

International Journal of Agriculture Extension and Social Development

Volume 9; Issue 4; April 2026; Page No. 515-519

Received: 05-01-2026
Accepted: 07-02-2026

Indexed Journal
Peer Reviewed Journal

Economic impact of castor hybrid GCH-8 on farmers of Gujarat: DiD Approach

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DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i4g.3520>

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Abstract

This study evaluates the economic impact of adopting the castor hybrid GCH-8 in the North Gujarat region, India. Using a Difference-in-Differences (DiD) approach, the study analyzes data from 240 farmers to compare productivity and profitability between adopters and non-adopters of the hybrid. The findings reveal that adopters of the GCH-8 hybrid experienced significant increases in yield (1.757 quintals per hectare) and gross income (₹15,281 per hectare), both statistically significant. The hybrid also led to higher net income, family labor income, and benefit-cost ratios, highlighting its potential to enhance agricultural productivity and economic returns for farmers.

Keywords: Castor hybrid GCH-8, Difference-in-Differences, agricultural productivity, profitability analysis

Introduction

India is a major producer of oilseeds, thanks to its diverse agro-ecological conditions. It grows nine major oilseeds, including seven edible ones like groundnut, mustard, soybean, and sunflower, as well as two non-edible ones, castor and linseed. India also sources oils from minor crops like coconut, oil palm, and even rice bran and cottonseed. However, India produces only about 10% of the total oilseeds needed to meet domestic demand, leading to imports to fill the gap. With the population and income rising, demand for edible oils is growing at 6% per year, while production increases by only 2% (Jha *et al.*, 2012) ^[5].

Castor (*Ricinus communis* L.) is a versatile, non-edible oilseed crop known for its economic value across various industries, including agriculture, pharmaceuticals, and chemicals. Originally from Eastern Africa and Ethiopia, it now thrives in tropical and subtropical regions worldwide. Castor oil is unique because it is the only source of hydroxylated fatty acids, making it valuable in making lubricants, automotive grease, and nylon.

Globally, castor production is around 19.38 lakh tonnes, with an average yield of 1,780 kg per hectare. India leads the world in castor production, contributing about 90.82% of the global output (17.60 lakh tonnes) and achieving a productivity of 2,070 kg per hectare (Anon., 2020-21^a). Within India, castor cultivation covers 8.87 lakh hectares, producing 16.47 lakh tonnes. Gujarat is the top producer, contributing 81.66% of the country's castor production (13.45 lakh tonnes from 6.53 lakh hectares). Rajasthan and Andhra Pradesh follow with 1.78 lakh tonnes and 0.64 lakh tonnes, respectively (Anon., 2020-21^b).

The GCH-8 castor hybrid, developed by Sardarkrushinagar Dantiwada Agricultural University in 2018, is widely used in Gujarat. Assessing the cost and impact of this hybrid

helps farmers understand its economic benefits and make informed decisions. The hybrid offers potential advantages like higher yields and disease resistance, which can lead to better farm productivity and income. This allows farmers to make more cost-effective choices aligned with their financial goals.

Objectives

1. To evaluating productivity and profitability of castor hybrid GCH-8 vs other castor varieties
2. Economic Impact assessment of castor hybrid GCH-8

Methodology

The focus of this study was on the North Gujarat region, which is a part of the Gujarat state in India. Three districts of this region like Banaskantha, Mehsana and Patan were selected for the study. The study was primarily based on the farm level cost pertaining to different aspects such as costs, return and profitability of castor. The multi-stage sampling technique was used for the selection of districts, talukas, and villages. From selected districts two talukas from each district were randomly selected for the study. Two villages from each taluka were selected randomly, resulting in a total of twelve villages and 20 farmers from each village (10 farmer adopter and 10 non-adopter farmer) chosen for the study. So, total 240 farmers were selected for the study. The selected respondent farmers were interviewed personally with the help of a well prepare questionnaires and pre-tested interview schedule.

