Comparative economic analysis of adopters and non-adopters of seed-to-seed mechanization in maize : A case study of Jangaon district in Telangana, India

Abstract

Seed-to-seed mechanization in maize reduces human drudgery, resolves labour scarcity problems during peak cropping seasons, and reduces the cost of cultivation by increasing the returns. In view of this, the present study compared the costs, returns, and farm business income of adopters and non-adopters of seed-to-seed mechanization, an agro-technology developed and promoted by the Maize Research Station, Hyderabad, Telangana. The cost of cultivation was worked out using cost concepts. A field survey was conducted with 120 sample respondents in Jangaon district during 2021–22. Results from the study revealed that the total cost of cultivation of adopters and non-adopters was Rs. 92,671.77 and Rs. 1,01,031.80, respectively, indicating a 9.02 per cent saving in the cost of cultivation of adopters of this technology. Net returns accrued were 50.41 per cent higher for adopters (Rs. 31,620.11) compared to non-adopters (Rs. 21,022.76). Results also concluded that the returns per rupee spent by adopters and non-adopters were 1.34 and 1.21, respectively, indicating the economic potential of technology adoption.

Key words: Cost concepts, farm income, comparative economics, seed-to-seed mechanization.

1 Introduction

Maize, also known as corn, holds significant importance as India's third-most crucial cereal crop, following rice and wheat. It is highly valued globally for its diverse uses as food, feed, fodder, and raw material for various industries. Leading the world in maize cultivation are China and the USA, accounting for 39 per cent of the total maize area. Since 2005, India ranked fourth in terms of area with 9.89 million ha land under maize (iimr.icar.gov.in). However, India's maize productivity lags behind the global average, currently standing at around 3.19 tons per hectare compared to the world average of 5.6 tons per hectare (iimr.icar.gov.in). In India, maize is cultivated on approximately 10.04 million hectares, yielding a production of 33.62 million metric tons and a productivity rate of 3349 kg/ha. Telangana contributes 6.35 percent of the total maize production in the country, with a production of 2.13 million tons. The yield in the state was 5178 kg/hectare (DA&FW, E&S Division, Fourth advance estimates, 2021-22).

In India, traditionally, maize was grown during the *kharif*, or rainy season, in northern regions. Over time, *rabi*, or winter maize, has gained popularity in non-traditional areas like coastal Andhra Pradesh, Bihar, Telangana, West Bengal, and others. The introduction of sweet corn, baby corn, and popcorn has significantly boosted the demand for maize in the Indian market. Maize's adaptability allows it to thrive in diverse agro-ecological zones (Sagar *et al*., 2019).

The conventional methods of maize cultivation in the country are labour-intensive, leading to challenges in timely operations, reduced crop yield, and increased cultivation costs. The scarcity of agricultural labourers during peak periods causes delays in key operations like sowing, weeding, nutrient application, irrigation, and harvesting. Consequently, the high demand

for labourers in peak cropping seasons increases labour wages, adding to the overall cultivation expenses and leading to production losses that can render agriculture non-viable under certain circumstances (Dixit *et al*., 2017).

Mechanization plays a crucial role in promoting efficient and large-scale maize production and fostering commercialization in the agriculture sector. It helps in reducing human drudgery, ensures timely operations, and addresses labour scarcity during peak cropping seasons. Mechanization can be applied throughout the production process, from land preparation to harvesting, making seed-to-seed mechanization a viable approach in maize cultivation (Bamboriya *et al*., 2020).

The seed-to-seed mechanization developed by PJTSAU and demonstrated in districts viz., Medak, Jangaon, Sangareddy, Warangal Rural, and Karimnagar during 2018-19 revealed that the cost of seed-to-seed operations was highest in the conventional method at Rs. 53,700 per ha over the mechanized method at Rs. 42,710 per ha (Sreelatha *et al*., 2022). The goal of seed-to-seed mechanization in maize is to replace manual labour with efficient machinery, resulting in reduced labour costs, workload, and operation time, ultimately leading to increased production and productivity (Santosh *et al*., 2021). In line with this, the present study aimed to compare the cost of cultivation between adopters and non-adopters of seed-to-seed mechanization in maize, as researched and promoted by scientists from the Maize Research Station, PJTSAU, Hyderabad.

Multi-crop vaccum planter and combined harvester were the technology used by maize adopters. Multi-crop vaccum planter provides high accuracy in seed spacing and allows single seed at time of sowing. Combined harvester can be used for shelling and harvesting simultaneously.

