



Does off-season cultivation pay? A comparative economic analysis of season and off-season vegetable production in Gujarat

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ABSTRACT

Off-season vegetable cultivation is widely promoted in India to raise incomes of marginal and smallholder farmers, but the evidence rests on gross margin comparisons that leave the underlying mechanism underexamined. This paper compares the economics of seasonal and off-season open-field cultivation of okra, cabbage, and cauliflower, using data from 180 farmers in the Tapi and Sabarkantha districts of Gujarat during 2024-25. The cost concepts of the Commission for Agricultural Costs and Prices method was used and the difference in net income was tested by independent samples t-test. Off-season cultivation raised the total cost by 11 to 18 per cent and lowered yields by 18 to 24 per cent, but generated a farm-gate price premium of 57 to 114 per cent that more than offset both penalties. Net return over Cost C₂ and the benefit-cost ratio improved in the off-season for every crop, the difference being significant at the one per cent level throughout. Decomposition analysis showed that the entire gain came from the price effect, which exceeded the combined yield and cost penalties by about 2.4 times in okra but only 1.4 times in cabbage. The break-even premium ranged from 33 to 38 per cent. In okra the actual price rise was far above this, so the price could fall a long way before the gain disappeared while in cabbage it was much closer. Since the benefit depends wholly on the lean-season price, off-season cultivation should be promoted only for crops that can command such a price.

Key words: *Abelmoschus esculentus*, *Brassica oleracea*, cost concepts, price premium, profitability.

INTRODUCTION

Horticulture contributes about a third of the gross value added in Indian agriculture on some 15 per cent of the cultivated area, and vegetables account for roughly two-thirds of Gujarat's horticultural production. Yet production is marked by pronounced seasonal gluts and lean periods. The concentration of arrivals within a narrow harvest window depresses farm-gate prices at the moment when most marketable surplus reaches the market, while consumers face elevated prices through the intervening months (BIRTHAL *et al.*, 4), and weakens the producer's bargaining position at the point of sale (Acharya and Agarwal, 1). Off-season cultivation, in which a crop is raised outside its conventional growing window, offers one route out of this mismatch by supplying a thin market and capturing the resulting premium. Vegetables suit smallholders for this reason: their labour intensity and short gestation allow households with more labour than land to convert family labour into income, and diversification towards high-value crops has been a principal source of farm income growth in India (BIRTHAL *et al.*, 3; Gulati *et al.*, 6). The economic case is nonetheless less straightforward than policy enthusiasm suggests. Growing a crop outside its optimal thermal window depresses yields, raises

pest and disease pressure and increases irrigation requirements. Whether off-season cultivation pays therefore depends on a question rarely posed directly: does the price premium exceed the combined yield and cost penalties, and by what margin?

Earlier Indian work has documented the profitability of off-season vegetables, particularly in the temperate hill economies where altitude confers a natural advantage in supplying plains markets during summer. Bala *et al.* (2) and Rahi and Choudhary (15) reported substantial returns in Himachal Pradesh, and comparable cost estimates for okra in middle Gujarat were given by Rami *et al.* (16) and Padavi and Singh (12), while Patel *et al.* (14) examined cabbage marketing in north Gujarat. Three gaps remain. First, the evidence base for the subtropical plains, where off-season production depends on heat-tolerant varieties rather than altitude, is thin. Second, much of the literature concerns protected cultivation, the coordinated study of Kumar *et al.* (8) in Uttarakhand being a leading example, which requires capital beyond the reach of marginal farmers, whereas open-field cultivation demands management adjustment rather than investment. Third, existing studies report gross margin comparisons without decomposing the source of the advantage or testing its reliability.

The present study therefore compared the cost structure and profitability of the two systems in okra,

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cabbage and cauliflower, tested the significance of the difference in net income, and decomposed the net return gap into its price, yield and cost components.