Cost of Cultivation

A net farm income model was used to calculate the profitability of farmers as well as the cost of castor cultivation.

Cost A1 includes

Value of human labour (family and hired), Value of bullock power (owned and hired), Value of machine power (owned and hired), Value of seeds, Value of manures and fertilizers, Value of plant protection chemicals, Value of weedicides, Irrigation charges, Depreciation on farm implements and farm buildings, Interest on working capital, Other miscellaneous expenses

Cost A2 includes,

Cost A1+Rent paid for leased land

Cost B1 includes

Cost A1 + Interest on the value of owned capital assets (Excluding land)

Cost B2 includes

Cost B1+ Rental value of owned land (less land revenue)

Cost C1 includes

Cost B1 + Imputed value of family labour.

Cost C2 includes

Cost C1 + 10% of cost C1

Incomes measure in relation to different cost concept

- Farm business income = Gross income - Cost A1
- Owned farm business income = Gross income - Cost

A2

- Family labour income = Gross income - Cost B2
- Net income = Gross income - Cost C2
- Farm investment income = Net income + Imputed rental value of owned land + Interest on fixed capital

$$\text{Benefit-cost ratio} = \frac{\text{Present value of benefits}}{\text{Present value of costs}}$$

Impact evaluation using Difference-in-Difference Approach

The double difference method or difference-in-differences method controlled for time-invariant characteristics while comparing the adopters and non-adopters of castor hybrid GCH-8. Data employed the double difference equivalent control group design to identify the difference in productivity between adopters and non-adopters of the castor hybrid GCH-8 (Table 1).

The base data of the year 2016-17 and subsequent data of the year 2023-24 regarding yield per hectare, gross income, etc. were collected from castor farmers.

The specification of the Difference-in-Difference (DiD) model was as follows:

$$\text{DiD} = \left\{ \left[\frac{1}{b} \sum_j (\bar{Y}_{dt} - \bar{Y}_{dt+1}) \right] \left\{ \frac{1}{nb} \sum_j (\bar{Y}_{1t} - \bar{Y}_{1t+1}) \right\} \right\}$$

Table 1: Differences in Difference for adopter and non-adopter of castor hybrid GCH-8

Particulars	Adopters	Non-adopters	Difference across groups
Group I Treated (GCH-8 cultivation)	D ₁	C ₁	D ₁ – D ₀
Group II Control (Group I before adopting GCH-8) *Base year data of 2016-17	D ₀	C ₀	C ₁ – C ₀
Difference across time	D ₁ – D ₀	C ₁ – C ₀	Double difference (D ₁ – D ₀) – (C ₁ – C ₀)

Where,

DiD = The difference between mean changes in castor yield for adopters and non-adopters farmers

$\bar{Y}_{dt} - \bar{Y}_{dt-1}$ = Difference of mean castor yield of adopters before and after adoption of GCH-8 castor hybrid respectively.

$\bar{Y}_{1t} - \bar{Y}_{1t-1}$ = Difference of mean castor yield of non-adopters before and after adoption of GCH-8 castor hybrid respectively.

Results and Discussion**Comparative productivity and profitability analysis of castor hybrid GCH-8 versus other castor varieties (2023-24)**

The productivity of main product of castor along with their prices, gross income, net income, family labour income, farm business income, farm investment income with benefit-cost ratio for adopter and non-adopter respondents with percentage difference over non-adopter in year 2023-24 are presented in the table 2.