Figure 1: Multi-crop vaccum planter

Figure 2: Combined harvester

2 MATERIALS AND METHODS

2.1 Cost Concepts

Primary data were collected from 120 sample respondents were selected randomly from Jangaon district, Telangana State, comprising 60 adopters and 60 non-adopters of mechanization technology in maize during 2021–22. Farmers were interviewed using a pre-tested and well-structured interview schedule.

The cost concepts were used to estimate the cost of cultivation. The following cost concepts, viz., cost A1, cost A2, cost B1, cost B2, and cost C1, C2, and C3, were used in the present study.

Cost A1: It includes all actual expenses in cash and kind in production by the owner farmer such as, value of hired human labour, owned and hired bullock labour, owned and hired machinery services, value of farm produced seed or purchased seed and FYM, value of fertilizers, plant protection chemicals, depreciation of implements and machinery, land revenue, interest on working capital and miscellaneous expenses.

Cost A2: Cost A1 + rent paid for leased in land.

Cost B1: Cost A1 + interest on fixed capital.

Cost B2: Cost B1+rental value of own land + rental value for leased in 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 Managerial cost of C2

2.2 Farm income measures

(a) Gross income: the income obtained from the sale of the main product and by-product. The actual amounts received from product marketed at the prevailing price were considered for arriving at gross income.

Gross income = Value of main product + Value of by - product

(b) Net income: This is the surplus over the gross costs i.e., commercial cost of cultivation (cost C2).

Net income = Gross income - Cost C2

(c) Farm business income = Gross income – Cost A1 or Cost A2

(d) Family labour income = Gross income – Cost B2

(e) Return per rupee spent = Present worth of gross return ÷ Present worth of gross cost

3 Results and discussion

3.1 Cost of Cultivation

Table 1. presented the cost of cultivating maize for both adopters and non-adopters of seed-to-seed mechanization technology. For adopters, human labour accounted for Rs. 14,113.54

(15.23 per cent), while for non-adopters, it accounted for Rs. 26,763.13 (26.49 per cent). Non-adopters incurred higher expenses for human labour than adopters. Examining the machine labour cost, adopters spent Rs. 15,557.08 (16.79 per cent) more than non-adopters, who spent Rs. 8,827.92 (8.74 per cent). Adopters also spent Rs. 4,277.92 (4.62 per cent) on seeds, whereas non-adopters spent Rs. 6,304.17 (5.99 per cent). This difference in seed cost was observed due to the low seed use in mechanized cultivation. The primary reason for higher cultivation costs among non-adopters of technology was the extensive use of human labor for farm operations. Out of total cultivation cost, total variable costs for adopters were Rs. 75,957.15 (81.96 per cent), while for non-adopters, they were Rs. 85,574.99 (84.70 per cent). This indicated that adopters achieved a cost savings of 12.66 per cent through technology adoption which was in consistent with findings by Suvashree *et al*. (2017) and Manjulatha *et al*. (2021), where around 12 per cent of cost savings over non-adopters was observed.

Moving on to fixed costs, both adopters and non-adopters incurred Rs. 16,714.62 (18.04 per cent) and Rs. 16,638.30 (16.47 per cent), respectively. Among all the fixed costs, the rental value of owned land was the highest, amounting to approximately Rs. 14,700 (13.32 per cent). Similar results were reported by Srikanth *et al.* (2017) who noticed the rental value of owned land was highest among fixed costs.

The variance in cultivation costs can largely be attributed to the increased expenses in seed, human labour, and bullock labour for those who have not adopted seed-to-seed mechanization technology. To determine the significance of the differences in cost components, a paired t-test was conducted. The t-value obtained from the test indicates the level of significance of the differences observed for seed, human labour, bullock labour, machine labour, and interest on working capital.

Table 1: Comparative economics of adopters and non-adopters of seed-to-seed mechanization in the study area (Rs./ha)

S. No.	Particulars	Adopters	Non-adopters	t value
Operational cost				
1	Land preparation	7805.00 (8.42)	6304.17 (6.24)	0.32
2	Seed	4277.92 (4.62)	6055.21 (5.99)	-14.71**
3	Fertilizers	11773.44 (12.70)	11705.73 (11.59)	0.24
4	Manures	11773.44 (3.73)	11705.73 (3.39)	1.00
5	Pesticides	6550.00 (7.07)	6529.17 (6.46)	0.11
6	Human labour	14113.54 (15.23)	26763.13 (26.49)	-28.68**
7	Bullock labour	1542.94 (1.66)	5733.33 (5.67)	-8.57**
8	Machine labour	15557.08 (16.79)	8827.92 (8.74)	26.23**
9	Interest on working capital	4922.98 (5.31)	5474.05 (5.42)	-9.84**
10	Miscellaneous expenses	705.83 (0.76)	718.75 (0.71)	-0.23
	Total operational cost	75957.15 (81.96)	85574.99 (84.70)	
Fixed cost				

