



Research Article

ECONOMIC FEASIBILITY OF COMBINE HARVESTER IN PADDY CULTIVATION

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Abstract: The present study was undertaken mainly to study the cost and returns of paddy under conventional and combine harvester methods and economic viability of Paddy combine harvester. Medak district in Telangana state was purposively chosen for the study as it has considerable area under paddy and more than 85 percent of paddy area is harvested with combine harvester. Three major mandals were selected purposively on the basis of area under paddy cultivation. One village from each selected mandal was chosen for the study. Paddy farmers from each village were randomly selected and made the total sample size to 30. The information pertaining to combine harvester was collected from the 10 combine harvester owners. Tabular analysis and discounted project evaluation techniques were used to study costs, returns of the paddy and economic feasibility of the combine harvester respectively. The problems were also ranked. The total cost expended per acre of paddy stood at Rs. 25850.18 and Rs. 22702.62 with manual and combine harvester methods of harvesting respectively. The gross and net income per acre were Rs.38770/- and Rs.12919.82/- respectively with Conventional method as against Rs.35770/- and Rs.13067.38/- respectively using Combine harvester method. The returns per rupee invested were higher in Combine harvester (1.58) compared to Conventional method (1.50). The net gain due to mechanized harvesting using combine harvester was Rs.147.56/- per acre. The net present worth was high and ranged from Rs.9, 69,426/- at 12 percent to Rs.8, 39,709.7 at 24 percent discount rates. The benefit cost ratio was more than unity at all the discount rates. The internal rate of return was found to be 23.79% which was much higher than the bank rate of interest (12 percent) on long term loans. The major problems encountered in farm mechanization in paddy cultivation were high investment on farm machineries followed by non-suitability for small sized holders. Fodder loss was another major problem due to use of combine harvester for harvesting. Custom hiring was the problem due to high hiring charges of farm equipment's or machineries.

Keywords: Paddy, Combine harvester, Costs, Returns, Economic feasibility

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Introduction

Rice production in India is an important part of the national economy. West Bengal is the leader among all rice producing states with more than 13% contribution in India's Rice Production followed by Uttar Pradesh, Andhra Pradesh and Telangana. Harvesting and threshing are the most important operations in the entire range of field operations which are laborious, human drudgery and requires about 150-200 man-h/ha for harvesting of paddy. To reduce the harvesting loss and cost, timely harvesting of paddy is very important. A well-designed combined harvester can play an important role in harvesting of paddy in time, efficiently and in less cost. There is a growing trend of using combine harvesters in paddy cultivation in Telangana state for the last 10 years. Therefore, this study was undertaken to evaluate the technical and economic performance of combine harvester available in farmer's field stand to find out the suitability of the machine in the socio-economic conditions of the farmers of Telangana state [1-4].

Material and Methods

Medak district was purposively chosen for the study as it has considerable area under Paddy in Telangana. The top 3 mandalas were selected purposively on the basis of area under Paddy cultivation. One village from each selected mandal was chosen purposively. Ten Paddy farmers from each village were randomly selected and thus making the total sample size to 30. Survey method was employed to collect the data from the Paddy growers. The information pertaining to combine harvester was collected from the 10 combine harvester owners. The data collected for the study related to the agricultural year 2016-17. The data collected were subjected to conventional tabular analysis to work out costs and returns of Paddy

with manual and Combine Harvester type of harvesting. Discounted cash flow techniques were used to analyze the capital productivity of combine harvester.

Discounted techniques

The following discounted cash flow measures were used in the analysis viz., Net present worth, Benefit-Cost Ratio and Internal Rate of Return.

Net Present worth (NPW)

It is sometimes referred to as net present value. It is the present worth of the incremental net benefits or incremental cash flow stream. The selection criterion of the project depends on the positive value of the net present worth when discounted at the opportunity cost of the capital. Net present worth of the project (NPW) is estimated using the following formula

$$\text{Net Present worth} = \sum_{j=1}^n \frac{B_j - C_j}{(1+i)^j}$$

B_j = Benefits in Rupees in j^{th} year

C_j = Costs incurred in j^{th} year

i = Discount Rate

N = No of Years

Benefit-cost Ratio (BCR)

This ratio compares the present worth of costs with present worth of benefits. The common procedure of selecting the project is to choose the projects having the B.C. ratio of more than one, when discounted at opportunity cost of capital.