MATERIALS AND METHODS

The study was conducted in Gujarat following a multi-stage sampling design. For okra, season and off-season cultivators were studied from Tapi district (Zone I, south Gujarat) and for cabbage as well as cauliflower, Sabarkantha district (Zone IV, north Gujarat) was selected on the prevalence of off-season cultivation. Within each crop, two talukas were selected purposively for seasonal and two for off-season cultivation, followed by three villages per taluka and five farmers per village at random, giving 30 growers per system per crop and a total sample of 180 farmers for three crops. Okra, conventionally a kharif and summer crop, was shifted into the rabi months, while cabbage and cauliflower, rabi crops, were advanced into the pre-monsoon period. The study was confined to open-field cultivation, since protected structures require investment that limits replicability among resource-poor farmers. Data were collected by personal interview using a pre-tested schedule during 2024-25. Farmers were classified into marginal, small, medium and large size groups; figures reported are unweighted means of the four size-group means.

Cost of cultivation followed the cost concepts of the Commission for Agricultural Costs and Prices. Cost A comprised all paid-out expenses including hired labour, seed or seedlings, manures, fertilizers, plant protection chemicals, irrigation and machinery charges, depreciation, interest on working capital at 12 per cent per annum and miscellaneous expenses; Cost B added the rental value of owned land at prevailing market rent and interest on owned fixed capital at 10 per cent per annum; Cost C_1 added the imputed value of family labour; and Cost C_2 , the basis for profitability comparison, added managerial charges at ten per cent of Cost C_1 . Gross returns and costs of production are averages of the four size-group values. Net return is gross return minus Cost C_2 , and the benefit-cost ratio is gross return divided by Cost C_2 .

The difference in net income was tested by independent samples two-tailed t-test as season and off-season cultivators constituted two independent groups. The t-test was applied separately for each crop at the one per cent level (Gupta and Kapoor, 7; Panse and Sukhatme, 13), in SPSS version 26. The change in net return was split into three parts. The price effect was the seasonal yield times the price difference. The yield effect was the off-season price times the yield difference. The cost effect was the

change in Cost C_2 , with the sign reversed. Together these three add up exactly to the observed change. The prices used were found by dividing gross return by yield. The break-even premium, the price rise at which the advantage disappears, was worked out from the same equation.

RESULTS AND DISCUSSION

The total cost of cultivation was higher under off-season conditions in all three vegetables (Table 1), the increase being steepest in okra and more moderate in the cole crops. Human labour remained the largest single cost head in every crop under both systems, confirming the labour-intensive character of vegetable cultivation, while fertilizers ranked second in both cole crops. The components that rose disproportionately were plant protection and irrigation, consistent with elevated pest pressure and the more frequent irrigation farmers reported outside the natural window. Plant protection alone accounted for 23 to 31 per cent of the off-season increment and was the largest contributor in each crop, with irrigation adding a further 9 to 14 per cent. The remainder was spread across labour, planting material and manures, indicating that the cost penalty arises principally from intensification of protective and water management inputs. A similar dominance of labour and plant protection in okra was reported by Rami *et al.* (16) and Padavi and Singh (12), and higher off-season protection costs by Singh and Chauhan (18).

Yields declined appreciably in the off-season in every crop (Table 2), the shortfall being greatest in cauliflower and least in okra, consistent with the reduced production efficiency reported for summer okra by Walke *et al.* (19). The ordering follows the underlying physiology: curd induction in cauliflower is temperature-triggered, and heat stress during curd development depresses yield more sharply than stress during the vegetative phase, inducing premature bolting and smaller curds (Mulodia *et al.*, 10). Advancing a rabi cole crop into the pre-monsoon period therefore places the most thermally sensitive stage under the greatest stress. Against this, off-season prices were markedly higher, the premium being largest in okra, where the average price more than doubled, reflecting the thinness of lean-season arrivals.

