

An Economic Analysis of Energy Use in ZBNF, Conventional Farming and Organic Farming in Rice Production in Visakhapatnam District of Andhra Pradesh

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ABSTRACT

The present study has assessed the economics of energy use in rice production in zero budget natural farming, organic farming and conventional farming in Visakhapatnam district of Andhra Pradesh, based on the data of costs and returns of crop. The results revealed that the returns per rupee expenditure was higher for organic farming (1.54) followed by ZBNF (1.24) and conventional farming (1.13). Human labour is the costliest source of energy in all the three farming methods of rice production. The total cost incurred for paddy cultivation is higher in conventional farming (Rs. 84784.30/ha) followed by ZBNF (Rs. 79489.64/ha) and organic farming (Rs. 45896.67/ha). Human labour is the costliest source of energy in all the three farming methods.

Key words: Cost concepts, Energy, Organic farming and conventional farming, Rice, ZBNF

In India, Rice (*Oryza sativa*) is one of the most important crops. In Andhra Pradesh during 2017-18, rice is cultivated in 22.18 lakh hectares and production and productivity are about 126.91 lakh tonnes and 5722 kg ha⁻¹ respectively. In Andhra Pradesh, Visakhapatnam district has a rice production of 3.43 lakh tonnes in 109 thousand hectares.

Rice is cultivated in different methods such as zero budget natural farming (ZBNF), conventional farming and organic farming. Conventional farming refers to farming systems which include the use of synthetic chemical fertilizers, pesticides, herbicides and other inputs, genetically modified organisms, concentrated animal feeding operations, heavy irrigation and intensive tillage. Organic farming involves cultivation of crop using biological materials, avoiding synthetic substances to maintain soil fertility and ecological balance. ZBNF involves the cultivation of crops using natural materials such as cow dung, cow urine, brown sugar etc. ZBNF includes fertilizers such as jeevamrutham, ghanajeevamrutham, beejamrutham etc., and biocides such as neemastra, agniastra, brahmastra. The energy consumption and cost of cultivation varies from each other in all the three farming methods. So, the study entitled with "An economic analysis energy use in ZBNF, conventional farming and organic farming in rice production in Visakhapatnam district of Andhra Pradesh state" was undertaken with an objective to "to access the economics of energy use in three different farming of methods rice production".

MATERIAL AND METHODS

A multi-stage sampling technique was adopted for selecting sampling units at various levels.

In Andhra Pradesh, Visakhapatnam district was selected as the three farming practices namely, Zero Budget Natural Farming, conventional farming and organic farming were being adopted and ZBNF was practiced in 71 villages in the district and organic farming was practiced in 626 villages in 30 mandals of the district. In Visakhapatnam, Anakapalle and Chodavaram mandals were selected for the study on ZBNF and conventional farming and Paderu and Hukumpeta mandals were selected for the study on organic farming. Based on Cochran's formula, total sample size of 136 respondents were selected out of 782 respondents identified by the Department of Agriculture for the present study. The respondents following zero budget natural farming, conventional farming and organic farming were randomly selected for the present study.

Analytical Framework

Costs and returns

The different cost concepts used in this study are A₁, A₂, B₁, B₂, C₁, C₂ and C₃. Based on these cost concepts the production cost of rice was calculated for ZBNF, organic and conventional farming.

The Commission on Agricultural Costs and Prices approved cost concepts are used for the study.
Cost A₁:

Cost A₁: Value of hired human labour + Value of owned and hired bullock power + Value of owned and hired machine power + Value of owned and purchased seed + Value of owned and purchased manures + Value of fertilisers and pesticides + Depreciation on farm implements, farm buildings etc. + Irrigation charges + Interest on working capital + Land revenue.