This ratio was arrived by using the following formula.

$$B.C. Ratio = \frac{\sum_{j=1}^n B_j / (1+i)^j}{\sum_{j=1}^n C_j / (1+i)^j}$$

Where B_j = Benefits in rupees in j^{th} year

C_j = Costs in rupees in j^{th} year

i = Discount rate

N = Number of years

Internal Rate of Return (IRR)

It represents the average earning capacity of an investment over the economic life period of the project. It is that discount rate which just makes the net present worth of cash flow equal to zero. In other words, the benefit cost ratio calculated at IRR is unity. IRR is the maximum interest that a project could pay for the resources used if the project is to recover its investment and operating costs and still break even. The IRR is arrived through interpolation technique by using different discount rates so as to see that the net present worth is equal to zero. Therefore, the project costs and benefits are discounted at a certain rate to find out the present worth of the project. Again, by selecting a higher discount rate, the costs and returns are discounted throughout the project period to get a negative net present worth. The higher value of IRR indicates the first, while lowest value being the last choice of preference. However, the IRR should be more than the discount rate being considered for economic feasibility and financial soundness.

$$IRR = ra + (rb - ra) (NPV_a / (NPV_a - NPV_b))$$

Where,

ra = lower discount rate

rb = higher discount rate

NPV_a = NPV using the lower discount rate

NPV_b = NPV using the higher discount rate

When the calculated IRR is greater than the market rate of interest, then the investment is considered viable.

Results and Discussion

Cost of cultivation of paddy using Conventional method of harvesting Vs. Harvesting with Combine harvester

The profitability of an enterprise mostly depends on the relation between the costs incurred in running the enterprise and the returns obtained from it. The study of costs and returns of Paddy cultivation helps the farmers to plan for the next season production programmes with a view to minimize the total costs and maximize the net profits by adopting efficient resource management practices. Generally, in any economic study total costs are discussed under two groups viz., variable costs and fixed costs. Variable costs include expenses on labour utilized for performing different cultural practices and expenditure on material inputs like seeds, FYM, Fertilizers, and Plant Protection Chemicals etc. The fixed costs are depreciation on working assets, interest on fixed capital, rental value of owned land, land revenue and interest on fixed capital.

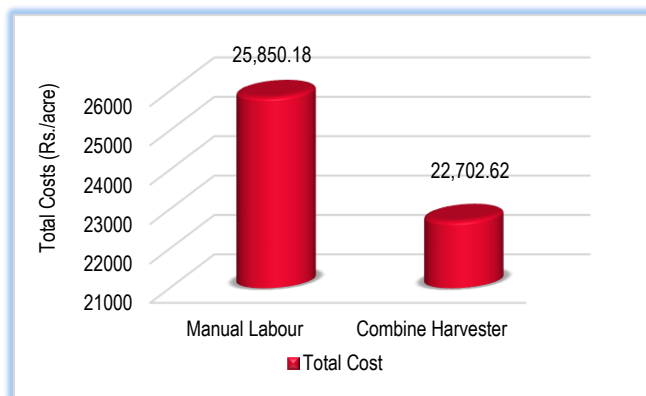


Fig-1 Cost structure of Paddy cultivation Manual Vs. Combine Harvester

Economics of Paddy cultivation of farmers using combine harvester and conventional method of harvesting per acre were presented in [Table-1]. The total costs expended per acre of paddy stood at Rs. 25,850.18 and Rs. 22,702.62 with manual and combine harvester methods of harvesting respectively [Fig-1].

The variable and fixed costs were more in case of manual method compared to combine harvester method. The variable and fixed costs were Rs. 14869.03 and Rs.10981.14 respectively in manual method where as those were Rs. 12771.20 and Rs. 9931.42 respectively in case of using combine harvester method.

Table-1 Comparative Economics of Rice Cultivation of farmers using Conventional and Combine harvester method of harvesting, (Rs. Per acre)

Particulars	Conventional Method		Combine Harvester	
	Rs/acre	%	Rs/acre	%
Variable Cost				
Men labour	735.00	2.84	735.00	3.24
Women labour	2220.00	8.59	2220.00	9.78
Tractor services	2892.50	11.19	2892.50	12.74
Seeds	875.00	3.38	875.00	3.85
Fertilizers and Pesticide	2530.00	9.79	2530.00	11.14
Harvesting	4257.50	16.47	2207.50	9.72
Others	1020.00	3.95	1020.00	4.49
Interest on working capital	339.03	1.31	291.20	1.28
Total Variable costs	14869.03	57.52	12771.20	56.25
Fixed Costs				
Land Revenue	283.50	1.1	283.5	1.25
Depreciation	390.10	1.51	390.1	1.72
Rental Value	9581.75	37.07	8641.75	38.06
Interest on fixed capital	725.80	2.81	616.07	2.710
Total Fixed costs	10981.15	42.48	9931.42	43.75
Total Cost of cultivation (A+B)	25850.18	100	22702.62	100

