

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/359230757>

Impact of National Horticulture Mission on Vegetables and Fruits Sectors of India

Article in Indian Journal of Economics and Development · March 2022

CITATIONS

3

READS

573

4 authors, including:



K. M. Singh

Dr Rajendra Prasad Central Agricultural University Pusa

482 PUBLICATIONS 2,168 CITATIONS

SEE PROFILE



Nasim Ahmad

Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur)

102 PUBLICATIONS 267 CITATIONS

SEE PROFILE



D.K.Sinha Sinha

Rajendra Agricultural University

60 PUBLICATIONS 201 CITATIONS

SEE PROFILE



Impact of National Horticulture Mission on Vegetables and Fruits Sectors of India

K.M. Singh¹, Nasim Ahmad^{1}, Vijay Laxmi Pandey² and D.K. Sinha¹*

¹Department of Agricultural Economics, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur-848125 (Bihar) and ²Indira Gandhi Institute of Development Research (IGIRD), Mumbai-400 065 (Maharashtra)

*Corresponding author's email: nasim.rau@gmail.com

Received: June 30, 2021

Revision Submitted:

Revision Accepted:

ABSTRACT

The comparative performance of vegetables and fruits during pre (1991-92 to 2005-06) and post (2006-07 to 2018-19) National Horticultural Mission (NHM) based on secondary data was assessed. The study revealed that the growth rates of area and production of vegetables increased during the post-NHM period, but the productivity marginally declined during the post-NHM. The growth rate of area under fruits during pre-NHM was comparatively more than the post-NHM period. However, the growth rate of production and productivity of fruits was recorded comparatively more during the post-NHM period. It was further revealed that the area, production and productivity of both the crop groups were more stable during the post-NHM period. Further, analysis of all the macro indicators showed significantly rising trends revealing a positive impact of NHM.

Keywords

Decomposition analysis, fruits, instability, kinked exponential growth model, National Horticultural Mission, vegetables.

JEL Codes

C23, Q00, Q19.

INTRODUCTION

India has been blessed with varied geographical and climatic conditions conducive to grow various horticultural crops. The development of the horticultural sector had not been the main priority until recently in India. During the Green Revolution and post-Green Revolution, the main focus was to ensure the food security of the nation through enhancing the production of food grains. The various schemes to boost the food grains production were launched under different five-year plans. The Government of India acknowledged the need for diversification of the horticulture sector during the mid-eighties by focusing its attention on investment. The aspect of horticultural development got some attention during the post-1993 period by emphasising the enhancement of plan allocation and knowledge-based technology. A centrally sponsored scheme named National Horticulture Mission (NHM) was launched in

April 2005 to promote holistic growth of the horticultural sector through area based regionally differentiated strategies. The major priority areas of the NHM were the development of horticultural research and development, improvement of post-harvest management and promotion of processing and marketing of horticultural crops. The foreign trade policy during 2004-09 encouraged the need to boost agricultural exports with due growth and promotion of exports of horticultural products.

Horticultural crops have an important role in accelerating the Indian economy through enhancing the income of the rural people. Though the cultivation of horticultural crops is labour intensive with a strong ability to generate sizeable employment opportunities for rural people, as a result, the sector has moved from rural confines to commercial front (Ahmad, Sinha, Singh & Mishra, 2018). The scenario of the horticulture sector in India is quite encouraging as the percentage share of

horticultural output in agricultural output is steadily rising as it was recorded 33 per cent during 2017-18. Vegetables and fruits are important components of the horticulture sector since these accounts for 90 per cent of the total horticultural production in the country (Horticulture Statistics Division, 2018). India ranks second in vegetables and fruits production and shares about 21 per cent of the total vegetable production and 13 per cent of total fruits production globally (Horticulture Statistics Division, 2017). Various factors have a catalytic effect on the growth of area and production of vegetable and fruit crops in the country. The productivity of vegetable and fruit crops has been continuously rising during the last many years. The factors like urbanization, increasing per capita income, health consciousness and shifting of farmers towards high-value crops have pitched the path for augmenting the income of the farming community. Favourable income elasticity of demand has also fostered the growth of vegetables and fruits produced in the country (Choudhary & Kundal 2015; Verma, Jha, Choudhary, Singh & Roy, 2016; Kandeegan, Mahendran & Lavanya, 2020).