Table 2: Comparison of productivity and profitability of castor hybrid GCH-8 vs other castor varieties (₹/ha)

Sr. No.	Particulars	Adopter	Non-adopter	% diff
1	Quantity of main product	32.77	30.10	08.15
2	Price of main product(₹/qtl)	5678	5580	
3	Main Produce (Outputs).	186068.06	167958	09.73
4	Gross Income	186068.06	167958	09.73
Income Measures				
5	Farm business income	139427.77	120237.76	13.76
6	Owned farm business income	139427.77	120237.76	13.76
7	Family labour income	118098.53	99486.74	15.76
8	Net Income	99944.56	78555.06	21.40
9	Farm investment income	121273.79	99303.35	18.12
10	Benefit-Cost ratio	2.16	1.88	

The table compares the productivity and profitability of the castor hybrid GCH-8 (adopters) with other castor varieties (non-adopters) on a per-hectare basis. Adopters of the hybrid GCH-8 achieve a higher quantity of the main product (32.77 qtl/ha) compared to non-adopters (30.10 qtl/ha), resulting in an 8.15% increase. The price per quintal is also slightly higher for adopters (₹5,678) compared to non-adopters (₹5,580). Consequently, the gross income and main produce value for adopters are 9.73% higher. In terms of profitability measures, adopters outperform non-adopters, with farm business income, owned farm business income, family labor income, net income, and farm investment income showing increases of 13.76%, 15.76%, 21.40%, and 18.12% respectively. The benefit-cost ratio is also more favorable for adopters at 2.16 compared to 1.88 for non-adopters, indicating a higher return on investment for adopters of the GCH-8 hybrid. Overall, the data suggests that adopting the castor hybrid GCH-8 leads to significantly better productivity and profitability outcomes.

Comparative productivity and profitability analysis of castor (2016-17)

Comparative analysis of the productivity and profitability of castor cultivation per hectare between adopters and non-adopters for the base year 2016-17 when both farmers using traditional varieties of castor. Adopters achieved a slightly higher quantity of the main product (24.91 qtl/ha) compared to non-adopters (24.12 qtl/ha), reflecting a 3.17% increase. However, the price of the main product is marginally lower for adopters (₹4,375/qtl) than for non-adopters (₹4,433/qtl), showing a slight decrease of 1.73%. Despite this, the gross income and main produce value for adopters are 1.88% higher than for non-adopters. Income measures, such as farm business income, owned farm business income, net income, and farm investment income, show modest improvements for adopters, ranging from 1.47% to 3.44%. Notably, family labor income for adopters is significantly higher by 16.46% compared to non-adopters. The benefit-cost ratio is also marginally better for adopters at 1.92 compared to 1.90 for non-adopters. Overall, the table indicates that adopting improved practices leads to slightly better productivity and profitability, especially in terms of family labor income, though the differences are generally modest.

The similar findings have been reported by Dhanushkodi *et al.* (2021)^[4] and Chouhan (2019)^[3].

Table 3: Comparative productivity and profitability analysis of castor (₹/ha) (2016-17)

Sr. No.	Particulars	Adopter	Non-adopter	% diff
1	Quantity of main product	24.91	24.12	3.17
2	Price of main product(₹/qtl)	4375	4433	1.73
3	Main Produce (Outputs).	108984.32	106931.97	1.88
4	Gross Income	108984.32	106931.97	1.88
Income Measures				
5	Farm business income	78063.08	76913.15	1.47
6	Owned farm business income	78063.08	76010.73	2.63
7	Family labour income	77320.61	64595.37	16.46
8	Net Income	52272.90	50705.24	3.00
9	Farm investment income	65269.54	63023.02	3.44
10	Benefit-Cost ratio	1.92	1.90	

Economic Impact assessment of castor hybrid GCH-8

This analysis evaluates the economic impact of adopting the castor hybrid GCH-8 by employing the Difference-in-Differences (DiD) method. By comparing productivity and profitability data from adopter and non-adopter groups before and after the introduction of the castor hybrid GCH-8, this result isolates the effect of the new variety and accurately assess its financial benefits for farmers.

