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Comparative economic analysis of organic versus inorganic paddy cultivation in Karnataka state

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ABSTRACT

Organic farming has the potential to provide benefits in terms of environmental protection, conservation of non-renewable resources and improved food quality. But it needs to overcome challenges like low yield during the initial years of conversion and government support to help farmers in the production as well as marketing process. Thus, the present study was conducted in the TBP command area comprising Raichur, Ballari and Koppala districts during the year 2023-24. A sample of 270 respondents was selected purposively from the selected three districts. The major findings of the study revealed that the total cost of organic paddy cultivation was similar or less than that of inorganic (transplanting) paddy cultivation and higher than DSR method of paddy cultivation. The average cost of cultivation of organic paddy was Rs. 48765.0 as against Rs. 48987.87 and 41187.00 on transplanting and DSR paddy cultivation. The cost of chemical fertilisers and cost of plant protection chemicals on inorganic paddy were the differing factors in the cost. In the total cost, variable costs accounted for a major share. The proportion of variable cost was Rs. 33455.69, Rs. 33427.87 and Rs. 25964.0 for organic, transplanting and DSR paddy, respectively. The share of fixed cost in total cost of cultivation of organic paddy and transplanting and DSR paddy was Rs. 15310.0, Rs. 15560.0 and 15223.0, respectively. Among the items of fixed cost, the rental value of the land had a maximum share in the total cost of cultivation on both organic and inorganic conditions. The per-acre average yield of organic paddy (main product 18.90 quintals and by product 0.94 TL) was far lower than that of inorganic paddy of transplanting method (main product 29.40 quintals and by product 1.10 TL) and DSR method of paddy cultivation (main product 28.32 quintals and by product 1.00 TL).

Keywords: *Organic paddy, Inorganic paddy, Direct seeded rice, Transplanting, Economic, Yield, and Cost and returns.*

INTRODUCTION

Agriculture continues to be a core sector of the Indian economy, on which more than 60 per cent of our population is dependent for their livelihood. Organic agriculture is a unique production management system which promotes and enhances the health of eco- system, including biodiversity, biological cycles and soil biological activity and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs.

India is bestowed with lot of potential to produce all varieties of organic products due to its suitable agro-climatic factors in several parts of the country; the inherited tradition of organic farming is an added advantage.

Karnataka state has a rich potential for organic farming. Farmers of Karnataka are progressive, innovative with great inclination towards the adoption of environment-friendly and sustainable organic agriculture. Considering this, the Karnataka Government brought out Organic Farming Policy during 2004 for promotion of organic farming in the state. With the successful implementation of organic farming policy initiatives and the great concern of the farming community, the state could achieve substantial progress in organic agriculture.

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At present, Karnataka stands 6th in the country in terms of total cultivated area under organic certification (including in conversion) accounting for approximately 93963 ha as on 2023 which was hardly 2500 ha during 2004-05. The state stood third in total certified production (2.83 lakh tons). This is indicative of immense opportunities available to the state in view of its inherent advantage of climate and diversified production (Anon., 2023a).

Karnataka is one of the major rice growing states in India with an area of 9.5 lakh ha with an annual production of 31.2 tonnes (2023-24), which shown decreasing trend in paddy yields over the past decade. Karnataka ranks fourth in productivity and ninth in production among major rice growing states of the country. The average yield of rice is 3282 kg/ha. The important rice growing districts of the state are Tumkuru, Dakshina Kannada, Shivamogga, Mandya, Uttara Kannada, Mysuru, Raichur and Kodagu (Anon., 2023b).

In TBP Command Area Rice, Sugarcane and Cotton are commonly grown, where Rice is the principal crop. The productivity in recent years is unsustainable due to indiscriminate use of nitrogenous fertilisers, application of low organic manures, increased pest and diseases and unscientific methods of water management practices. In this area the demand for organic rice is increasing and also area is also being increased year after year.