The price effect dominated in every case. Gross returns rose despite lower physical output, and net return over Cost C_2 improved substantially in all three crops, with corresponding gains in the benefit-cost ratio, a finding consistent in direction with Bala *et al.* (2), Ghosh and Jana (5), Rahi and Choudhary (15) and Singh and Chauhan (18). Although the cost of

Table 1: Component-wise cost of cultivation of selected vegetables under season (S) and off-season (OS) open-field cultivation in Gujarat, 2024-25 (Rs. ha⁻¹).

Cost component	Okra S	Okra OS	Cabbage S	Cabbage OS	Cauliflower S	Cauliflower OS
Human labour	22,863	25,147	19,210	20,607	18,630	20,930
Family*	11,944	12,473	9,277	10,197	7,749	8,886
Hired*	10,919	12,674	9,932	10,409	10,882	12,045
Seed / seedlings	18,230	22,001	10,895	11,095	11,095	12,746
Manures	11,802	14,003	11,447	12,053	10,431	10,785
Fertilizers	9,959	10,801	13,023	13,387	14,890	15,309
Irrigation	2,225	4,306	8,481	10,075	8,150	9,233
Plant protection chemicals	11,017	15,324	6,979	10,269	6,489	10,011
Tractor charges	6,623	7,553	6,149	6,644	6,968	7,406
Miscellaneous	291	347	998	1,165	1,175	1,292
Depreciation on implements	1,300	1,948	2,315	4,142	1,417	1,528
Interest on working capital	2,895	3,558	2,809	3,170	2,860	3,214
Rental value of owned land	7,799	7,205	7,213	7,209	7,271	7,277
Interest on fixed capital	1,442	1,476	1,495	1,568	1,424	1,468
Managerial cost	9,645	11,367	9,101	10,138	9,080	10,120
Total cost (Cost C ₂)	1,06,090	1,25,036	1,00,114	1,11,521	99,878	1,11,321

Source: Field survey

Note: Seed refers to okra; seedlings to cabbage and cauliflower. Family and hired are sub-components of human labour. Managerial cost imputed at 10 per cent of Cost C₁. Figures rounded to the nearest rupee, so components may not sum exactly to the total.

Table 2: Yield, price and returns of selected vegetables under season (S) and off-season (OS) cultivation.

Particular	Okra S	Okra OS	Cabbage S	Cabbage OS	Cauliflower S	Cauliflower OS
Yield (q ha ⁻¹)	140.54	114.65	202.34	157.02	225.11	170.40
Price (Rs. q ⁻¹)	1,599	3,426	1,006	1,572	1,133	1,875
Gross return (Rs. ha ⁻¹)	2,25,627	3,93,107	2,03,568	2,48,204	2,55,106	3,19,588
Net return over Cost C ₂	1,19,537	2,68,072	1,03,454	1,36,683	1,55,228	2,08,267
Cost of production (Rs. q ⁻¹)	755	1,091	541	710	444	653
Benefit-cost ratio	2.13	3.14	2.03	2.23	2.55	2.87

Source: Field survey.

Note: Gross return and cost of production are means of size-group values and therefore differ marginally from the product of mean yield and mean price, and from Cost C₂ divided by mean yield, respectively.

producing one quintal increased in the off-season for every crop, this is because yields fell by more than costs rose, in percentage terms. Off-season cultivation is thus less efficient to produce; its profit comes entirely from the higher price each quintal fetches.

The t-test confirmed that the differences in net income are significant and not due to chance (Table 3). For all three crops the calculated t-value was above the critical value at the one per cent level. The margin was much narrower in cabbage, however. Its t-value was closer to the critical value than in okra and cauliflower, and its confidence interval was wide

compared with the difference itself. This shows that the off-season gain varied more from farm to farm in cabbage. The means in Table 3 are averages over all individual farms, while the net returns in Table 2 are averages of the four size-group values. The two therefore differ a little in level, but agree closely on the size of the off-season gain.