Vegetables and fruits have occupied an important place in everyday meals since these contribute a balance diet with required nutrients. In addition to this, they also have medicinal and aesthetic value. In an economic sense, the cultivation of high-value crops can potentially increase farm incomes, especially in India, where demand for high-valued food products has increased more quickly than that of staple crops (Kumar & Mruthyunjaya, 2002). Diversification towards horticultural crops has been suggested as a viable option to raise farm income, enhance agricultural growth and increase employment opportunities (Birlal, Joshi, Chauhan & Singh, 2008). It also allows smallholders to enhance their income and escape poverty (Joshi, Gulati, Birlal & Tewari, 2004).

A study in Andhra Pradesh emphasized the value chain and retailing of fresh vegetables in the present emerging markets, which offer greater opportunities to the farmers who can reap a larger chunk of financial and economic benefits out of the cultivation of fruits and vegetables (Reddy, Murthy, & Meena, 2010). The use of hybrid seeds in the cultivation of vegetables has had a huge impact on the farm incomes of the farmers growing vegetables by adopting commercial hybrid seeds. In their study, Sudha, Gajanan and Murthy (2006) observed that use of commercial hybrid seeds resulted in a tremendous increase in the production of okra and tomato. It encouraged the farmers to boost their income up to a great margin. As agriculture is the backbone of the Indian

economy, and growth of this sector has a strong linkage with other sectors and has a striking effect on poverty and unemployment (Mohapatra, Mohapatra & Mishra, 2017). It has also been pointed out that per capita income in the agriculture sector was just one-third of the per capita income of the country, thereby creating huge income disparity between primary agriculture vis-à-vis other sectors of the economy. The gap has been continuously widened, showing alarming unrest among the farming community across the different states (Sarial, 2016). As per NSSO 70th round data in 2013, 53 per cent of farm households earned income lesser than poverty-level income, and 52 per cent of the farmers were reported under indebtedness; most were marginal farmers and agricultural labourers (Government of India, 2014). As it is observed that there is an absence of efficient supply chain and comparatively less value realization of agricultural products, as well as the fluctuations in prices during low harvest and good harvest keep the cultivators almost in same income level.

Many studies have revealed that as agriculture shifts from traditional subsistence farming to a commercial one with the availability of a supply chain, it acts as the key driver for the industrialization of agriculture. Mediterranean countries were traditional growers of fruits and vegetables but are currently struggling to remain competitive and relevant in the global market for an efficient supply chain (Galanopoulos, Nilsson, Wajnbom, & Emma Surry (2009).

Patil and Hosamani (2017) studied the performance of the national horticulture mission (NHM) scheme and its impact on horticulture development in Karnataka and found that area coverage, creation of water resources, protected cultivation, horticulture mechanization, post-harvest management and rejuvenation, vermin-composting units/bio-digester unit were the most important components which influences the performance of NHM in the study area.

The tremendous increase in the production of vegetables and fruits was witnessed in India during the last few years. The production of vegetables increased from 101.2 to 183.17 million tonnes during 2004-05 to 2018-19 and production of fruits increased from 50.9 to 97.96 million tonnes during the above period. It is a prominent income augmenting sector as it generates employment, especially for youth and women in the rural area where 65.53 per cent of the Indian population resides. The income generated from the cultivation of horticultural crops is comparatively high than that of field crops. The government of India has declared its goal to

double the income of the farming community by 2022; in this regard, it is presumed that the horticultural sector will probably play a lead role in achieving this target.