Organic farming systems have attracted increasing attention over the last one decade because they are perceived to offer some solutions to the problems currently besetting the agricultural sector.

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Organic farming has the potential to provide benefits in terms of environmental protection, conservation of non-renewable resources and improved food quality. In India, there is considerable latent interest among farmers in conversion to organic farming. But some farmers are reluctant to convert because of the perceived high costs and risks involved. Those who have converted are earning equal incomes to their conventional counterparts, if premium markets exist for organic produce. In this scenario, few studies are available to educate the farmers on the benefits of organic farming, especially on cost and returns and, efficiency fronts over conventional farming.

Thus, the study carried out with an objective which helps the conventional and organic paddy growers to analyse the cost and returns involved in paddy cultivation.

MATERIAL AND METHODS

The *ex-post facto* research design was used for the study. This design was considered appropriate because the phenomenon had already occurred.

The present study was conducted purposively during the year 2023-24 in Tungabhadra Command Area, comprising of Raichur, Ballari and Koppala districts (Fig. 1) were paddy (Rice) is being grown under both organic farming and conventional condition in a larger proportion.

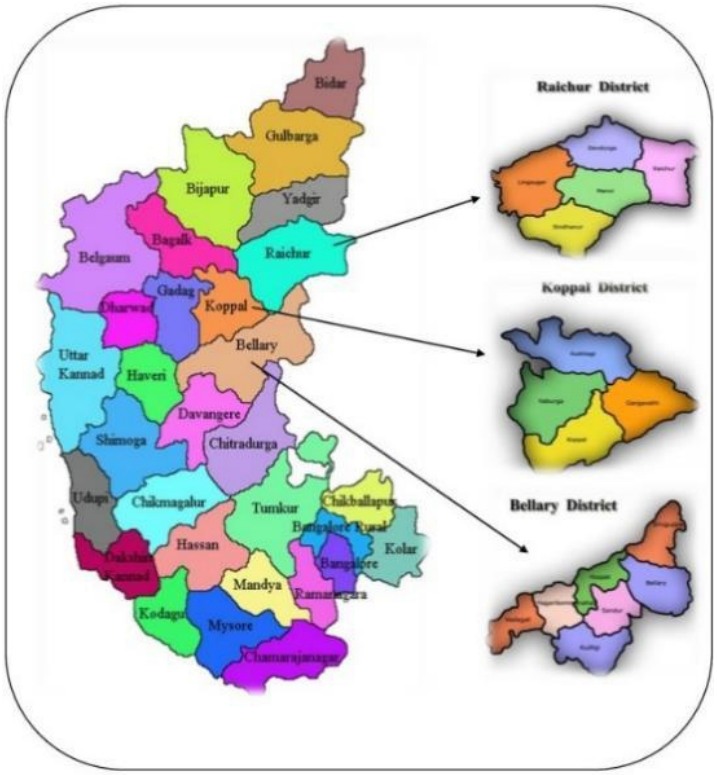

Fig. 1. Map showing the study area

Two talukas from Raichur and Ballari districts and one taluka from Koppala district were selected based on the highest area under paddy. The talukas selected for the study were Sindhanur and Manvi from Raichur district, Siraguppa and Ballari from Ballari district and Gangavathi from Koppala district, respectively. A list of villages where paddy is grown under organic conditions is prepared in consultation with officials of the Department of Agriculture and NGOs working in the respective districts under "Savayava Bhagya" scheme of GOK and also from the Organic Farming Research Institute, UAS, Raichur. All villages cultivating paddy in organic conditions were chosen for the study.

Thus, a total of 38 villages were selected, viz., 19 villages from Raichur district, 9 villages from Ballari district and 10 villages from Koppala district. From each selected village, all the farmers who are cultivating paddy under organic condition for a minimum of three years and also who are beneficiaries of Savayava Bhagya scheme of Govt. Karnataka were considered as sample organic paddy growers and on the contrary the paddy growers who are cultivating paddy under inorganic / chemical method were considered as conventional paddy growers. A separate list of conventional paddy growers from the same villages was prepared in consultation with farm facilitators and officials working at Raitha Samparka Kendra (RSK).