The dataset comprises 480 observations, split equally between control (non-adopter) and treated (adopter) groups, with each group containing 120 observations before and after the introduction of the castor hybrid GCH-8. This balanced panel data structure ensures a robust comparative analysis. By maintaining equal sample sizes across both periods and groups, the analysis mitigates biases and allows for a clear assessment of the impact of adopting the castor hybrid GCH-8. This setup is crucial for the Difference-in-Differences (DiD) estimation, providing result to identify and attribute changes in productivity and profitability directly to the adoption of the castor hybrid GCH-8.

Impact of castor hybrid GCH-8 on farmers gross income from castor cultivation

Castor hybrid GCH-8 have positive or negative impact on farmers gross income from the cultivation of castor per hectare was calculated. Table 4 shows the difference-in-differences (DiD) analysis results highlight the economic impact of adopting the castor hybrid GCH-8 on farmers gross income. Before the release of the castor hybrid GCH-8, the control group (non-adopter farmers) had an average gross income of ₹106908.10 per hectare, while the treated group (adopter farmers of castor hybrid GCH-8) had a slightly higher average gross income of ₹108,956.80 per hectare. The difference between the two groups before the introduction of the castor hybrid GCH-8 was ₹2048.80, which is not statistically significant (p-value = 0.17), indicating that there was no significant disparity in income between adopters and non-adopters prior to the introduction of the castor hybrid GCH-8. This difference was non-significant because of adopter and non-adopter farmers was cultivating same varieties before release of castor hybrid GCH-8

Table 4: Difference-in-differences estimation results for gross income

Outcome var.	Gross Income (in ₹/ha)	Standard error	p- value
Before			
Control	106908.10		
Treated	108956.80		
Diff (T-C)	2048.80	1497.816	0.17
After			
Control	167900.70		
Treated	185230.40		
Diff (T-C)	17329.80***	1497.816	0.00
Diff in Diff	15281.00***	2118.232	0.00
R square	0.90		

Note: Means and Standard Errors are estimated by linear regression

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

After the release of the castor hybrid GCH-8, the average gross income of the control group increased to ₹167900.70 per hectare because the non-adopter farmers had also

benefited with new technologies and practices in castor cultivation by using traditional varieties of castor, whereas the treated group saw a more substantial increase to ₹185230.40 per hectare. The increase in gross income for adopter farmers because of the benefits of new technologies and practices with new high yielding variety of castor hybrid GCH-8. The difference between the two groups after the introduction was ₹17329.80, which is highly significant ($p=0.00$). This substantial increase in income for the treated group compared to the control group indicates a positive impact on gross income by adopting the castor hybrid GCH-8.

The DiD estimate, which measures the net effect of adopting the castor hybrid GCH-8, is ₹15281.0 per hectare with a standard error of 2118.23 and it is statistically significant (p -value = 0.00). This positive and significant DiD estimate suggests that the adoption of the castor hybrid GCH-8 has led to a significant increase in gross income for adopters compared to non-adopters. The high R-square value of 0.90 further indicates that the model explains a large portion of the variability in gross income, reinforcing the reliability of the results. This analysis underscores the economic benefits of adopting the castor hybrid GCH-8, demonstrating its potential to significantly enhance farmers' incomes.

Table 4.18 shows the DiD analysis of yield per hectare offers significant insights into the impact of adopting the castor hybrid GCH-8 on agricultural productivity. Before the adoption of the castor hybrid GCH-8, the average yield for the control group (non-adopters) was 24.117 quintals per hectare, while for the treated group (adopters), it was slightly higher at 24.914 quintals per hectare. The difference between the two groups in the pre-adoption period was 0.797 quintals per hectare, which is statistically significant at 1 per cent. This initial difference suggests that even before the adoption, the treated group had a marginally higher yield compared to the control group.

Following the adoption of the castor hybrid GCH-8, the yield for the control group increased to 30.10 quintals per hectare. In contrast, the treated group experienced a more substantial increase in yield, reaching 32.654 quintals per hectare. The after-adoption difference between the two groups was 2.554 quintals per hectare, which is highly significant at 1 per cent. This marked increase in the yield for the treated group compared to the control group indicates a significant positive impact of adopting the castor hybrid GCH-8.