Table 1. Cost and returns in rice production (Rs/ha)

S. No.	Particulars	ZBNF (n=27)	Percentage	Conventional farming (n=69)	Percentage	Organic farming (n=40)	Percentage
1	Hired human labour	29411.00	48.07	27160.00	40.94	12165.00	28.69
2	Imputed value of family labour	11632.00	19.01	9381.00	14.14	1105.11	2.60
3	Human labour (1+2)	41043.00	67.08	36541.00	55.08	13270.11	31.37
4	Seed cost	1704.00	2.78	1704.00	2.56	1719.12	4.06
5	Animal power	-	-	-	-	4320.30	10.21
6	Machine power	12208.00	19.95	9172.00	13.82	8022.50	18.97
7	Manures	5835.50	9.53	4495.30	6.77	8359.00	19.71
	Natural fertilizers	243.20	0.39	-	-	-	-
	Chemical fertilizers	-	-	11925.40	17.97	-	-
	Organic fertilizers	-	-	-	-	5524.35	13.03
8	Plant protection chemicals	-	-	2500.00	3.76	-	-
	Biocides	149.73	0.24	-	-	1074.02	2.53
9	Total	61183.43	100.00	66337.71	100.00	42389.40	100.00
10	Interest on working capital	889.06	-	956.60	-	470.42	-
11	Land revenue	600.00	-	600.00	-	50.00	-
12	Rental value of owned land	15000.00	-	15000.00	-	2625.78	-
13	Depreciation	233.78	-	300.00	-	85.00	-
14	Interest on fixed capital	1583.37	-	1590.00	-	276.07	-
15	Total fixed capital	17417.15	-	17490.00	-	3036.85	-
16	Grand total	79489.64	-	84784.30	-	45896.67	-
17	Cost A1 (Total operational cost)	51274.27	-	58813.30	-	41889.71	-
18	Cost A2	51274.27	-	58813.30	-	41889.71	-
19	Cost B1	52857.64	-	60403.30	-	42165.78	-
20	Cost B2	67857.64	-	75403.30	-	44791.56	-
21	Cost C1	64489.64	-	69784.30	-	43270.89	-
22	Cost C2	79489.64	-	84784.30	-	45896.67	-
23	Cost C3	87438.61	-	93262.73	-	50486.33	-
24	Yield (kg ha ⁻¹)	4875.00	-	4312.00	-	5062.50	-
25	Gross income (yield + straw)	98500.00	-	95500.00	-	70568.00	-
26	Net income	19010.35	-	10715.69	-	24671.33	-
27	Returns per rupee of expenditure	1.24	-	1.13	-	1.54	-

Cost A₂: Cost A₁ + Rent paid for the leased-in land.

Cost B₁: Cost A₂ + Interest on fixed assets (excluding land)

Cost B₂: Cost B₁ + Rental value of the owned land

Cost C₁: Cost B₁ + Imputed value of family labour.

Cost C₂: Cost B₂ + Imputed value of family labour

Cost C₃: Cost C₂ + 10% of Cost C₂

RESULTS AND DISCUSSION

Farm income measures

Gross Income: Synonymous with value of output (both main and by product)

Net Income: Gross Income – Cost C₂

Returns per rupee expenditure:

Gross returns / Total cost (Cost C₂)

From Table 1, it could be observed that, the cost of human labour was highest in ZBNF (67.08 %) followed by conventional farming (55.08 %) when compared to all other operations involved in rice production and the cost of organic fertilizers and manures was highest in organic farming (32.82 %). The cost of biocides was lowest in ZBNF 0.24 % and the cost of seed was lowest in conventional farming 2.56 %.

The costs involved on fertilizers and plant protection measures were low in zero budget natural farming when compared to organic and chemical fertilizers as these are home prepared and the most of the materials used for preparation were naturally available and costs involved in organic fertilizers and

Table 2. Energy use pattern (MJ/ha.) in rice production

S. No.	Input Energy	Zero budget natural farming (n=27)		Conventional farming (n=69)		Organic farming (n=40)	
		MJ ha ⁻¹	Percentage	MJ ha ⁻¹	Percentage	MJ ha ⁻¹	Percentage
1	Human energy	2377.86	16.67	1778.42	7.71	1332.90	9.53
2	Mechanical energy	4518.00	31.68	4552.46	19.74	1322.12	9.45
3	Animal energy	-	-	-	-	471.34	3.37
4	Seed energy	1089.13	7.63	1046.37	4.53	1089.00	7.79
5	Fertilizers and manures energy	4708.55	33.01	15351.87	66.58	8823.42	63.11
6	Plant protection measures energy	1566.96	10.98	326.48	1.41	940.06	6.72
7	Total	14260.00		23055.60		13978.84	
	Output Energy	68906.25		64771.87		75796.87	