Under inorganic paddy cultivation it is commonly found two methods of cultivation. i.e., transplanting and direct-seeded rice (DSR). Keeping this in mind 90 transplanting and 90 DSR method of paddy growers were selected using a proportionate sampling method. Thus, making the total sample size 270, comprising of 90 organic paddy growers and 180 inorganic paddy growers (90 transplanting + 90 DSR).

FINDINGS AND DISCUSSION

Cost and returns involved in organic and inorganic paddy cultivation

1. Input usage pattern under organic and inorganic paddy cultivation

In the study area growers use different types of inputs in the cultivation of paddy both organically and inorganically. About 11 types of inputs were used in the organic paddy cultivation (Table 1). They were seeds, farm yard manure, vermicompost, city compost, neem cake, jeevamritha, panchagavya, cow urine, dhashaparani kashaya, bio-insecticides and neem oil. But in case of inorganic paddy cultivation about 10 types of inputs were used (Table 2 and 3) namely seeds, urea, DAP, potash, complex fertilisers, zinc sulphate, herbicide, plant growth promoters, micro-nutrient mixtures and plant protection chemicals.

In DSR paddy cultivation less quantity of seeds was used than that of organic and inorganic paddy and the cost involved in usage of seeds in DSR paddy (Rs 337.0) was lower than that of organic (Rs 1400.0) and inorganic paddy (Rs 1060.0). The main reasons for lesser seed rate were in DSR because of sowing method seeds required is less and in case of organic paddy a higher germination percentage was observed and plant population maintained on organic paddy was comparatively less than that of inorganic paddy. The organic growers used 1.58 tonnes of FYM, whereas the inorganic (transplanting and DSR) growers not apply FYM since the inorganic growers used more of chemical fertilizers. In addition to FYM the organic growers also applied vermicompost (530.0 kg), city compost (200 kg), neem cake (112.6 kg) and liquid organic solutions (23.18 litre). Hence, the cost involved in the usage of vermicompost is more in case of organic growers. Both transplanting and DSR growers are mandatorily using urea (178.52 and 98.26 kg), DAP (42.50 and 58.50 kg), potash (50 and 41.50 kg) and complex fertilisers (177.53 and 105.32 kg) as source of nutrients. The high usage of chemical fertilisers in the study area is due to less nutrients and less soil fauna (microbes) present in the soil. Since these chemical fertilisers given three to four times and also, they are cheaper than organic manures, the total cost involved in the usage of chemical fertilisers is lesser (Rs. 5400.0 in DSR and Rs. 7010.0 in transplanting) than that of organic fertilizers (Rs. 8466.0).

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In the case of plant protection measures, the organic growers used liquid organic solutions (Rs. 2267.0) whereas, the inorganic (transplanting and DSR) growers used plant protection chemicals (Rs. 6263.0 and 5710.0) and used herbicides (Rs. 443.0 and 700.0) for controlling weeds. Though organic growers used more quantity of liquid organic solutions (biopestcides) than plant protection chemicals in inorganic paddy but cost involved was much higher in case of inorganic paddy (Rs. 6263.0 and 5710.0) than organic paddy (Rs. 2267.0). The results are in confirmity with the results of Sale and Yadav (2008) and Raghavendra et al. (2014).

2. Labour use pattern in organic and inorganic paddy cultivation

The quantity of labour used and costs involved in the different operations of organic and inorganic paddy cultivation are presented in the Table 4.

It can be observed from Table 4 that, the organic growers use less quantity of machine labour, more quantity of human labour than that of inorganic farmers in various operations. In case of organic paddy production, for ploughing 2.20 hours of machine labour was used for an acre. In case of puddling operation, 1.80 hours of machine labour was used for transportation of FYM 1.09 hours of machine was used. About 0.50 man-days of human labour was used for spreading of FYM. In case of seed bed preparation, 2.40 man-days of human labour was used. In case of transplanting operation 15.80 man-days, for organic manures application, 4.90 man-days and for hand weeding, about 17.10 man-days of human labour were used. About 8.30 man-days for the spraying of biopesticides and 3.50 man-days for irrigation were used. For harvesting 1.15 hours of machine labour (combined harvester) was used.