1	Land revenue	0.00 (0.00)	0.00 (0.00)	0.00
2	Rental value of owned land	14750.00 (15.92)	14708.33 (14.56)	0.10
3	Depreciation	445.11 (0.48)	417.39 (0.41)	1.07
4	Interest on fixed capital	1519.51 (1.64)	1512.57 (1.50)	0.16
	Total fixed cost	16714.62 (18.04)	16638.30 (16.47)	
	Total cost	92671.77	101031.80	

Source: Estimated by authors

Note: ** denotes significance at 5 per cent, Figures in parenthesis explains percentage to the total

The table (Table 2) presented the cost of cultivation based on various cost concepts. In the case of technology adoption, Cost A1 amounted to Rs. 56,880.3, whereas it was Rs. 63,742.80 for non-adoption. For Cost A2, in the technology adoption scenario, it was Rs. 71,630.30, compared to Rs. 78,451.13 in the non-adoption scenario. Adopters incurred Rs. 58,399.81 for Cost B1, while non-adopters spent Rs. 65,255.37. For Cost B2, adopters' expenses were Rs. 73,149.81, while non-adopters paid Rs. 79,963.70. In the case of Cost C1, adopters' expenditure was Rs. 64,866.69, while non-adopters' expenses were Rs. 77,166.41. For Cost C2, adopters spent Rs. 79,616.69, and non-adopters incurred Rs. 91,874.74. Lastly, Cost C3 for adopters was Rs. 87,578.35, whereas it amounted to Rs. 1,01,062.20 for non-adopters. These findings aligned with previous research conducted by Harendra *et al*. (2018) and Manjulatha *et al*. (2021), who observed similar results by using the same method.

Table 2: Cost of cultivation as per cost concepts (Rs./ha)

S. No.	Particulars	Adopters	Non-adopters
1	Cost A1	56880.30	63742.80
2	Cost A2	71630.30	78451.13
3	Cost B1	58399.81	65255.37
4	Cost B2	73149.81	79963.70
5	Cost C1	64866.69	77166.41
6	Cost C2	79616.69	91874.74
7	Cost C3	87578.35	101062.20

3.2 Returns per Rupee of Investment

Table 3 presented the total per hectare cost of cultivation for technology adopters and non-adopters, which amounted to Rs. 92,671.77 and Rs. 1,01,031.80 respectively. Additionally, the gross returns per hectare were Rs. 1,24,291.90 for adopters, while non-adopters recorded Rs. 1,22,054.60. These results were closely similar to the findings reported by Vasanth *et al*. (2020). Moreover, the net returns per hectare were significantly higher for adopters at Rs. 31,620.11 compared to Rs. 21,022.76 for non-adopters, indicating a 50.41 per cent increase in net returns through technology adoption. The returns per rupee of investment were 1.34 for adopters and

1.21 for non-adopters, further highlighting the economic advantage of adopting seed-to-seed mechanization.

Based on these findings, it can be concluded that adopting seed-to-seed mechanization technology proved to be economically superior to non-adopters in the region. There is good scope for spread of the technology through popularization by demonstrations to reap the benefits in maize cultivated areas.

Table 3: Returns per rupee of investment per hectare

S. No.	Particulars	Adopters	Non-adopters
1	Total cost of cultivation (Rs./ha)	92671.77	101031.80
2	Gross return (Rs./ha)	124291.90	122054.60
3	Net return (Rs./ha)	31620.11	21022.76
4	Return per rupee spent	1.34	1.21

4 Conclusion

The present study revealed that the adoption of seed-to-seed mechanization technology resulted in significant labour-saving and cost-reduction by 12.66 per cent. Comparatively, non-adopters experienced higher variable costs of Rs. 85574.99, while adopters enjoyed higher net income of Rs. 31620.11 due to increased yields per hectare and reduced cultivation expenses. The improved outcomes for adopters can be attributed to timely operations, precise depth of sowing, and efficient harvesting using combined harvesters, all made possible by mechanization. Additionally, the adoption of technology substantially decreased the labour requirements for farmers, further contributing to overall cost savings. As a result, mechanization emerged as a valuable tool for enhancing agricultural output and ultimately increasing the income of farmers. In conclusion, the findings highlighted the importance of embracing seed-to-seed mechanization technology in agriculture. Its positive impact on productivity, cost-effectiveness, and labour efficiency can potentially lead to a more prosperous and sustainable future for farmers. Policymakers and stakeholders should promote and support the adoption of mechanization to empower farmers and drive agricultural growth.

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