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Growth performance and instability of flower production in Gujarat: A post-MIDH analysis

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Abstract

Floriculture is an emerging sector in the horticulture industry, not just in terms of production but in terms of income and employment generation. The production of total flowers in India during 2023-24 was 3,231 thousand tonnes which highlights the rising importance of this sector. Gujarat ranks 6th in terms of flower crops production. The study explores the trends in the production of major flower crops of Gujarat state like rose, marigold, lily, mogra and total flowers during 2013-14 to 2023-24 (Post-MIDH period). The secondary data on area, production and yield were analysed using the tools such as compound growth rates, Cuddy- Della Valle index and decomposition model. The district wise growth rates and instability indices were found out for total as well as major flower crops producing districts of Gujarat. The results indicated that total flower production in Gujarat increased at the CGAR of 2.04 per cent while area and yield were increased with the rate of 1.59 and 0.44 per cent, respectively. The results of growth performance of individual flower crops revealed that the growth of area in case of rose, marigold and mogra was 0.75, 2.43 and 1.60 per cent, respectively while growth of production of rose, marigold and mogra increased significantly during the study period. The negative and significant growth of yield in case of marigold (-0.27%) and mogra (-0.33%) is a matter of concern for the researchers to sustain flower cultivation in the state. The results also revealed that the production of rose flower showed high instability with index value of 23.99 per cent. The instability indices of area, production and productivity of total flowers were 3.44, 5.77 and 4.62 per cent, respectively showed the stability in production. The decomposition results exhibited area effect was more dominating in major flower crops rather than yield and interaction effect. Policymaker needs to focus in improvement of the MIDH scheme and formulate policies that sustain the production with higher productivity and stable growth.

Keywords: Flower crops, growth and trend, instability index, decomposition, Gujarat

Introduction

The global floriculture market has reached around 57.5 billion USD in the year 2021 and cultivation is spread in more than 145 countries and expected to reach 106.1 billion USD at CAGR of 6.3 per cent from 2023 to 2033. India stands in the 2nd position in Asia and 25th position in world related to the production and trade of floriculture, respectively.

India's varied agro-climatic zones make it a perfect location for producing and cultivating a wide range of cut and loose flowers. The total area under flower production in India was 389.11 thousand hectares in 2024-25 where Andhra Pradesh holds the first place. After implementation of Mission for Integrated Development of Horticulture (MIDH) in 2014 -15, the flower production increased from 1636 thousand MT to 2510 thousand MT during 2010-11 to 2017-18 and in 2024-25 it reached at 4016.81 thousand MT (Jaiswal *et al.*, 2023)^[4].

Gujarat stands in the 6th position in terms of total flower production in India. The Gujarat produced 2,00,900 MT of total flowers in 2023-24 and in terms of production Aravalli district contributed the highest share (DHG, 2024). In Gujarat major flower crops are rose, marigold, lily and mogra while major flowers producing districts are Aravalli, Ahmedabad, Panchmahal, Vadodara and Dang *etc* (Table 1). The increase in area, production and productivity of flowers at the rate of 13.61, 18.64 and 4.43 per cent per annum was reported by Suvagiya *et al.* (2017)^[9] in Gujarat during 2002-03 to 2012-13. This study explores the growth performance, its stability and its sources after implementation of MIDH with following specific objectives.

Table 1: Top ten flower crops producing districts of Gujarat in 2023-24 (DHG, 2024) (MT = Metric tonnes, ha= hectare)

Sr. No.	Name of District	Area (ha)	Production (MT)	Productivity (MT/ha)
1	Aravalli	2394	24206	10.11
2	Ahmedabad	2110	20592	9.76
3	Panchmahal	2326	19937	8.57
4	Vadodara	453	19733	8.73
5	Dang	1991	19064	9.57
6	Kutch	1900	17157	9.03
7	Bhavnagar	1230	11514	9.36
8	Patan	1419	10876	7.66
9	Dahod	444	4167	9.38
10	Mehsana	427	4146	9.71
Total		21810	200900	9.21

Objectives

1. To investigate the growth pattern in area, production and yield of major flower crops in Gujarat
2. To investigate the instability indices in area, production and yield of major flower crops in Gujarat
3. To identify the sources of growth and variability in average production of major flower crops in Gujarat

Methodology

The district wise time series data for the then 26 districts of Gujarat on area, production and yield of major and total flower crops (rose, marigold, lilly, mogra) of Gujarat was collected from National Horticulture Board and Director of Horticulture of Gujarat, Directorate of Economics and Statistics (DES) and their websites during the period from 2013-14 to 2023-24 ^[3] (Post-MIDH). The compound growth rates were calculated for area, production and yield of flower crops by fitting the exponential function of the form $Y = a b^t e^u$ where, Y is dependent variable, a is intercept, b is regression coefficient, t is the time period in years and e^u is the error term. The instability indices (Cuddy *et al.*, 1978) ^[2] for the same was also computed by multiplying the coefficient of variation with square root of $1-\bar{R}^2$ (Adjusted coefficient of multiple determination). The trade-off between growth and instability was also taken by using nine-fold typology for classifying the preferable and non-preferable situation. Minhas and Vaidyanathan (1965) ^[5] decomposition model were used with the assumption of $P = A * Y$, where P is production, A is area and Y is yield to estimate the change in production was estimated by using the given formula, Change in production (%) = Area effect + Yield effect + Interaction effect.