In case of inorganic (transplanting) paddy cultivation, for ploughing 2.30 hours of machine labour was used for an acre, for puddling operation 1.90 hours of machine labour was used. About 0.80 man-days of human labour was used for cleaning of bunds. In case of seed bed preparation 2.50 man-days of human labour were used. In case of transplanting operation 16.60 man-days, for chemical fertilizers application 4.20 man-days and for hand weeding 9.80 man-days of human labour were used. About 5.80 man-days for spraying of plant protection chemicals and 3.70 man-days for irrigation were used. For harvesting 1.10 hour of machine-labour was used. Thus, human labour use was more in organic paddy cultivation as compared to inorganic paddy cultivation.

This was mainly since the organic paddy cultivation involves more number of times of hand weeding operation i.e., intensive usage of human labour in hand weeding than inorganic paddy cultivation as it usually follows less number of times of hand weeding due to usage of herbicide application and also the organic paddy cultivation involves more number of human labourers in spreading of FYM, seed bed preparation, organic manures application and for preparing and spraying of biopesicides than that of inorganic cultivation. Hence the cost involved on human labour in organic paddy was more than that of inorganic paddy cultivation. The findings of the study are in agreement with Sujatha et al. (2006).

In case of inorganic (DSR) paddy cultivation, for ploughing 2.26 hours of machine labour was used for an acre, for rotavator operation 1.20 hours of machine labour was used. In case of chemical fertiliser application 3.50 man-days and for hand weeding 19.25 man-days of human labour were used. About 4.30 man-days for spraying of plant protection chemicals and 3.10 man-days for irrigation were used.

For harvesting 1.12 hour of machine labour was used. Thus, human labour use was less in DSR paddy cultivation as compared to transplanting paddy cultivation.

This was mainly since the in DSR paddy cultivation there is a high intensity of weed. This involves more number of times of hand weeding operation i.e., intensive usage of human labour in hand weeding than transplanting paddy cultivation as it usually follows less number of times of hand weeding due to standing water in the field and usage of herbicide application followed in DSR method. This method involves less number of human labourers in fertilizer application and for spraying of insecticides than that of transplanting paddy cultivation. Hence the cost involved on human labour in DSR paddy was less than that of transplanting paddy cultivation. The findings of the study are in agreement with Sujatha et al. (2006).

3. Cost incurred in organic and inorganic paddy cultivation

It is evident from the results presented in the Table 5 that, the cost incurred in DSR paddy cultivation (Rs 41187.0) was less when compared to that on organic (Rs 48765.0) and transplanting paddy cultivation (Rs 49937.0). This difference in cost of cultivation was due to the higher cost incurred on chemical fertilizers as well as on plant protection chemicals by inorganic growers.

The per acre variable cost in DSR paddy (Rs 25964.0) was less as compared to that on organic paddy cultivation (Rs 33455.0) and inorganic paddy cultivation (Rs 34377.0). The cost incurred on organic manures was high in organic paddy cultivation as compared to cost incurred on chemical fertilizers in inorganic paddy cultivation, but most of the organic paddy growers prepare the manures in their own and also most of the raw materials required were available at village level and were cheaper as compared to chemical fertilizers.

The cost on total human labour was higher in organic paddy cultivation and DSR method as compared to transplanting paddy cultivation this was mainly because of more number of times of hand weeding operation and also the organic cultivation involves more number of human labour in spreading of FYM, organic manures application and for preparing and spraying of biopesicides than that of transplanting paddy cultivation.