Decomposition of the net return gap shows why off-season cultivation paid (Table 4). In every crop the price effect was large and positive, while the yield and cost effects were negative. The advantage existed only because the price gain was bigger than the two penalties combined. But the size of this

Table 3: Independent samples t-test for difference in net income between season and off-season cultivation.

Crop	Season mean	Off-season mean	Difference	t-value	99% confidence interval
Okra	1,09,127	2,54,338	1,45,211	16.49*	1,21,762 to 1,68,661
Cabbage	1,14,002	1,50,172	36,170	4.24*	13,442 to 58,898
Cauliflower	1,59,612	2,14,322	54,710	12.96*	43,468 to 65,953

Source: Field survey

Note: All values in Rs. ha⁻¹ except t-values. Means are computed over all 30 individual farm observations. *Significant at 1 per cent level (two-tailed, df = 58, critical value 2.66); n = 30 per group per crop.**Table 4:** Change in net return from season to off-season cultivation.

Crop	Price effect	Yield effect	Cost effect	Net change	Break-even premium (%)
Okra	2,56,251	-88,770	-18,946	1,48,535	32.9
Cabbage	1,16,274	-71,638	-11,407	33,229	36.1
Cauliflower	1,67,091	-1,02,610	-11,443	53,038	38.0

Source: Field survey

Note: All values in Rs. ha⁻¹ except break-even premium. Price effect is seasonal yield times price change; yield effect is off-season price times yield change; cost effect is the negative of the change in Cost C₂. Components sum to the net change.

margin differed sharply between crops. The price effect was about 2.4 times the penalties in okra, 1.5 times in cauliflower, and only 1.4 times in cabbage. The break-even premium shows the same pattern. In okra the price could fall to about a third of the seasonal price before the gain disappeared, a wide safety margin. Cauliflower had a smaller margin, and cabbage the smallest of all.

This difference between crops has a clear message. Off-season cultivation is not profitable by nature; it is profitable only because of the market. The premium exists because few farmers grow these crops in the lean season. When arrivals are low, prices are high, and when arrivals rise, prices fall. This link between arrivals and prices is well established for these crops. Kumar *et al.* (9) found significantly negative correlations between arrivals and wholesale prices of cabbage and cauliflower, both across months and over years, in four metropolitan markets. If promotion leads many farmers to take up off-season cultivation, arrivals in the lean season would rise, and by the same logic the premium would be pushed down. Crops with a small safety margin would lose their advantage first. Treating all off-season vegetables as equally profitable is therefore risky, as it could push farmers towards the very crops most likely to fail once many adopt them. This study is based on data from a single point in time and cannot measure exactly how much the lean-season price falls as arrivals rise. The break-even figures therefore show which crops are more at risk, not the point at which adoption would end profitability.

These results work differently from the studies in the hill states. In the hills, off-season supply is

possible because of high altitude, and yields need not fall; in the subtropical plains, yields clearly drop, and only the higher price can make up for it. It is concluded that off-season open-field cultivation of okra, cabbage and cauliflower earns significantly more than seasonal cultivation in the study districts. But the whole gain comes from the lean-season price, and the safety margin differs a lot between crops, so promotion should be planned crop by crop. The extra cost falls mainly on plant protection and irrigation, so support should focus on integrated pest management and efficient irrigation, both of which have shown good returns in similar systems (Narayanamoorthy *et al.*, 11; Sharma *et al.*, 17). The lack of heat-tolerant varieties was a major constraint, and closing the yield gap would reduce the dependence on price. The study covers only three crops, two districts and one year; data over several years would allow a direct estimate of how arrivals affect prices, on which the long-term case depends.

AUTHOR'S CONTRIBUTION

Conceptualization of research (VRK, YAL); Designing of the experiments (VRK, YAL); Contribution of experimental materials (VRK); Execution of field experiments and data collection (VRK); Analysis of data and interpretation (VRK, YAL); Preparation of the manuscript (VRK, YAL).

DECLARATION

The authors declare that they do not have any conflict of interest.

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