Table 2: The range of growth and instability

Category	Growth rate	Instability
Low	Between 0 to 5	Between 0 to 15
Medium	Greater than 5 and up to 10	Between 15 to 30
High	Greater than 10	Greater than 30

Results and Discussion

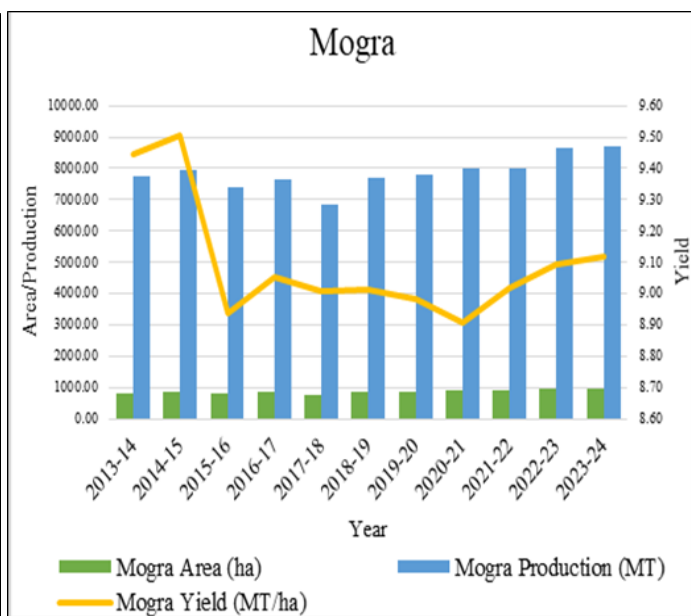
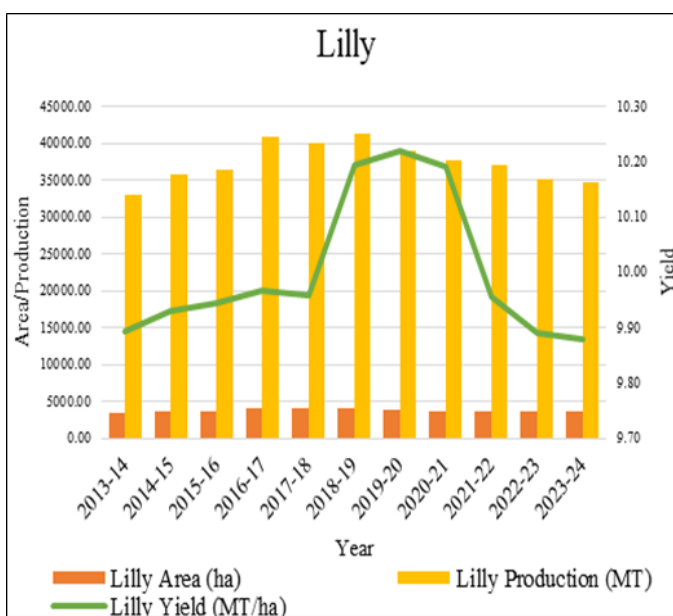
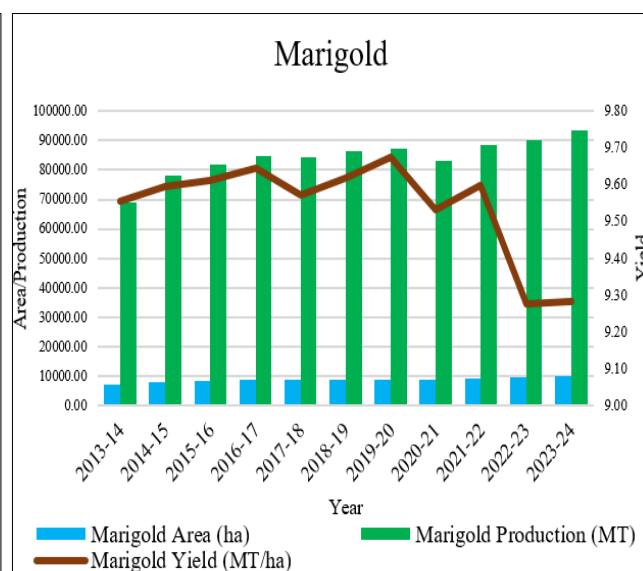
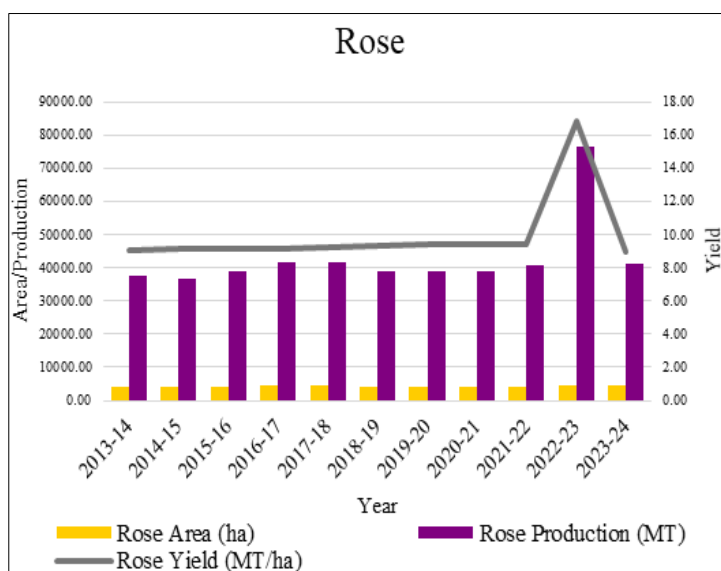
The results of growth performance, instability analysis, growth pattern and decomposition of major flower crops in different districts of Gujarat and state as a whole are deliberated here. The Figure 1 represents the trend performance of major flower crops of Gujarat during Post-MIDH period. The given figure clearly showed that marigold and mogra showed continuous increasing trend of area and production while yield revealed decreasing trend. The lilly and total flowers exhibited slightly decreasing trend of area and production whereas the yield of lilly crop showed drastic reduction which is a matter of concern. The area, production and yield of rose and total flower crops illustrated higher value in 2022-23 while in 2023-24 it exhibited decreasing trend. As for the rose and total flowers showed stable trend during the study period. rate of area of rose crop was recorded in Dahod district at the rate of 16.53 per cent per annum, significant at one per cent level of significance followed by Patan (14.56%/annum) while other district like Ahmedabad, Amreli, Anand, Dang, Jamnagar and Junagadh showed lower rate of growth. District like Banaskantha, Bharuch, Bhavnagar, Gandhinagar, Kheda, and Kutch recorded negative and significant growth rates of area of rose crop. The significant increase in area under marigold crop during the study period was reported in Patan (21.91%/annum), followed by Panchmahal (18.41%/annum) and Dahod (18.27%/annum). While, Banaskantha, Bharuch, Bhavnagar, Gandhinagar, Kutch, Porbandar, Rajkot, Surat, Tapi and Valsad showed significantly negative growth of marigold area. The area of lilly crop illustrated low and medium rate of growth whereas the highest growth was reported by Dahod district at the rate of 12.01 per cent per annum followed by Junagadh and Ahmedabad. The Kutch exhibit the highest negative rate of growth at the rate of -17.53 per cent per annum followed by Gandhinagar and Surat. The area of mogra crop showed more or less moderate rate of growth. The Kheda district showed the highest positive growth increased at the rate of 27.09 per cent per annum followed by Dahod, Panchmahal and Patan. Kutch, Gandhinagar, Bhavnagar, Bharuch, Tapi and Surat showed negative but significant growth rate of area of mogra crop. In terms of area of total flower crops, Dahod registered the significantly higher rate of growth increased at the rate of 19.33 per cent per annum followed by Patan and Panchmahal. While, Ahmedabad, Amreli, Anand, Dang, Kheda, Mehsana, Navsari and Vadodara showed lower but significant growth rate. Gandhinagar, Surat, Kutch and Banaskantha exhibited negative rate of growth of area of total flowers. The Gujarat state as whole showed lower growth of area of all major and total flower crops. In terms of rose, marigold, mogra and total flowers the growth increased at the rate of 0.75, 2.43, 1.60 and 1.59 per cent per annum while in case of lilly crop it displayed non-significant results (Table 3). The similar results were furnished by Shreeram and Leelavathi (2017) ^[8] in terms of flower cultivation in India during study period 2005-06 to 2020-21, in that the area of loose and cut flowers showed positive and significant growth.