There was more seed quantity required in transplanting paddy cultivation than organic and DSR paddy cultivation, this was mainly due to the reason that germination percentage was much higher in organically produced seeds and plant population maintained in organic paddy cultivation was comparatively less than that on inorganic paddy cultivation and also less seeds were required in DSR because of sowing. The cost incurred on plant protection measures was low in organic paddy compared to inorganic paddy because of the organic growers used biopesticides, most of which were prepared in home and some are purchased in a smaller quantity.

The cost incurred on land revenue and land rent was mere similar in both organic and inorganic paddy cultivation. The depreciation charge was relatively high on transplanting paddy and low in DSR and organic paddy cultivation because of the inorganic growers material/asset position was high. Similar results were observed by Jitendra Singh et al. (2006), Sujatha et al. (2006) and Raghavendra et al. (2014).

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4. Cost and returns structure in organic and inorganic paddy cultivation

It is evident from the results presented in the Table 6 and Fig. 2 that, the average yield of paddy was low on organic paddy cultivation as compared to inorganic (transplanting and DSR) paddy cultivation. This was mainly due to the fact that most of the organic growers practiced the organic farming from last three years only, since building up soil fertility it takes more than five years and hence in initial four years there is yield loss in the organic paddy compared to inorganic paddy cultivation.

The average market price of organic paddy (main product) was (Rs 4652.0 per quintal) and by product was (Rs 3152.0 per TL) found to be higher than that of inorganic paddy (main product) was (Rs 2113.0 and Rs 2112.50 per quintal) and by product was (Rs 2887.0 and Rs 2850.0 per TL), since the organically produced paddy could fetch premium price in the market. Though yields were less but because of the premium price it fetched the net return on organic paddy was more (Rs 40330.0) than that of inorganic paddy (Rs 13551.13.and 20036.0). The returns per rupee of investment was also higher on organic paddy (1.79) compared to DSR (1.46) and transplanting paddy (1.30). The findings conform with the results of Naik et al. (2011), Inder pal Singh and Grover (2011) and Raghavendra et al. (2014).

Table 1. Input usage pattern in organic paddy cultivation ***(per acre) n=90***

Sl. No.	Type of input	Unit	Quantity used	Price/unit	Cost of input (Rs.)
1	Seeds	kg	22.40	62.50	1400
2	Organic fertilizers	kg	2422	-	8325
a	FYM	kg	1580	1400.00	2212
b	Vermicompost	kg	530.00	6.20	3286
c	City compost	kg	200.00	400.0	800
d	Neem cake	kg	112.60	18.00	2027
3	Liquid organic solutions*	lit	23.18	-	2267

*Note: *Includes Jeevamrutha, Panchagavya, Cow urine, Dashaparanikashaya, Bio-insecticides and neem oil*

Table 2. Input usage pattern in inorganic (transplanting) paddy cultivation ***(per acre) n=90***

Sl. No.	Type of input	Unit	Quantity used	Price/unit (Rs.)	Cost of input (Rs.)
1	Seeds	kg	24.72	42.89	1060
2	Chemical fertilizers	kg	458.75	-	7010
a	Urea (N)	kg	178.52	6.20	1107
b	DAP (P)	kg	42.50	26	1105
c	Potash (K)	kg	50.00	18	900
d	Complex fertilizers	kg	177.53	-	3653
	10:26:26	kg	65.33	25	1633
	20.:20:0:1	kg	112.20	18	2020
e	Zn sulphate	kg	10.20	24	245
3	Herbicide	lit	0.43	1030	443
4	Plant growth promoters	lit	0.46	1020	469
5	Micronutrient mixture	kg	0.52	1520	760
6	Plant protection chemicals	lit	7.43	-	6263
a	Insecticides		5.18	-	4135
b	Fungicides		2.25	-	2128

Table 3. Input usage pattern in inorganic (DSR) paddy cultivation ***(per acre) n=90***