The present study was conducted to investigate the performance of fruits and vegetables in India before and after implementing the National Horticulture Mission. To the best of our knowledge, available literature has mostly used the point-to-point growth rate using the ordinary least squares (OLS) technique for estimating growth rates of area, production, and yield of horticultural crops. These trend lines are likely to be discontinuous; hence may result in errors in estimating growth rates using OLS.

METHODOLOGY

The secondary data were used to understand the performance of NHM. First, the physical and financial achievements were analysed using descriptive analysis. Further, growth in the area, production and productivity under fruits and vegetables were computed using the kinked exponential model. The instability index was computed using Cuddy- Della Valle index, as well as decomposition of growth components was also carried out.

Physical and Financial Achievements of NHM

The impact of NHM in terms of physical and financial achievements using some important indicators like area and production of fruits and vegetables, percentage share of area under fruits and vegetables to gross cropped area, the value of the output of fruits and vegetables, and exports earning from fruits and vegetables in India for pre and post NHM periods were discussed. State-wise data related to area and production of fruits and vegetables in 2004-05 (just before the initiation of NHM) was considered pre-NHM and 2018-19 data as post-NHM. The proportion of area density under fruits and vegetables at all India levels was estimated as percentages of the area under fruits and vegetables to gross cropped area. For the financial evaluation at all India levels, the output value for fruits and vegetables was computed. With the increase in production of fruits and vegetables, earnings from exports were also taken as one of the indicators for the financial impact of NHM.

Export plays a fuelling role in augmenting the economic growth of a nation. It is common parlance that every nation has a keen desire to participate in the international market to enlarge its market share in global trade for sustainable economic development. Generally, in the export endeavour, the main aim of a country revolves around manufactured products, even though fresh fruits and vegetables and value-added agricultural

commodities also provide vast opportunities for export earnings. Liberalization and globalization have recently changed the scenario of international trade. In boosting GDP, export plays a dynamic role; the higher the exports, the stronger are the boosts to the economic growth. Agriculture is the mainstay of the Indian economy provides a comprehensive platform for exporting agriculture and allied products.

Growth Rate of Area, Production and Productivity

The production and productivity of vegetables and fruits retrieved from different published sources covering 28 years from 1991-92 to 2018-19, growth rates in the area, production and productivity were computed applying the Kinked exponential model. The period was subdivided into two sub-periods, 1991-92 to 2005-06 (Pre-NHM) and 2006-07 to 2018-19 (Post-NHM).

Kinked Exponential Model for Growth Rate

The usual technique for estimating growth rates in sub-periods of a time series data is to fit separate exponential trend lines by applying ordinary least squares to each part of the sub-periods. These trend lines are likely to be discontinuous, resulting in errors like sub-periods growth rates may be more or less than that of growth rate for the period. There is a possibility that the estimated growth for the sub-periods may be negative, while the growth rate for the period as a whole is positive or vice versa (Boyce, 1986; Senapati & Goyari, 2019).

The Kinked exponential growth models differ from conventional discontinuous models. The rationale for preferring fitted trends (kinked exponential growth models) over simple point-to-point growth rate calculations is that OLS estimates are less affected by instability or cyclical fluctuations. In conventional exponential growth rates, while comparing the resulting growth rates of two periods, a mark of ignorance regarding those values taken by the variable outside each given period is dropped. Kinked exponential models, by contrast, make use of the complete set of available information from the beginning of the estimation exercise. There is no asymmetry in the treatment of all information/observations lying prior to and after the starting and endpoints of the sub-period; that is, all information/observations are used to differentiate the underlying growth trends from instability or fluctuations around them.

Applying all information/observations to the kinked model removes the discontinuity bias of the conventional sub-period growth rate estimates. The kinked exponential model minimises the sensitivity of conventional growth rate estimates to instability. The result, in general, is more

accurate estimates of underlying trends.