Table 5: Difference-in-differences estimation results for yield per hectare

Outcome var.	Yield (in qtl. /ha)	Standard error	p- value
Before			
Control	24.117		
Treated	24.914		
Diff (T-C)	0.797***	0.303	0.009
After			
Control	30.100		
Treated	32.654		
Diff (T-C)	2.554***	0.303	0.00
Diff in Diff	1.757***	0.429	0.00
R square	0.70		

Note: Means and Standard Errors are estimated by linear regression

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

The DiD estimate, which measures the net effect of the adoption, was 1.757 quintals per hectare with a standard error of 0.429 and it is statistically significant at 1 per cent. This significant DiD value indicates that the adoption of the castor hybrid GCH-8 led to a substantial increase in yield for adopters compared to non-adopters. The R-square value of 0.70 implies that the model explains a substantial portion of the variability in yield, highlighting the robustness of the results.

Overall, these results strongly suggest that the adoption of the castor hybrid GCH-8 has had a significant and positive impact on gross income and yield, leading to higher productivity for farmers who adopted the new variety compared to those who did not. This underscores the agronomic benefits of the castor hybrid GCH-8, supporting its potential to enhance agricultural productivity and contribute to increased agricultural efficiency.

Partially similar result was found by Sharna *et al.* (2020) & Koner and Laha (2020) ^[6].

Conclusion

The result clearly demonstrates that the adoption of the castor hybrid GCH-8 has led to a significant increase in both productivity and profitability for farmers compared to those using traditional castor varieties. The Difference-in-Differences (DiD) method shows that adopters of the GCH-8 hybrid achieved substantial gains in gross income and yield per hectare, which were statistically significant. The higher benefit-cost ratio and increased income measures such as net income, family labor income, and farm business income further underscore the economic advantages of adopting this hybrid. Overall, the findings highlight the potential of the castor hybrid GCH-8 to improve agricultural efficiency and enhance farmers' economic outcomes.

Disclaimer (Artificial Intelligence)

The authors declare that no generative artificial intelligence tools (e.g., ChatGPT, Copilot, or similar technologies) were used in the writing, analysis, or preparation of this manuscript. All work presented is the original intellectual output of the authors.

Competing Interests

Authors have declared that no competing interests exist.

References

1. Anonymous. Food and Agriculture Organization. 2020-21a. <https://www.fao.org>
2. Anonymous. Ministry of Agriculture and Farmers Welfare, Government of India. 2020-21b. <https://eands.dacnet.nic.in/>
3. Chouhan AS. An economic analysis of farm profitability and efficiency of KVK adopted and non-adopted farmers in Malwa Plateau of Madhya Pradesh. Jabalpur: Jawaharlal Nehru Krishi Vishwa Vidyalaya; 2019. M.Sc. (Agri.) thesis (unpublished).
4. Dhanushkodi V, Hanif NA, Tamilselvan N. Castor cultivation: An approach to get sustainable income under rainfed condition. International Journal of Farm Sciences. 2021;11(3):10-13.
5. Jha GK, Pal S, Mathur VC, Bisaria G, Anbukani P, Burman RR, *et al.* Edible oilseeds supply and demand

- scenario in India: Implications for policy. New Delhi: Division of Agricultural Economics, Indian Agricultural Research Institute; 2012.
6. Koner N, Laha A. Economics of zero budget natural farming in Purulia District of West Bengal: Is it economically viable? *Studies in Agricultural Economics*. 2020;122(1):22-28.
 7. Sharma SC, Kamruzzaman M, Siddique ST. Impact of improved chickpea cultivation on profitability and livelihood of farmers in drought-prone areas of Bangladesh. *SAARC Journal of Agriculture*. 2020;18(1):129-142.