Sl. No.	Type of input	Unit	Quantity used	Price/unit (Rs.)	Cost of input (Rs.)
1	Seeds	kg	10.89	30	327
2	Chemical fertilizers	kg	313.58	-	5400
a	Urea (N)	kg	98.26	6.20	609
b	DAP (P)	kg	58.50	26	1521
c	Potash (K)	kg	41.50	18	747
d	Complex fertilizers	kg	105.32	-	2283
	10:26:26	kg	55.32	25	1383
	20.:20:0:1	kg	50.00	18	900
E	Zn sulphate	kg	10.00	24	240
3	Herbicide	lit	0.68	1030	700
4	Plant growth promoters	lit	0.54	1020	551
5	Micronutrient mixture	kg	0.51	1520	775
6	Plant protection chemicals	lit	6.52	-	5710
a	Insecticides		4.72	-	3816
b	Fungicides		1.80	-	1894

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Table 4. Labour use pattern in organic and inorganic paddy cultivation *(per acre) n=270*

Sl. No.	Particulars	Units	Organic paddy (n_1=90)		Inorganic paddy (n_2=180)			
					Transplanting (n_1=90)		DSR (n_2=90)	
			Quantity	Cost (Rs.)	Quantity	Cost (Rs.)	Quantity	Cost (Rs.)
1	Ploughing	Machine hours	2.20	1600	2.30	1630	2.26	1620
2	Puddling/ rotavator	Machine hours	1.80	1200	1.90	1296	1.20	6.30
3	Transportation of FYM/compost	Machine hours	1.09	560	0.00	0.0	0.0	0.0
4	Cleaning of bunds	Man days	1.00	300	0.80	280	0.0	0.0
5	Spreading of FYM	Man days	0.50	150	0.0	0.0	0.0	0.0
6	Seed bed preparation	Man days	2.40	720	2.50	750	0.0	0.0
7	Transplanting	Man days	15.80	2370	16.60	2490	0.0	0.0
8	Organic manure/ chemical fertilizer application	Man days	4.90	1470	4.20	1260	3.50	1050
9	Hand weeding	Man days	17.10	2560	9.80	1470	19.25	2887.5
10	Herbicide application	Man days	-	-	1.80	540	2.4	720
11	Preparation of organic solutions	Man days	2.60	780	0.0	0.0	00	0.0
11	Spraying biopesticides/ PPC	Man days	8.30	2490	5.80	1740	4.30	1290
12	Irrigation	Man days	3.50	1050	3.70	1110	3.10	930
13	Harvesting	Machine hours	1.15	2696	1.10	2560	1.12	2592

Table 5. Cost incurred in organic and inorganic paddy cultivation *(per acre) n=270*