The results of instability of area of major flower crops displayed in Table 3 revealed that the rose area in Gandhinagar exhibited the highest instability at 63.92 per cent followed by Panchmahal (32.75%) and Rajkot (31.93%) while district like Banaskantha, Dang, Kutch, Mehsana and Valsad recorded medium instability and other showed lower instability. While the area of marigold showed stable condition with lower to medium instability indices where the

highest instability was found in case of Surendranagar with 41.37 per cent followed by Rajkot (29.75%) and Banaskantha (24.10%). The Ahmedabad, Bharuch, Bhavnagar, Dahod, Dang, Junagadh and other districts witnessed lower rate of instability. The highest instability of area of lilly crop recorded by Gandhinagar district at 88.90 per cent followed by Rajkot (65.38%) and Dahod (39.52%). While the low instability of area, was reported by Ahmedabad, Anand, Junagadh, Kheda and Narmada. The highest instability of area of mogra was found in case of Gandhinagar with 96.37 per cent followed by Panchmahal (77.54%), Banaskantha (29.24%), Jamnagar (27.34%) and Patan (24.41%). While Ahmedabad, Vadodara and Narmada showed low instability. The area of total flower crops showed low to medium instability with the highest instability reported by Rajkot with 30.98 per cent followed by Surendranagar (29.05%) and Banaskantha (22.29%). While the low instability was found in Kheda, Vadodara, Bharuch, Ahmedabad and Tapi. The Gujarat state as whole exhibited more or less stable condition in terms of area of major flower crops with lower instability in all of the cases. Patil *et al.* (2020) ^[7] showed similar results in terms of flower cultivation in India and different states during study period 1994-95 to 2018-19 showed decreased

instability in both cases in Post-NHM as compared to Pre-NHM period.

The results of growth performance of production of major flower crops revealed that the district of Dahod (19.00%/annum) reported the highest growth rate followed by Patan and Anand whereas, Gandhinagar, Kutch, Surat exhibit negative growth rate in case if rose, while in case of production of marigold, the highest growth was reported by Patan that increased at the rate of 22.64 per cent per annum while Gandhinagar and other districts showed significantly negative growth. The production of lilly crop showed moderate rate of growth with the highest growth reported by Dahod at 15.30 per cent per annum followed by Narmada (6.23%/annum), and Ahmedabad (6.01%/annum). Whereas, Kutch recorded the negative rate of growth at -17.39 per cent per annum which was tailed by Gandhinagar and Surat. The highest growth rate of production of mogra was reported in Dahod about 29.46 per cent per annum followed by Panchmahal and Kheda. The highest negative growth rate of mogra production during study period was reported in Kutch at -19.50 per cent per annum followed by Gandhinagar and Bhavnagar (Table 4).