The generalized Kinked exponential model forms sub-periods and m-1 kinks, suppose K_1, K_2, \dots, K_{m-1} be the kink points and D_1, D_2, \dots, D_m is the dummies for the sub-periods, then unrestricted model for joint estimation of sub-period growth rate without discontinuity is

$$\ln Y_t = (\alpha_1 D_1 + \alpha_2 D_2 + \dots + \alpha_m D_m) + (\beta_1 D_1 + \beta_2 D_2 + \dots + \beta_m D_m)t + u_t \quad (1)$$

Applying the appropriate m-1 linear restrictions, $\alpha_i + \beta_i K_i = \alpha_{i+1} + \beta_{i+1} K_i$ for all $i=1, 2, \dots, m-1$,

We can estimate growth rates for sub-periods

$$\ln Y = \alpha_1 + \beta_1 (D_1 t + D_2 K) + \alpha_2 + \beta_2 (D_2 t + D_3 K) + u_t \quad (2)$$

where Y is area/production/productivity, D_1 is the dummy for the pre-National Horticultural Mission period, D_2 is post-National Horticultural Mission and β_1 and β_2 are the corresponding growth rates for these periods. The significance of the difference in sub-period growth rates can be tested by computing the following trend break equation

$$\ln Y = \alpha_1 + \beta_1 t + \beta_1 (D_2 t + D_2 K) + u_t \quad (3)$$

Where, β_1^* is the difference in sub-period growth rates

Estimation of Instability Index

Instability is the deviation from the trend. In various literature, researchers have applied the coefficient of variation (CV per cent) to measure instability. Instability indices were used to examine the extent of instability in area, production and yield of vegetables and fruits grown in India. Only CV does not explain suitable trend components inherent in the time series data; hence, the instability index was computed applying a measure of variability suggested by Cuddy-Della Valle index (Cuddy & Valle, 1978). The formula for computation is given as under:

$$\text{Instability Index} = CV * \sqrt{1 - R^2}$$

$$CV = \frac{\text{Standard deviation of the variable}}{\text{Mean of the variable}} \times 100$$

If the estimated coefficient of the regression equation is not significant, then the CV itself is taken as an instability index. Where CV is the coefficient of variation and R^2 is the Coefficient of determination from a time series trend regression adjusted by the number of degrees of freedom.

Decomposition of Growth Components

Total production of crop output is determined mainly by area, yield and the interaction effect of its area and yield. To measure the relative contribution of the area and yield towards the total production change concerning individual crops, the technique of decomposition was adopted. The change in the production of the crop

between any two periods can be expressed as

Change in production = Yield effect + Area effect + Interaction effect

Thus, the total change in production is attributed to area and yield that can be decomposed into three effects, viz., yield, area and interaction effects.

RESULTS AND DISCUSSION

Impact of NHM on Area and Production

Expansion in horticultural areas and production are considered the key indicators to assess the impact of the NHM. Thus, the state-wise area and production of fruits and vegetables for pre-NHM (2004-05) and post-NHM (2018-19) were used for the calculation of percentage change in area and production of fruits and vegetables in 2018-19 over 2004-05 (Table 1 and 2). At the national level, expansion in fruit crops was recorded 31.73 per cent, whereas production escalated as much as 88.88 per cent in 2018-19 over 2004-05. In the case of vegetable crops, the area had increased to nearly 50.78 per cent, and production picked up to 84.77 per cent at all India levels during the same period. It is encouraging to note that some states showed more than 100 per cent expansion in both area and production of fruits and vegetables, namely, Madhya Pradesh, Chhattisgarh, Mizoram, Haryana, Nagaland, and Sikkim.

The perusal of Table 2 revealed a steep rise in the area and production of fruits and vegetables at the national level after implementing the National Horticulture Mission in the country. Except for a few states, almost all the states could register positive percentage change (2018-19 over 2004-05), revealing the positive impact of different technological interventions and infrastructural development after implementation of NHM.