All the input costs were same in both conventional and combine harvester method of harvesting except harvesting cost, Interest on working and interest on fixed capital which were higher in case of conventional method. In case of Conventional method of cultivation, the lion share was taken by rental value of land 9581.75 (37.07%) followed by harvesting cost Rs. 4257.50 (16.47%), Tractor Services Rs. 2892.50 (11.19%), Fertilizer and pesticide cost Rs. 2350.00 (9.79%), women labour Rs.2220 (8.59%), Seeds Rs. 875 (3.38%), Men labor Rs. 735.00 (2.84%), Others Rs. 1020 (3.95%), Interest on fixed capital Rs. 725.80 (2.81%), Depreciation Rs. 390.10 (1.51%), interest on Working capitals Rs. 339.03(1.31%) and land revenue Rs. 283.50(1.10%).

In case of Combine harvesting the major share was taken by rental value of land 8641.75(38.06) followed by tractor services Rs.2892.50 (12.74%), Fertilizer and Pesticides cost Rs.2530.00 (11.14%), Women labour cost Rs. 2220.00 (9.78%), harvesting cost Rs. 2207.50(9.72%), Others Rs. 1020.00(4.49%), Seeds Rs. 875.00(3.85%), Men labor Rs. 735.00(3.24%), Interest on fixed capital Rs. 616.07(2.71%), Depreciation Rs. 390.10 (1.72%), Interest on working Capital Rs. 291.20 (1.28%) and land revenue Rs. 283.50(1.25%).

In Medak district, the entire Paddy area has been harvested with combine harvester. The farmers assume all the costs were same for both methods except harvesting and the data for manual harvesting was collected based on the recall memory of the farmer in order to understand the drudgery and costs involved in manual method of harvesting and experience the value of mechanization.

Table-2 Yield and returns of Paddy using Conventional Vs. Combine harvester

Particulars	Conventional Method	Combine Harvester
Yield (Qt/acre)	24.2	23
Unit Price (Rs/Qt)	1500	1500
Yield (Rs/acre)	36300	34500
Paddy Straw (Rs.)	2470	1270
Gross Income	38770	35770
Total Costs	25850.18	22702.62
Net Income	12919.82	13067.38
Returns per Rupee spent	1.50	1.58

Returns from paddy using Conventional method and Combine Harvester

The results of yield and returns of paddy using Conventional and Combine harvester methods are presented in [Table-2]. The main yield was higher in case of conventional method (24.2 quintals per acre) compared to combine harvester (23.0 quintals per acre) and the value of by product yield was higher in case of Conventional method (Rs. 2470/- per acre) compared to Combine harvester (Rs. 1270/- per acre). The gross income and net income per acre were Rs.38770/- and Rs.12919.82/- respectively with Conventional method as against Rs.35770/- and Rs.13067.38/- respectively per acre using Combine harvester method [Fig-2].

The returns per rupee invested were higher in Combine harvester (1.58) compared to Conventional method (1.50).

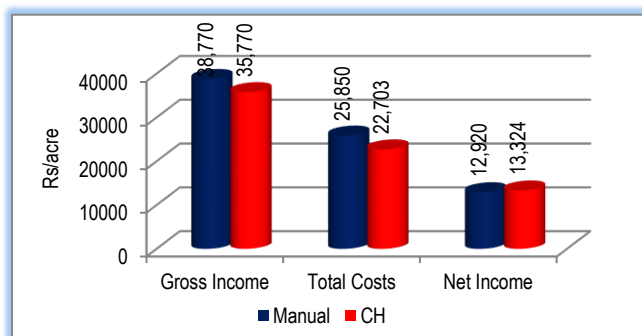


Fig-2 Returns from paddy with manual labour vs CH harvesting

Economic viability of paddy combine harvester in Paddy cultivation

The costs and returns are not the perfect measures to assess the profitability from investment made on Paddy Combine harvester. Before making a choice on any enterprise, it becomes necessary to examine the economic feasibility of that enterprise. The length of the period a particular enterprise bears fruits play a key role in the selection of indicators that would examine the economic feasibility of the enterprise. Several techniques are available for evaluating the economic viability of Paddy combine harvester. For this study project evaluation techniques like discounted measures namely Net Present Worth, Benefit cost ratio and Internal Rate of returns were employed to examine the economic feasibility of investment on Paddy combine harvester.