Sl. No.	Particulars	Organic paddy growers (n_1=90)		Inorganic paddy growers (n_2=180)			
				Transplanting (n_1=90)		DSR (n_2=90)	
		Quantity	Cost (Rs.)	Quantity	Cost (Rs.)	Quantity	Cost (Rs.)
A	**Variable cost**						
1	Seeds (kg)	22.40	1400	24.72	1060	10.89	327
2	Organic manures (kg)	2422	8325				
	FYM/compost	1508	2212	-	-	-	-
	Vermicompost	530.00	3286	-	-	-	-
	City compost	200.00	800	-	-	-	-
	Neem cake	112.60	2027	-	-	-	-
3	Chemical fertilizers (kg)	-	-	458.75	7010	313.58	5400
	Urea	-	-	178.52	1107	98.26	609
	DAP	-	-	42.50	1105	58.50	1521
	Potash	-	-	50.00	900	41.50	747
	Complex fertilizers	-	-	177.53	3653	105.32	2283
	Zinc sulphate	-	-	10.20	245	10.00	240
4	Organic liquid solutions (lt)	23.18	2267	-	-	-	-
5	Herbicide (lt)	-	-	0.43	443	0.68	700
6	Plant protection chemicals (lt)	-	-	7.43	6263	6.52	5710
7	Plant growth promoters (lt)	-	-	0.46	469	0.54	551
8	Micronutrient mixture	-	-	0.52	760	0.51	755
9	Labour usage	56.10	19125.0	45.20	15086.00	26.55	10672.50
a	Family labour	7.06	1717.50	5.03	1350.00	4.26	1125.00
i	Men	4.39	1317.00	3.97	1191.00	3.24	972.00
ii	Women	2.67	400.50	1.06	159.00	1.02	153.00
b	Hired labour	40.74	9037.50	34.37	6510.00	23.99	4462.50
i	Men	14.01	4503.00	9.03	2709.00	5.76	1728.00
ii	Women	30.23	4534.50	25.34	3801.00	18.23	2734.50
c	Machine labour	14.54	8546.00	11.12	7226.00	4.58	4842.00
i	Tractor (hr)	5.09	3360.00	4.20	2926.00	3.46	2250.00
ii	Combined harvester (hr)	1.15	2696.00	1.10	2560.00	1.12	2592.00
iii	Sprayer (days)	8.30	2490.00	5.82	1740.00	4.30	1290.00
10	Irrigation charge	-	150	-	150	-	150
11	Interest on working capital @7%	-	2188.69	-	2186.87	-	1698.50
	Sub total (A)	-	33455.69	-	33427.87		25964.0
B	**Fixed cost**						
	Land revenue	-	150.00	-	150.00	-	150.00
	Rental value of the land	-	12543.00	-	12528.00	-	12310.00
	Depreciation cost	-	1100.00	-	1340.00	-	1254.00
	Interest on fixed capital @ 11%	-	1517.00	-	1542.00	-	1509.00
	Sub total (B)	-	15310.00	-	15560.00	-	15223.00
	Total cost of cultivation (A+B)	-	48765.69	-	48987.87	-	41187.00

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Table 6. Cost and returns structure in organic and inorganic paddy cultivation *n=270*

Sl. No.	Particulars	Organic paddy (n_1=90)	Inorganic paddy (n_2=180)	
			Transplanting (n_i=90)	DSR (n_{ii}=90)
1	Yield / acre			
i	Main product (qntls/ac)	18.90	29.40	28.32
ii	By product (tractor load/ac)	0.94 TL	1.10 TL	1.00 TL
2	Market price			
i	Main product (Rs./qntls)	4652.00	2113.00	2112.50
ii	By product (Rs./tractor load)	3152.00	2887.00	2850.00
3	Gross returns (Rs./ac)	**91075.00**	**65009.00**	**62676.00**
4	Cost of cultivation (Rs./ac)	48765.00	49987.87	41187.00
5	Total marketing cost (Rs./ac)	1980.00	1470.00	1453.00
6	Net returns (Rs./ac)	40330.00	13551.13	20036.00
7	**Returns per rupee of investment**	1.79	1.30	1.46

TL- Tractor load

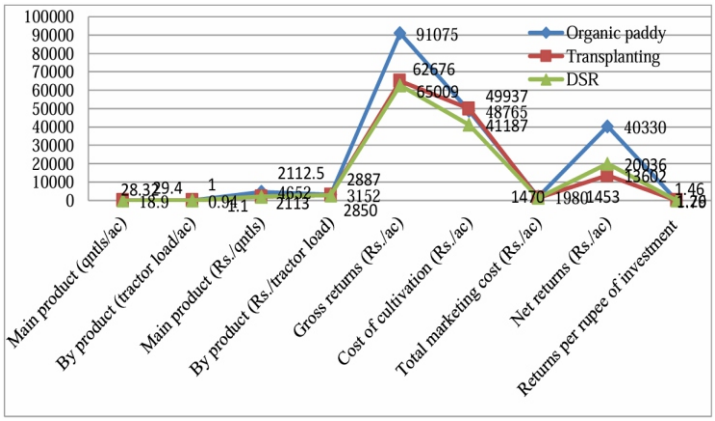

Fig. 2: Cost and returns structure in organic and inorganic paddy cultivation

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