Area Density of Fruits and Vegetables

Growth in terms of percentage share of area under fruits and vegetables to gross cropped area is also considered one of the important indicators of diversification from traditional foodgrain cultivation to commercial cultivation, emphasizing the impact of NHM. The percentage share of area under fruit and vegetable crops to GCA during the period from 1991-92 to 2018-19 are presented (Figure 1).

It was evident from the graph that the share of area under fruits and vegetables to GCA enhanced continuously during the period under investigation. It was observed that the share of area under fruits and vegetables to GCA showed a more than the two-fold increase (2.25 per cent) in post-NHM (2018-19) over pre-NHM (2004-05).

The Output Value of Fruits and Vegetables

The value of production is considered an indicator of

the ultimate impact of the scheme. The value of production increases both on account of area expansion or increased productivity. Even though the area and productivity are the only primary factors influencing the output value, the price of the commodity in the market cannot be ignored. The output values (at the current price) of fruit and vegetable crops have been graphically presented (Figure 2). It indicated a continuous rise over the period under investigation. The value of output was ₹113 34052 lakh in 2004-05, which further increased to ₹58715818 lakh in 2017-18 (at current price). During the last two decades, the horticultural sector gained prominence and contributed a large share in the Gross Value Addition (GVA) of agriculture and allied sectors.

The Government of India has further launched the Mission for Integrated Development of Horticulture (MIDH), aiming to enhance horticultural produce and reduce post-harvest losses.

Export of Fruits and Vegetables from India

Fruits and vegetables are among the most important and fast-growing sub-sectors of Indian agriculture, which forms an indispensable part of a healthy diet. India ranked second in fruits and vegetable production globally, after China, yet our share in the global trade of fruits and vegetables was negligible. The export of fruits and vegetables from India had slowly gained pace. It occurred due to concurrent expansion and development in the areas of cold chain infrastructure, increase in productivity and

Table 1. Percentage change in area and production of fruits in 2018-19 over 2004-05

States	Area (000' ha)			Production (000'tonnes)		
	2004-05	2018-19	Percent change	2004-05	2018-19	Percent change
Andhra Pradesh	652.0	718.91	10.26	9121.60	17614.5	93.11
Arunachal Pradesh	50.7	48.14	-5.05	103.20	125.85	21.95
Assam	93.3	167.2	79.21	1151.00	2518.89	118.84
Bihar	276.1	313.95	13.71	2769.50	4384.46	58.31
Chhattisgarh	48.7	225.24	362.51	343.20	2580.31	651.84
Gujarat	251.9	433.79	72.21	4014.40	9227.76	129.87
Haryana	24.1	67.28	179.17	232.20	712.02	206.64
Himachal Pradesh	175.9	230.85	31.24	688.30	571.74	-16.93
Jammu and Kashmir	167.5	345.39	106.20	1217.60	2564.27	110.60
Jharkhand	33.2	105.39	217.44	403.40	1111.96	175.65
Karnataka	255.3	395.5	54.92	4078.90	6567.29	61.01
Kerala	332.0	321.36	-3.20	2643.40	1885.97	-28.65
Madhya Pradesh	48.7	357.01	633.08	1102.60	7464.97	577.03
Maharashtra	1346.5	756.97	-43.78	10586.30	10822.8	2.23
Manipur	51.2	46.74	-8.71	320.90	451.23	40.61
Meghalaya	23.8	35.75	50.21	199.60	331.67	66.17
Mizoram	21.2	62.91	196.75	42.50	339.18	698.07
Nagaland	13.3	33.94	155.19	48.90	315.34	544.87
Odisha	233.4	337.29	44.51	1404.00	2361.13	68.17
Punjab	47.1	94.8	101.27	679.50	2001.69	194.58
Rajasthan	24.0	62.35	159.79	290.00	919.9	217.21
Sikkim	8.2	19.54	138.29	12.20	55.45	354.51
Tamil Nadu	224.6	293.97	30.89	4467.60	5767.95	29.11
Telangana	0.0	175.9	0.00	0.00	2034.29	0.00
Tripura	32.4	53.7	65.74	503.40	555.47	10.34
Uttar Pradesh	274.9	480.53	74.80	2912.80	10651.3	265.67
Uttarakhand	156.2	178.8	14.47	652.00	670.63	2.86
West Bengal	166.3	266.33	60.15	2128.30	3829.85	79.95
All India	5032.50	6629.53	31.73	52117.30	98437.77	88.88