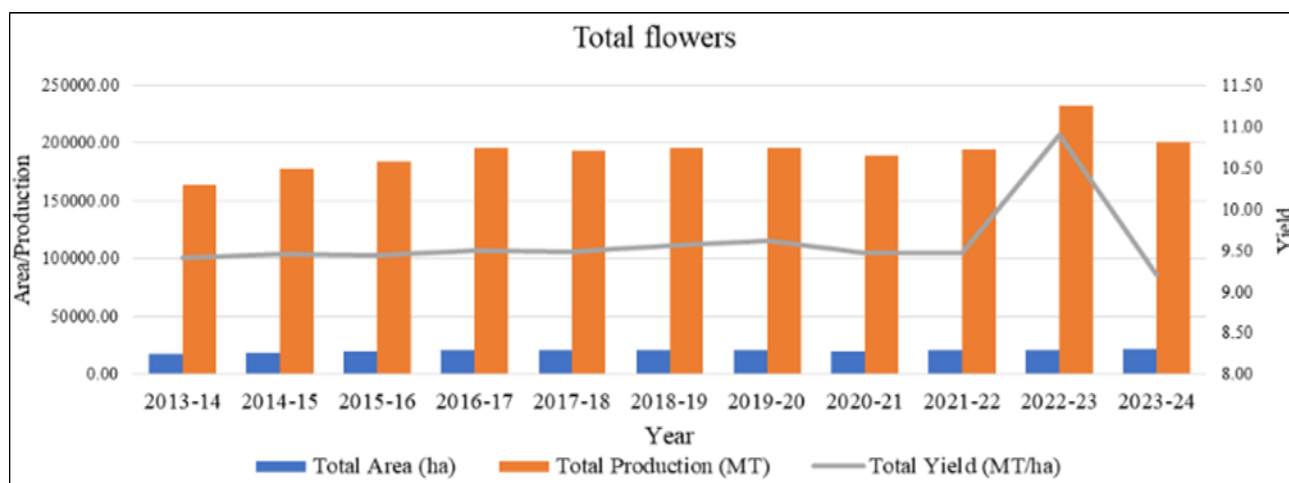


Fig 1: Trends of flower production in Gujarat state during Post-MIDH period

Table 3: Growth rate and instability indices of area of major flower crops of Gujarat during Post-MIDH period (2013-14 to 2023-24)

Sr. No.	Name of District	Rose		Marigold		Lilly		Mogra		Total	
		CAGR	CDVI	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
1	Ahmedabad	2.44***	1.05	2.20***	7.20	5.66***	2.92	1.70***	2.44	2.63***	4.36
2	Amreli	1.77***	9.56	4.59***	18.42	-	-	-	-	2.45***	11.27
3	Anand	1.42	32.07^	2.53***	4.84	2.65***	14.65	2.71	35.30^	2.75***	4.09
4	Banaskantha	-10.49***	22.13	-11.89***	24.10	-	-	9.39***	29.24	-11.40***	22.29
5	Bharuch	-0.92***	5.13	-4.92***	9.78	-	-	-1.80*	17.34	-2.47***	4.17
6	Bhavnagar	-4.03***	13.26	-4.23***	13.51	-	-	-9.02***	18.92	-5.80***	17.78
7	Dahod	16.54***	13.56	18.28***	13.57	12.01***	39.52	24.35***	16.22	19.34***	15.58
8	Dang	1.69*	18.75	5.44***	9.59	-	-	-	-	3.56***	12.12
9	Gandhinagar	-23.34***	63.92	-11.30***	14.28	-11.81**	88.90	-9.71**	96.37	-13.51***	16.21
10	Jamnagar	4.27***	13.76	8.29***	6.73	-	-	16.47***	27.34	5.18***	9.64
11	Junagadh	4.60***	7.89	7.48***	12.98	6.19***	7.82	-	-	5.30***	6.75
12	Kheda	-2.50***	8.61	6.19***	6.96	-2.65***	6.65	27.10***	20.05	2.93***	3.60
13	Kutch	-16.66***	22.86	-1.99***	13.26	-17.53***	25.32	-19.34***	17.72	-11.59***	13.02
14	Mehsana	2.30**	17.40	6.36***	8.72	-	-	-	-	3.87***	11.29
15	Narmada	1.33	18.72^	9.49***	15.17	4.18***	11.93	13.37***	10.23	6.37***	12.36
16	Navsari	0.20	19.91^	1.93***	5.76	1.68***	5.83	-	-	1.85***	6.30
17	Panchmahal	9.92***	32.75	18.41***	9.71	0.67	24.65^	23.06***	77.54	16.77***	7.37
18	Patan	14.57***	11.63	21.91***	14.45	-	-	19.76***	24.41	19.11***	12.61
19	Porbandar	-11.40***	17.16	-5.02***	16.49	-	-	-	-	-9.65***	15.86
20	Rajkot	-13.42***	31.93	-9.87***	29.75	-4.82*	65.38	-	-	-10.43***	30.98
21	Sabarkantha	5.89***	16.73	6.18***	19.20	-	-	-	-	5.70***	17.26
22	Surat	-14.63***	28.73	-10.93***	23.34	-11.43***	15.24	-0.09	10.70^	-11.88***	20.45
23	Surendranagar	-0.68	19.88^	10.44***	41.37	-	-	-	-	8.50***	29.05
24	Tapi	-2.13***	10.74	-2.19***	5.31	-3.64***	19.86	-0.22	10.18^	-2.09***	5.08
25	Vadodara	3.96***	5.31	1.43***	2.96	0.81***	1.84	1.86***	3.85	2.56***	3.27
26	Valsad	-7.88***	20.88	-1.14	17.94^	-5.07***	13.80	-	-	-4.07***	15.33
	Gujarat	0.75***	4.28	2.43***	4.00	-0.01	6.73^	1.60***	4.22	1.59***	3.44

Note: 1. CAGR: Compound Annual Growth Rate (%/annum), CDVI: Cuddy-Della Vella Index (%), ^: Non significant

2. *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively

3. Area in hectare (ha), Production in Metric tonnes (MT) and Yield in Metric tonnes per hectare (MT/ha)

In case of production of total flowers during the study period, the highest growth rate was registered by Dahod district with compound annum growth rate at 20.49 per cent per annum followed by Patan (19.51%/annum) and Panchmahal (15.98%/annum). The highest negative growth of production recorded by Gandhinagar (-13.39%/annum) followed by Rajkot (-11.94%/annum) and Surat (-11.88%/annum). At Gujarat level the production of major flower crops showed lower growth with the rate of 3.11 per cent per annum in rose, 2.15 per cent per annum in marigold, 1.26 per cent per annum in mogra and 2.04 per cent per annum in total flower crops while lilly crops exhibited non-significant results (Table 4). Angel *et al.* (2024) [1] showed similar results related to growth performance of rose crop production in India during the study period 2013-14 to 2023-24 where the production was

increased with at the rate of 5.98 per cent per annum, respectively.