Table 3. Economics of energy use in rice production

S. No.	INPUTS	Zero budget natural farming (n=27)		Conventional farming (n=69)		Organic farming (n=40)	
		Rs MJ ⁻¹	Percentage	Rs MJ ⁻¹	Percentage	Rs MJ ⁻¹	Percentage
1	Human labour	17.26	75.53	20.54	62.46	9.95	33.78
2	Machine labour	2.70	11.79	2.01	6.11	6.06	20.57
3	Animal labour	-	-	-	-	9.16	31.10
4	Seed	1.56	6.81	1.63	4.92	1.57	5.33
5	Fertilizers and manures	1.29	5.63	1.06	3.22	1.57	5.33
8	Plant protection measures	0.09	0.39	7.65	23.26	1.14	3.87
	Total	22.90	100.00	32.88	100.00	29.45	100.00

plant protection measures were low when compared to conventional farming because they are home prepared and microbial extracts purchased will be used in small quantities and available at lower prices.

The cost of human labour was low in organic farming when compared to conventional farming and zero budget natural farming as the requirement of labour for fertilizer application and for plant protection measures is low.

The total cost involved in conventional farming was highest when compared to ZBNF and organic farming. The net income was highest in organic farming followed by ZBNF and conventional farming. The returns per rupee expenditure for ZBNF, conventional farming and organic farming was 1.24, 1.13 and 1.54 respectively. The returns per rupee expenditure for organic farming is highest when compared to ZBNF and conventional farming because lower cost of cultivation in organic farming when compared to ZBNF and conventional farming.

The input- wise per hectare energy use pattern of zero budget natural farming, conventional farming and organic farming in rice production was presented in Table 2. In three different farming methods for rice production, conventional farming consumed maximum amount of energy (23055.6 MJ/ha.) followed by zero budget natural farming (14260.5 MJ/ha.) and organic farming (13978.84 MJ/ha.). Among all the operations in three farming methods, fertilizer and manures consumed maximum energy when compared to all the operations involved in rice production. These findings are in line with the findings of Pradhan *et al.* (2015) who reported that fertilizer consumed highest amount of energy in rice production.

The yield energy estimated for rice production in organic farming (75796.87 MJ/ha.) was highest followed by zero budget natural farming (68906.25 MJ/ha.) and conventional farming (64771.87 MJ/ha.)

The operation- wise cost of each input in all the three different farming methods in rice production

is presented in Table 3. In zero budget natural farming, human labour (Rs.17.26MJ⁻¹) is the costliest source of energy which accounted for 75.53 per cent of total unit energy cost followed by machine labour (Rs.2.70MJ⁻¹), which accounted to 11.79 per cent. In conventional farming, human labour (Rs.20.54MJ⁻¹) was the costliest source of energy which accounted for 62.46 per cent of total unit energy cost followed by plant protection chemicals (Rs.7.65MJ⁻¹) which accounted for 23.26 per cent. In organic farming, human labour (Rs.9.95MJ⁻¹) is the costliest source of energy which accounted for 33.78 per cent of total unit energy cost followed by animal labour (9.16 Rs MJ⁻¹) accounted 31.10 per cent.

Among all the operations, the cost of human labour was the highest in all the three farming methods. Various operations such as land preparation, sowing, application of fertilizers, plant protection measures etc., are done by human labour and the wages are also high. Fertilizer and manure is the cheapest source of energy in conventional farming and plant protection measures is the cheapest source of energy in ZBNF and organic farming.

CONCLUSION

From the results, human labour is the costliest source of energy in all the three farming methods of rice production. The total cost incurred for paddy cultivation is higher in conventional farming (Rs. 84784.30/ha) followed by ZBNF (Rs. 79489.64/ha)

and organic farming (Rs. 45896.67/ha). The returns per rupee expenditure for ZBNF, conventional farming and organic farming was 1.24, 1.13 and 1.54 respectively. The yield of the rice is higher in organic farming (5062.5 kg/ha) followed by ZBNF (4875 kg/ha) and conventional farming (4312 kg/ha) respectively.

Policies

Organic farming is recommended as best farming method when compared to ZBNF and conventional farming as returns per rupee expenditure is highest in organic farming.

Awareness should be created among the farmers on optimum usage of inputs through extension services which saves the cost and energy per unit of output.

Certification of ZBNF and organic rice production helps the farmers in setting incentive price of the rice.

LITERATURE CITED

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