Source: Ministry of Agriculture and Farmers' Welfare (2018).

quality improvement through research, modern post-harvest technologies, favourable government policies and various initiatives taken by APEDA.

The vast production base offers the country tremendous opportunities for export promotion. India exported fruits and vegetables worth ₹14935.75 crores in

2018-19 to only ₹1657.41 crores in 2004-05. The year-wise export value is depicted in Figure 3, which indicated the significant enhancement in the export of fruits and vegetables from India, consequently depicting the influence of NHM as an indicator. Grapes, pomegranates, mangoes, bananas, oranges accounted for a larger

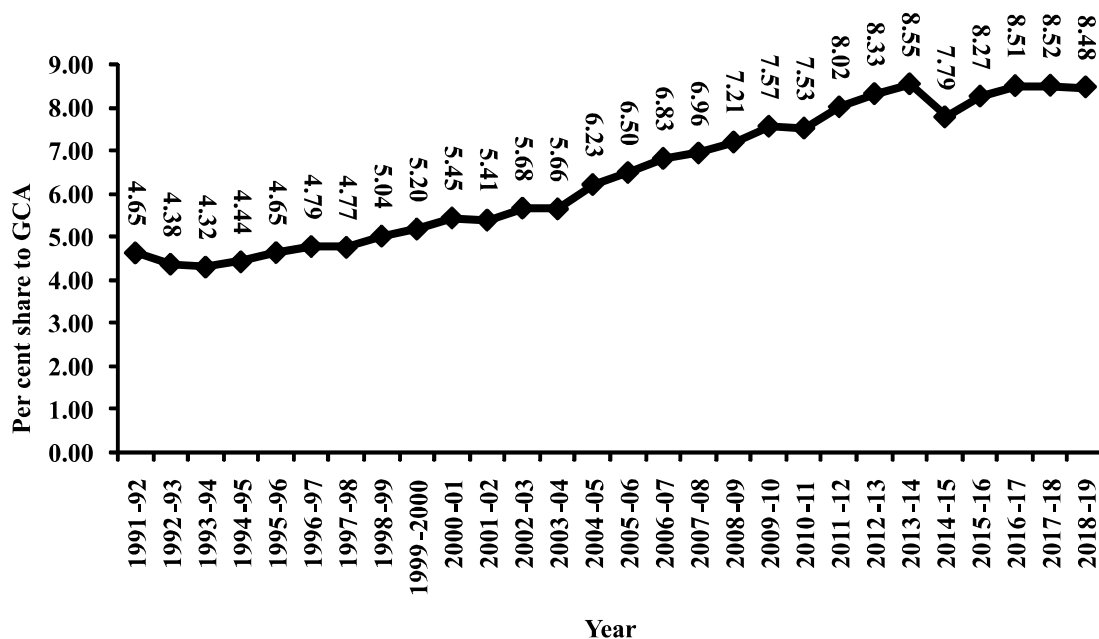


Figure 1. Percentage share of area under fruits and vegetables to gross cropped area (GCA)