Net Present Worth

The basic data presented were collected from the combine harvester owner. Economic life span of new and refresh combine harvester were assumed to be 10 years. During the harvesting season, combine harvester was effectively operated for 10 hours in a day. The price of the combine harvester was Rs. 1800000/-. In the first year the maintenance cost were Rs.700000/-. In the 2nd and 3rd years the maintenance costs were Rs.1000000/- and 500000/- respectively. From the fourth year onwards the maintenance costs were assumed as same up to 10th year. In the first year the net returns were negative as it involves purchase cost of machine. It was observed from [Table-3] and [Table-4] that the net present worth

was high and ranged from Rs. 9, 69,426/- at 12 percent to Rs. 19,663 at 24 percent discount rates. The high positive net present worth even at higher discount rates indicated the soundness of the investment made in maintaining the Combine harvester as entrepreneur.

Table-3 Estimation of NPW at 12 percent Discount Rate

Year	Costs	Gross Returns	Net Returns	Discount Factor	NPW
1 Year	2500000	800000	-1700000	0.8929	-1517857
2 Year	1000000	1000000	0	0.7972	0
3 Year	500000	1000000	500000	0.7118	355890
4 Year	360000	1000000	640000	0.6355	406732
5 Year	360000	1000000	640000	0.5674	363153
6 Year	360000	1000000	640000	0.5066	324244
7 Year	360000	1000000	640000	0.4523	289503
8 Year	360000	1000000	640000	0.4039	258485
9 Year	360000	1000000	640000	0.4039	258485
10 Year	360000	1000000	640000	0.3606	230790
				NPW	969426

Table-4 Estimation of NPW at 24 percent Discount Rate

Year	Costs	Gross Returns	Net Returns	Discount Factor	NPW
1 Year	2500000	800000	-1700000	0.8065	-1370968
2 Year	1000000	1000000	0	0.6504	0
3 Year	500000	1000000	500000	0.5245	262244
4 Year	360000	1000000	640000	0.423	270703
5 Year	360000	1000000	640000	0.3411	218309
6 Year	360000	1000000	640000	0.2751	176056
7 Year	360000	1000000	640000	0.2218	141980
8 Year	360000	1000000	640000	0.1789	114500
9 Year	360000	1000000	640000	0.1789	114500
10 Year	360000	1000000	640000	0.1443	92339
				NPW	19663

Benefit cost ratio

From the [Table-5] and [Table-6] it was observed that, the benefit cost ratios were 1.21 and 1.01 at 12 and 24 percent discount rates respectively. The benefit cost ratio was more than unity at all the discount rates. Even at higher discount rate of 24 percent it was 1.01 showing that a rupee invested in combine harvester enterprise would fetch Rs. 1.01 and this proved profitability of combine harvester enterprise. So, the investment on combine harvester enterprise was economically feasible.

Table-5 Estimation of BCR at 12 percent Discount Rate

Year	Costs	Gross Returns	Net Returns	Discount Factor	Present worth of Costs	Present worth of Gross returns
1 Year	2500000	800000	-1700000	0.8929	2232143	714286
2 Year	1000000	1000000	0	0.7972	797194	797194
3 Year	500000	1000000	500000	0.7118	355890	711780
4 Year	360000	1000000	640000	0.6355	228787	635518
5 Year	360000	1000000	640000	0.5674	204274	567427
6 Year	360000	1000000	640000	0.5066	182387	506631
7 Year	360000	1000000	640000	0.4523	162846	452349
8 Year	360000	1000000	640000	0.4039	145398	403883
9 Year	360000	1000000	640000	0.4039	145398	403883
10 Year	360000	1000000	640000	0.3606	129820	360610
					4584135	5553562
				BCR		1.21

