMM_MARKETS_MONITORING/Rice/Images/RMM/RMM_JUL16.pdf.

Fuglie K O and Kascak C A. (2001). Adoption and diffusion of natural-resource-conserving agricultural technology. *Review of Agricultural Economics* **23** (2): 386-403.

IGNOU. (2007). BAPI003 Economics and marketing of organic produce. http://vedyadhara. Available at http://www.ignou.ac.in/wiki/images/b/bb/BAPI00301.pdf.

INDIASTAT (2016). Area, production and yield of rice in India (1949-1950 to 2017-2018-1st Advance Estimates). Available at: https://www.indiastat.com/table/agriculture/2/rice/17194/7264/data.aspx.

INDIASTAT (2016).State/Season- wise Area, Production and Productivity of Rice in India, 2015-16. Available at: https://www.indiastat.com/table/agriculture/2/rice/17194/1004419/data.aspx.

Jeon B N, Han K S and Lee M J. (2006). Determining factors for the adoption of e-business: the case of SMEs in Korea. *Applied Economics* **38**: 1905-1916.

Kumar P, Kumar S and Joshi L. (2015). Alternative Uses of Crop Stubble. In: *Socioeconomic and Environmental Implications of Agricultural Residue Burning*. Springer Briefs in Environmental Science. Springer, New Delhi.

Li D, Liu M and Deng G. (2010). Willingness and determinants of farmers' adoption of new rice varieties. *China Agricultural Economic Review* **2**(4): 456-471.

Mitra B, Mookherjee S and Miswas S. (2014). Promotion of short duration rice variety Gotra Bidhan-1(IET 17430) through front line demonstrations in terai region of West Bengal. *Journal of Crop and Weed* **10**(1): 111-114.

Nirmala B and Muthuraman P. (2009). Economic and constraint analysis of rice cultivation in Kaithal Districtof Haryana. *Indian Research Journal of Extension Education* **9**(1): 47-49.

Nirmala B, Vasudev N, and Suhasini K. (2012). A comparison of economic potential of HYVs Hybrid rice cultivation in Ambedkar Nagar district of Uttar Pradesh. *World Research Journal of Agronomy* **1**(1): 7-10.

Nurunnaher K M, Rahman and Ali M H. (2003). Productivity and efficiency measurement of rice production by Member and Non-member Farmers in Selected Cooperative Societies of Bangladesh, *Economic Affairs* **48**(4): 220.

Odisha Agriculture Statistics (2014). Odisha Agriculture Statistics, 2013-14.Directorate of Agriculture and Food Production, Odisha. Available at: http://agriodisha.nic.in/content/pdf/Agriculture%20Statistics_2013-14.pdf.

Odisha Economic Survey (2017). Odisha Economic Survey, 2016-17.Planning and Convergence Department, Directorate of Economics and Statistics, Government of Odisha. Available at: http://pc.odisha.gov.in/Download/Economic_Survey_2016-17.pdf.

Open Government Data Platform India (2014). District-wise, season-wise crop production statistics from 1997. Available at: https:// data.gov.in/resources/district-wise-season-wise-crop-production-statistics-1997.

Pannell D J, Marshall G R, Barr N, Curtis A, Vanclay F and Wilkinson R. (2006). Understanding and promoting adoption of conservation practices by rural landholders. *Australian Journal of Experimental Agriculture* **46**(11): 1407-1424.

Samant T K, Mohanty B and Dhir B C. (2015). On farm assessment of short duration rice variety Sahabhagidhan. *International Journal of Environmental & Agriculture Research* **1**(3): 1-4.

Sarnklong C, Cone J W, Pellikaan W and Hendriks W H. (2010). Utilization of rice straw and different treatments to improve its feed value for ruminants: A Review. *Asian-Australasian Journal of Animal Sciences* **23**(5): 680-692.

Sharma P K, Khar S, Kumar S, Ishar A, Prakash S, Mahajan V and Jamwal S. (2011). Economic impact of front line demonstrations on cereals in Poonch district of Jammu and Kashmir. *Journal of Progressive Agriculture* **2**(1): 21-25.

STATISTA (2018). World rice acreage from 2008-2009 to 2016-2017. Available at: https://www.statista.com/statistics/271969/world-rice-acreage-since-2008/.

Witcombe J R, Petre S J and Joshi A. (1996). Farmer participatory crop improvement. IV. The spread and impact of a rice variety identified by participatory varietal selection. *Experimental Agriculture* **35**: 471-487.