In case of instability of production of rose, only Anand (175.88%), Gandhinagar (64.13%) and Rajkot (31.03%) reported higher instability and other districts showed lower to medium instability which is given in Table 4. In terms of production of marigold crop the highest instability was reported by Surendranagar at 39.01 per cent followed by Rajkot (29.36%), Banaskantha (26.39%) and Surat (23.70%) while the lowest instability was recorded by Vadodara district at 3.17 per cent followed by Tapi (5.28%) and Jamnagar (5.92%). In terms of production of lilly crop, the instability indices illustrated that the highest instability was found in case of Gandhinagar (97.36%) followed by Rajkot (67.49%) and Dahod (45.33%) whereas other all districts exhibited medium

to low instability and the medium instability was registered by Kutch, Panchmahal, Surat and Tapi. The highest instability of production of mogra was reported by Gandhinagar district at 95.47 per cent followed by Panchmahal (85.42%), Dahod (58.65%) and Banaskantha (31.22%). Whereas district like Ahmedabad, Vadodara, Narmada and Kheda showed low instability of production of mogra crop. In case of production of total flowers, the moderate instability was found. The highest instability was reported by Anand district at 41.26 per cent followed by Rajkot (32.07%), and Surendranagar (29.25%). The low instability of production was reported by

Ahmedabad, Bharuch, Vadodara, Kheda, Junagadh and others. In case of Gujarat state, the production of rose flower revealed medium instability while other all flower crops exhibited lower instability.

The yield of rose crop showed medium to low rate of growth may be due to the low area and production rate. The highest rate of growth in terms of yield was found in case of Anand at the rate of 8.75 per cent per annum followed by Narmada (2.14%/annum) and Dahod (2.12%/annum). The Panchmahal district recorded the highest negative growth of yield at the rate of -11.85 per cent per annum (Table 5).

Table 4: Growth rate and instability indices of production of major flower crops of Gujarat during Post-MIDH period (2013-14 to 2023-24)

Sr. No.	Name of District	Rose		Marigold		Lilly		Mogra		Total	
		CAGR	CDVI	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
1	Ahmedabad	2.90***	1.89	2.28***	6.46	6.01***	3.21	1.45***	3.39	2.88***	3.96
2	Amreli	0.93**	8.97	3.00***	18.36	-	-	-	-	1.43***	10.88
3	Anand	10.30**	175.88	2.78***	4.97	3.08***	14.60	2.99	38.23^	6.51***	41.26
4	Banaskantha	-10.32***	24.29	-10.77***	26.39	-	-	4.24**	31.22	-10.64***	24.45
5	Bharuch	-0.39	6.08^	-4.90***	10.46	-	-	-1.75*	17.05	-2.12***	5.02
6	Bhavnagar	-3.94***	13.33	-4.49***	14.06	-	-	-8.92***	20.28	-5.87***	17.63
7	Dahod	19.01***	13.25	19.23***	13.56	15.30***	45.33	29.46***	58.65	20.49***	15.61
8	Dang	3.53***	20.80	7.70***	10.55	-	-	-	-	5.82***	12.56
9	Gandhinagar	-23.36***	64.13	-11.32***	15.90	-11.89**	97.36	-9.91**	95.47	-13.39***	18.07
10	Jamnagar	5.24***	15.07	8.11***	5.92	-	-	17.48***	27.08	5.68***	9.65
11	Junagadh	3.96***	7.57	6.10***	11.73	5.76***	8.44	-	-	4.37***	6.85
12	Kheda	-2.33***	8.88	5.56***	7.64	-2.93***	6.40	22.72***	13.18	2.22***	5.81
13	Kutch	-16.46***	23.66	-1.91***	13.78	-17.39***	25.02	-19.50***	17.84	-11.46***	13.44
14	Mehsana	2.69***	17.52	6.67***	7.84	-	-	-	-	4.38***	10.70
15	Narmada	3.50***	17.78	10.69***	14.50	6.23***	13.93	13.40***	12.12	8.60***	11.66
16	Navsari	-0.46	20.36^	-2.05**	15.73	1.51***	7.54	-	-	0.63	10.21^
17	Panchmahal	-3.10**	28.24	18.92***	10.13	3.36**	22.63	24.78***	85.42	15.98***	8.62
18	Patan	14.64***	11.62	22.64***	14.53	-	-	18.91***	24.90	19.51***	12.59
19	Porbandar	-10.90***	18.66	-5.89***	17.84	-	-	-	-	-10.06***	17.14
20	Rajkot	-14.61***	31.03	-10.12***	29.36	-5.86**	67.49	-	-	-11.95***	32.07
21	Sabarkantha	6.11***	17.29	6.35***	19.55	-	-	-	-	5.90***	17.63
22	Surat	-14.94***	29.10	-10.92***	23.70	-11.29***	15.67	8.10***	19.57	-11.89***	20.96
23	Surendranagar	-1.28	22.76^	8.75***	39.01	-	-	-	-	7.10***	29.25
24	Tapi	-3.11***	10.37	-2.45***	5.28	-4.02***	22.06	-0.47	12.54^	-2.50***	6.09
25	Vadodara	4.03***	5.63	1.49***	3.17	0.95***	1.94	1.61***	4.46	2.55***	3.47
26	Valsad	-6.91***	15.03	-2.50***	18.49	-5.16***	13.94	-	-	-4.61***	14.28
	Gujarat	3.11***	23.99	2.15***	4.19	0.04	7.45^	1.26***	5.43	2.04***	5.77

Note: 1. CAGR: Compound Annual Growth Rate (%/annum), CDVI: Cuddy-Della Vella Index (%), ^: Non significant

2. *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively

3. Area in hectare (ha), Production in Metric tonnes (MT) and Yield in Metric tonnes per hectare (MT/ha)

The marigold yield revealed drastic reduction in growth rate with negative and lower rate of growth in all of districts of Gujarat. The growth rate of yield of marigold was reported to be highest in Dang at the rate of 2.14 per cent per annum followed by Banaskantha and Narmada. Moreover, district Navsari (-3.90%/annum), Surendranagar, (-1.52%/annum), Amreli (-1.51%/annum) and others showed negative growth in marigold yield. The yield of lilly crop showed least rate of growth in most of the districts with the highest rate of growth found in case of Dahod district at the rate of 2.94 per cent per annum. The district like Junagadh, Kheda, Navsari, Rajkot, Tapi and Valsad revealed negative rate of growth rate (Table 5).