Table-6 Estimation of BCR at 24 percent Discount Rate

Year	Costs	Gross Returns	Net Returns	Discount Factor	Present worth of Costs	Present worth of Gross returns
1 Year	2500000	800000	-1700000	0.8065	2016129	645161
2 Year	1000000	1000000	0	0.6504	650364	650364
3 Year	500000	1000000	500000	0.5245	262244	524487
4 Year	360000	1000000	640000	0.423	152270	422974
5 Year	360000	1000000	640000	0.3411	122799	341108
6 Year	360000	1000000	640000	0.2751	99031	275087
7 Year	360000	1000000	640000	0.2218	79864	221844
8 Year	360000	1000000	640000	0.1789	64406	178907
9 Year	360000	1000000	640000	0.1789	64406	178907
10 Year	360000	1000000	640000	0.1443	51941	144280
					3563455	3583118
				BCR		1.01

Table-7 Estimation of Internal Rate of Returns

Year	Net Returns	Discount Factor 23.50%	Discounted Net returns @23.5%	Discount Factor 25%	Discounted Net returns @25%
1 Year	-1700000	0.8097	-1376518	0.8065	-1370968
2 Year	0	0.6556	0	0.6504	0
3 Year	500000	0.5309	265442	0.5245	262244
4 Year	640000	0.4299	275114	0.423	270703
5 Year	640000	0.3481	222764	0.3411	218309
6 Year	640000	0.2818	180376	0.2751	176056
7 Year	640000	0.2282	146053	0.2218	141980
8 Year	640000	0.1848	118262	0.1789	114500
9 Year	640000	0.1496	95759	0.1443	92339
10 Year	640000	0.1212	77537	0.1164	74467
			4787.77		-20370.06
				IRR	23.79

Internal rate of Return

The [Table-7] showed that, the internal rate of return was found to be 23.79% which was much higher than the bank rate of interest (12 percent) on long term loans and hence the combine harvester as an enterprise is economically feasible. It is evident from the above discussion that the investment on Paddy combine harvester is profitable proposition for entrepreneurs.

Problems encountered in farm mechanization in rice cultivation

The problems encountered in farm mechanization in paddy cultivation were presented in [Table-8]. The problems were ranked using Garrett ranking technique. It was observed that high investment on farm machineries problem ranked I which recorded mean score of 80.5 followed by not suitable for small sized holder's problem ranked II which recorded mean score of 75.5. Fodder loss due to use of combine harvester problem ranked III with a mean score of 60.1, and high hiring charges problem ranked IV with a mean score of 55.3. Other minor problems were wet fields (Rank V), non-availability of machineries during working periods (Rank VI), not suitable for undulating areas (Rank VII), grain damage (Rank VIII), Soil compaction (IX) and non-availability of skilled labours to operate machineries (Rank X).

Table-8 Problems Encountered in Farm Mechanization in Rice Cultivation

Problems	Mean Score	Rank
High investment on farm machineries	80.5	I
Not suitable for small sized holders	75.5	II
Fodder loss due to use of combine harvester	60.1	III
High hiring charges	55.3	IV
Wet fields	44.5	V
Non availability of machineries during working periods	38.2	VI
Not suitable for undulating areas	32.1	VII
Grain damage	27.5	VIII
Soil compaction	22.1	IX
Non availability of skilled labour	20.0	X

Conclusion

Some of the operations like transplantation and harvesting consume more labour, to solve this labour problem mechanization is only solution. The cost of cultivation is less if we use combine harvester instead of human labour. On the basis of above results, it can be inferred that, investment on paddy combine harvester is a profitable proposition for entrepreneurs. Improve the extension service realizing the importance and the economic viability as well as the reliability of the paddy combine harvesters among farmers and also entrepreneurs.

Application of research: The results of the study would be very useful to the paddy cultivators, combine harvester entrepreneurs and it would indicate whether there is any scope for expanding area under Paddy cultivation.

The cost structure gives useful information regarding reduction in the cost of cultivation of paddy by using combine harvester and there would be a scope to the entrepreneurs to start an enterprise with Paddy Combine harvesters.

The results of the Net Present Worth, Benefit – cost ratio and Internal Rate of Return tells about the profitability of owning or maintaining a Combine harvester and the worthiness of the investment.

Research Category: Agriculture economics

Abbreviations:

NPW: Net Present worth

BCR: Benefit-cost Ratio

IRR: Internal Rate of Return

NPV: Net Present Value

FYM: Farm Yard Manure

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University: Professor Jayashankar Telangana State Agricultural University, Hyderabad, 500030, Telangana, India

Research project name or number: Research station trials

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Telangana

Cultivar / Variety / Breed name: Rice

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number: Nil

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