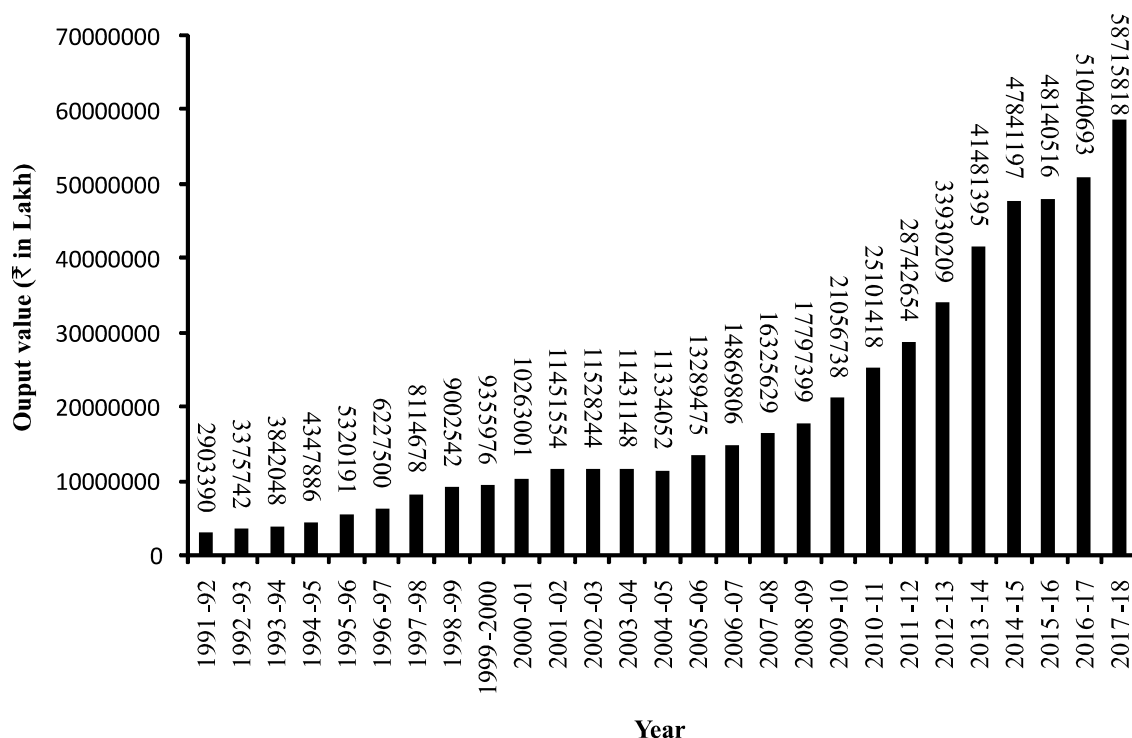


Figure 2. Output value of fruits and vegetables

proportion of fruits exported from the country, while onions, mixed vegetables, potatoes, tomatoes, and green chilly contributed mainly to the vegetable export basket. The major destinations for Indian fruits and vegetables were recorded as Bangladesh, UAE, Netherland, Nepal, Malaysia, UK, Sri Lanka, Oman and Qatar.

Growth Rate of Area, Production and Productivity

The growth rates of area, production and productivity of vegetables and fruits produced in India for the pre-NHM period (1991-92 to 2005-06) and post-NHM (2006-07 to 2018-19) was estimated using Kink exponential model. The results revealed that kinked growth rates of acreage under vegetable crops increased significantly

during the post-NHM period, evidenced by the significant value of trend break (0.88 per cent). However, the growth rates of the area under vegetables were also significant statistically. Separately, the growth rate was 2.53 per cent during pre-NHM and 3.41 per cent during post-NHM periods. The kinked growth rate of production of vegetables increased; however, the increase was non-significant during post-NHM compared to the pre-NHM period because the figure of trend break was insignificant. It was further revealed that kinked growth in the productivity of vegetables was observed to have a non-significant decrease during the post-NHM period with pre-NHM period though the growth rates were significant