The Surat recorded the highest significant increase in mogra yield at the rate of 8.21 per cent per annum. Whereas, Dahod showed low but significant growth rate at 4.11 per cent per annum followed by Panchmahal (1.39%/annum) and Jamnagar. Furthermore, Banaskantha, Kheda, Patan, Tapi, Vadodara, Ahmedabad, Gandhinagar and Kutch showed negatively significant growth in yield of mogra crop. The yield of total flower crop, showed lower rate of growth in

which the highest rate of growth was found in case of Anand with compound annual growth rate of 3.66 per cent per annum followed by Dang (2.18%/annum) and Narmada (2.09%/annum). The highest negative rate of growth of yield of total flower crop was found in case of Rajkot (-1.69%/annum) followed by Surendranagar and Navsari. At the Gujarat level the rose and total flower crops showed lower but positive rate of growth increased at the rate of 2.34 and 0.44 per cent per annum, respectively while the yield of marigold and mogra decreased at the rate of -0.27 and -0.33 per cent per annum, respectively (Table 5). The similar results in terms of total flowers cultivation in India were furnished by Theenathayalan and Murugan (2022) ^[10] during study period 2010-11 to 2020-21 they observed the yield was increased at the rate of 3.56 per cent per annum.

The yield of rose crop, revealed significant and stable growth with lower instability in most of districts where only Anand (148.31%) and Panchmahal (30.88%) showed higher instability which was displayed in Table 5. The other district like Ahmedabad (1.03%), Amreli (2.12%), Bharuch (1.39%) and others showed lower instability. The yield of marigold

crop exhibits lower instability indices in all of the districts of Gujarat and the highest instability was found in Navsari at 11.28 per cent followed by Valsad (10.59%) and Surendranagar (5.81%). The highest instability in terms of yield of lilly was reported in Gandhinagar at 92.41 per cent while other all districts showed low instability in single digit term and the lowest instability was reported in Anand (0.63%), Vadodara (0.80%) and Surat (0.84%). The Kheda district reflected highest instability of yield of mogra at 26.45 per cent followed by Surat (20.92%) and Banaskantha (9.21%) while the low instability was found in case of Vadodara (1.45%), Kutch (1.66%) and Ahmedabad (2.10%). As for the yield of total flowers concern the highest instability reported by Anand at 38.72 per cent whereas the other all districts showed low instability. At the Gujarat level the yield of rose crop only revealed medium instability while other all flower crops exhibited lower instability during the study period.

Among different trade-off between growth and instability of area of major flower crops in Gujarat, the high growth with low instability was mostly preferable while the high growth and high instability was only preferable if growth rate was greater than the instability and as for the low growth and high instability it was not preferable at all. In case of area of rose flower only Dahod and Patan district were highly preferable while other all districts and Gujarat come under less preferable category. In terms of marigold crop also Dahod, Panchmahal and Patan district comes under highly preferable one while other all districts and Gujarat state registered under less preferable criteria and Valsad district was not preferable at all. The different districts of Gujarat and state as whole were not considered preferable in terms of area of lilly crop

while only Ahmedabad and Junagadh showed some preferable condition. The Narmada district considered as the most preferable district in terms of area of mogra crop while as a state as whole it was less preferable. In terms of area of total flower crop Panchmahal and Patan district illustrated preferable nature followed by Dahod whereas the other districts and Gujarat state was come under the less preferable nature and Rajkot district was not preferable at all in Post-MIDH period (Table 6).

As for the trade-off between growth and instability of production of major flower crops in Gujarat, Dahod and Patan district were most preferable for rose and marigold crop while in terms of mogra and total flower crops Kheda, Narmada, Jamnagar, Patan and Panchmahal, Patan, Dahod were preferable, respectively. In terms of production of major flower crops also the Gujarat state comes under the less preferable nature. The Rajkot district in rose, lilly and total flower crops, Gandhinagar district in rose, lilly and mogra and Navsari district in production of rose and total flower crops were not preferable (Table 7).

As for the yield of the major flower crops in Gujarat given in Table 8 most of the districts and state as a whole comes under the less preferable zone or in low growth and low instability while only Anand district in case of rose and Surat district in case of mogra crop revealed different trend. In terms of rose crop, Banaskantha and Panchmahal district was not preferable while in marigold crop Ahmedabad, Bharuch and Surat were not preferable. In case of mogra Dahod and as for the total flower crops Anand, Surat and Vadodara were not preferable. The Gandhinagar district was not preferable in terms of yield of all major and total flower crops of Gujarat in Post-MIDH period.

Table 5: Growth rate and instability indices of yield of major flower crops of Gujarat during Post-MIDH period (2013-14 to 2023-24)

Sr. No.	Name of District	Rose		Marigold		Lilly		Mogra		Total	
		CAGR	CDVI	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI	CAGR	CDVI
1	Ahmedabad	0.44***	1.03	0.08	1.46^	0.33***	1.38	-0.24**	2.10	0.24***	0.73
2	Amreli	-0.83***	2.12	-1.52***	4.64	-	-	-	-	-1.00***	2.71
3	Anand	8.75**	148.31	0.24***	0.28	0.41***	0.63	0.27*	3.27	3.66***	38.72
4	Banaskantha	0.19	2.88^	1.27***	3.19	-	-	-4.71***	9.21	0.88***	2.84
5	Bharuch	0.53***	1.39	0.02	2.16^	-	-	0.06	2.82^	0.36***	1.50
6	Bhavnagar	0.10***	0.56	-0.28***	0.55	-	-	0.11	2.40^	-0.07*	0.67
7	Dahod	2.12***	4.87	0.81***	2.23	2.94***	6.35	4.11***	53.65	0.97***	1.85
8	Dang	1.80***	3.63	2.14***	2.90	-	-	-	-	2.18***	2.45
9	Gandhinagar	-0.02	81.34^	-0.02	4.13^	0.07**	92.41	-0.22	124.11^	0.14	3.88^
10	Jamnagar	0.94***	2.79	-0.16**	1.47	-	-	0.87***	2.32	0.47***	0.44
11	Junagadh	-0.61***	1.68	-1.28***	2.32	-0.41***	1.91	-	-	-0.89***	1.68
12	Kheda	0.18***	0.57	-0.60***	1.98	-0.29***	0.87	-3.45**	26.45	-0.69***	2.64
13	Kutch	0.23***	1.20	0.09**	0.72	0.17***	0.88	-0.20**	1.66	0.15***	0.68
14	Mehsana	0.39***	1.13	0.29***	1.60	-	-	-	-	0.49***	0.88
15	Narmada	2.14***	3.58	1.10***	1.86	1.97***	3.76	0.02	3.59^	2.09***	3.90
16	Navsari	-0.66***	1.45	-3.90***	11.28	-0.17	2.79^	-	-	-1.19***	4.49
17	Panchmahal	-11.85***	30.88	0.43***	0.85	2.67***	5.48	1.40***	5.82	-0.68**	5.32
18	Patan	0.08***	0.37	0.60***	1.68	-	-	-0.71***	2.99	0.34***	1.08
19	Porbandar	0.56***	4.37	-0.92***	3.24	-	-	-	-	-0.46***	1.87
20	Rajkot	-1.38***	3.31	-0.29**	2.68	-1.09***	1.74	-	-	-1.69***	3.83
21	Sabarkantha	0.21***	0.83	0.16***	0.53	-	-	-	-	0.19**	0.68
22	Surat	-0.35***	1.93	0.01	0.57^	0.16***	0.84	8.20***	20.92	-0.01	0.69^
23	Surendranagar	-0.61**	4.53	-1.52***	5.81	-	-	-	-	-1.28***	4.53
24	Tapi	-1.00***	2.06	-0.27***	1.67	-0.40***	2.55	-0.25*	3.16	-0.42***	1.73
25	Vadodara	0.06**	0.57	0.06***	0.33	0.14***	0.80	-0.25***	1.45	-0.02	0.37^
26	Valsad	1.05**	8.83	-1.38**	10.59	-0.10*	1.24	-	-	-0.56**	5.15
	Gujarat	2.34**	22.28	-0.27***	1.17	0.05	1.38^	-0.33***	1.96	0.44**	4.62

Note: 1. CAGR: Compound Annual Growth Rate (%/annum), CDVI: Cuddy-Della Vella Index (%), ^: Non significant

2. *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively

3. Area in hectare (ha), Production in Metric tonnes (MT) and Yield in Metric tonnes per hectare (MT/ha)

Table 6: Growth rate v/s instability of area of major flower crops of Gujarat

Criteria	Rose	Marigold	Lilly	Mogra	Total
High growth rate with low instability (Highly preferable)	Dahod, Patan	Dahod, Panchmahal, Patan	-	Narmada	Panchmahal, Patan
High growth with medium instability	-	-	-	Dahod, Jamnagar, Kheda, Patan	Dahod
High growth rate with high instability	-	Surendranagar	Dahod	Panchmahal	-
Medium growth rate with low instability	-	Dang, Jamnagar, Junagadh, Kheda, Mehsana	Ahmedabad, Junagadh	-	Jamnagar, Junagadh, Narmada
Medium growth with medium instability	Sabarkantha	Narmada, Sabarkantha	-	Banaskantha	Sabarkantha, Surendranagar
Medium growth rate with high instability	Panchmahal	-	-	-	-
Low growth rate with low instability (Less preferable)	Ahmedabad, Amreli, Bharuch, Bhavnagar, Jamnagar, Junagadh, Kheda, Tapi, Vadodara, Gujarat	Ahmedabad, Anand, Bharuch, Bhavnagar, Gandhinagar, Kutch, Navsari, Tapi, Vadodara, Gujarat	Anand, Kheda, Narmada, Navsari, Vadodara, Valsad, Gujarat	Ahmedabad, Surat, Tapi, Vadodara, Gujarat	Ahmedabad, Amreli, Anand, Bharuch, Dang, Kheda, Kutch, Mehsana, Navsari, Tapi, Vadodara, Gujarat
Low growth with medium instability	Banaskantha, Dang, Kutch, Mehsana, Porbandar, Surat, Valsad	Amreli, Banaskantha, Porbandar, Rajkot, Surat	Kutch, Panchmahal, Surat, Tapi	Bharuch, Bhavnagar, Kutch	Banaskantha, Bhavnagar, Gandhinagar, Porbandar, Surat, Valsad
Low growth rate with high instability (Not preferable)	Anand, Gandhinagar, Narmada, Navsari, Rajkot, Surendranagar	Valsad	Gandhinagar, Rajkot	Anand, Gandhinagar	Rajkot

Table 7: Growth rate v/s instability of production of major flower crops of Gujarat

Criteria	Rose	Marigold	Lilly	Mogra	Total
High growth rate with low instability (Highly preferable)	Dahod, Patan	Dahod, Narmada, Panchmahal, Patan	-	Kheda, Narmada	Panchmahal, Patan
High growth with medium instability	-	-	-	Jamnagar, Patan	Dahod
High growth rate with high instability	Anand	-	Dahod	Dahod, Panchmahal	-
Medium growth rate with low instability	-	Dang, Jamnagar, Junagadh, Kheda, Mehsana	Ahmedabad, Junagadh, Narmada	-	Dang, Jamnagar, Narmada
Medium growth with medium instability	Jamnagar, Sabarkantha	Sabarkantha	-	Surat	Sabarkantha, Surendranagar
Medium growth rate with high instability	-	Surendranagar	-	-	Anand
Low growth rate with low instability (Less preferable)	Ahmedabad, Amreli, Bhavnagar, Junagadh, Kheda, Tapi, Vadodara	Ahmedabad, Anand, Bharuch, Bhavnagar, Kutch, Tapi, Vadodara, Gujarat	Anand, Kheda, Navsari, Vadodara, Valsad, Gujarat	Ahmedabad, Tapi, Vadodara, Gujarat	Ahmedabad, Amreli, Bharuch, Junagadh, Kheda, Kutch, Mehsana, Tapi, Vadodara, Valsad, Gujarat
Low growth with medium instability	Banaskantha, Dang, Kutch, Mehsana, Narmada, Panchmahal, Porbandar, Surat, Valsad, Gujarat	Amreli, Banaskantha, Gandhinagar, Navsari, Porbandar, Rajkot, Surat, Valsad	Kutch, Panchmahal, Surat, Tapi	Bharuch, Bhavnagar, Kutch	Banaskantha, Bhavnagar, Gandhinagar, Porbandar, Surat
Low growth rate with high instability (Not preferable)	Bharuch, Gandhinagar, Navsari, Rajkot, Surendranagar	-	Gandhinagar, Rajkot	Anand, Banaskantha, Gandhinagar	Navsari, Rajkot

Table 8: Growth rate v/s instability of yield of major flower crops of Gujarat

Criteria	Rose	Marigold	Lilly	Mogra	Total
High growth rate with low instability (Highly preferable)	-	-	-	-	-
High growth with medium instability	-	-	-	-	-
High growth rate with high instability	-	-	-	-	-
Medium growth rate with low instability	-	-	-	-	-
Medium growth with medium instability	-	-	-	Surat	-
Medium growth rate with high instability	Anand	-	-	-	-
Low growth rate with low instability (Less preferable)	Ahmedabad, Amreli, Bharuch, Bhavnagar, Dahod, Dang, Jamnagar, Junagadh, Kheda, Kutch, Mehsana, Narmada, Navsari, Patan, Porbandar, Rajkot, Sabarkantha, Surat, Surendranagar, Tapi, Vadodara, Valsad	Amreli, Anand, Banaskantha, Bhavnagar, Dahod, Dang, Jamnagar, Junagadh, Kheda, Kutch, Mehsana, Narmada, Navsari, Panchmahal, Patan, Porbandar, Rajkot, Sabarkantha, Surendranagar, Tapi, Vadodara, Valsad, Gujarat	Ahmedabad, Anand, Dahod, Junagadh, Kheda, Kutch, Narmada, Navsari, Panchmahal, Rajkot, Surat, Tapi, Vadodara, Valsad, Gujarat	Ahmedabad, Anand, Banaskantha, Bharuch, Bhavnagar, Jamnagar, Kutch, Narmada, Panchmahal, Patan, Tapi, Vadodara, Gujarat	Ahmedabad, Amreli, Banaskantha, Bharuch, Bhavnagar, Dahod, Dang, Jamnagar, Junagadh, Kheda, Kutch, Mehsana, Narmada, Navsari, Panchmahal, Patan, Porbandar, Rajkot, Sabarkantha, Surendranagar, Tapi, Valsad, Gujarat
Low growth with medium instability	Gujarat	-	-	Kheda	-
Low growth rate with high instability (Not preferable)	Banaskantha, Gandhinagar, Panchmahal	Ahmedabad, Bharuch, Gandhinagar, Surat	Gandhinagar	Dahod, Gandhinagar	Anand, Gandhinagar, Surat, Vadodara

The decomposition results of flower production in Gujarat state during Post-MIDH period revealed that on majority of the cases area effect showed higher contribution to the growth of production of different flower crops rather than price and interaction effect (Table 9). In case of rose the yield and interaction effect showed negative share while area effect contributed 111.98 per cent share to the growth of production. As for the marigold, lilly and mogra the interaction effect exhibited negative share while area effect contributed higher share at 94.64, 76.65 and 65.47 per cent, respectively. In

terms of total flower production in Gujarat the area and interaction effect showed negative share while the yield effect illustrated higher contribution with 125.35 per cent of share value. The study by Narmadha and Karunakaran (2022) ^[6] showed similar results in terms of decomposition analysis of flower production in India. Furthermore, according to the study, area and yield effect showed higher contribution as compared to interaction effect during study period from 1991-92 to 2020-21.

Table 9: Decomposition results of major flower crops of Gujarat in Post-MIDH period (2013-14-2023-24)

Sr. No.	Crop	Per cent contribution (%)		
		Yield effect	Area effect	Interaction effect
1	Rose	-4.01	111.98	-7.97
2	Marigold	15.21	94.64	-9.84
3	Lilly	32.31	76.65	-8.96
4	Mogra	43.88	65.47	-9.35
5	Total flowers	125.35	-16.26	-9.09

Conclusion

The flower cultivation in Gujarat exhibited moderate growth during the Post-MIDH period, with total flower production increased at the rate of 2.04 per cent per annum mainly due to expansion in area rather than yield gains. While crops like rose, marigold and mogra illustrated positive growth of area and production. The declining yield of marigold and mogra raises concerns regarding long-term sustainability. The instability indices of cultivation of major flower crops remained largely stable, though rose exhibited higher instability. At the district-level Dahod, Patan and Panchmahal emerged as high-performing regions with favourable growth-instability combinations, whereas districts such as Gandhinagar and Rajkot were identified as less or non-

preferable due to low growth with high instability. Additionally, the decomposition analysis confirmed that area effect was the dominant contributor to production growth in most crops. While the yield and interaction effects contributed either marginally or negatively, reflecting the limited technological advancement in productivity enhancement. Thus, the impact of MIDH scheme was relatively less in flower production in Gujarat. It demands more policy interventions focus on to emphasize yield enhancement, advanced technological adoption, effective input use and risk management strategies to ensure sustainable and stable growth of flower cultivation in Gujarat.

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