Table 2. Percentage change in area and production of vegetables in 2018-19 over 2004-05

States	Area (000' ha)			Production (000'tonnes)		
	2004-05	2018-19	Percent change	2004-05	2018-19	Percent change
Andhra Pradesh	258.40	259.83	0.55	3861.90	7091.37	83.62
Arunachal Pradesh	20.40	2.62	-87.16	78.80	17.39	-77.93
Assam	194.50	324.13	66.65	2020.40	4060.36	100.97
Bihar	816.60	872.55	6.85	13349.10	16699.84	25.10
Chhattisgarh	125.10	498.93	298.82	1266.30	6910.32	445.71
Gujarat	331.50	626.26	88.92	4867.90	12552.15	157.86
Haryana	207.80	438.39	110.97	2980.40	7172.11	140.64
Himachal Pradesh	43.60	87.31	100.25	805.80	1755.43	117.85
Jammu & Kashmir	52.10	60.12	15.39	843.00	1337.12	58.61
Jharkhand	223.60	293.42	31.23	3394.90	3501.45	3.14
Karnataka	371.10	430.93	16.12	4402.60	7044.89	60.02
Kerala	107.60	98.77	-8.21	2490.10	3042.86	22.20
Madhya Pradesh	184.40	897.99	386.98	2659.60	17773.19	568.27
Maharashtra	372.20	649.79	74.58	4044.40	11283.23	178.98
Manipur	13.40	45.55	239.93	86.00	354.92	312.70
Meghalaya	32.70	49.02	49.91	270.50	514.75	90.30
Mizoram	5.70	34.65	507.89	24.00	163.80	582.50
Nagaland	11.90	41.11	245.46	88.10	455.87	417.45
Odisha	655.90	613.62	-6.45	8045.60	8466.17	5.23
Punjab	158.60	249.32	57.20	2677.40	5207.36	94.49
Rajasthan	124.10	178.01	43.44	650.20	2047.13	214.85
Sikkim	17.00	38.8	128.24	76.50	231.40	202.48
Tamil Nadu	215.30	235.77	9.51	6218.30	6082.54	-2.18
Telangana	0.00	140.31	0.00	0.00	2548.69	0.00
Tripura	32.70	46.71	42.84	373.40	813.37	117.83
Uttar Pradesh	840.90	1256.27	49.40	15792.80	27703.82	75.42
Uttarakhand	72.80	100.14	37.55	951.80	1002.64	5.34
West Bengal	1189.00	1490.9	25.39	18103.20	29545.23	63.20
All India	6698.30	10099.82	50.78	100603.20	185883.22	84.77

Source: Ministry of Agriculture and Farmers' Welfare (2018).

for both the study periods, separately. There may be the reason that farmers put more area under vegetables. Hence, the production increased, but in the absence of suitable infrastructures for vegetable production such as irrigation, quality inputs and susceptibility of high yielding varieties to pests and diseases, the productivity of vegetables decreased during the post-NHM period. Similar results were found in the investigations carried out by Suvagiya Shilpa, Shah and Ardeshta (2017); Mehta (2012).

Estimation of growth rates of area, production, and productivity of fruits in India during and pre and post-NHM are presented in Table 4. The results revealed that the kinked growth rate of area under fruits declined significantly during the post-NHM period. The value of trend break could evidence a significant decline of the area. The production growth of fruit crops revealed an increase in its growth, but it was estimated to be non-significant. On the other hand, the kinked growth rate of productivity was found to be increased significantly during post-NHM (2.47 per cent) to that of pre-NHM (-0.49 per cent) since it was evident from the trend value (2.96). Even after a decrease in area under fruits during post-NHM, the production and productivity increased, indicating diffusion of technologies and adoption of modern technology by the fruit growing farmers. Besides, initiatives taken by the government through NHM might

Table 3. Growth in area, production and productivity of vegetables, 1991-92 to 2018-19

Periods	Area	Production	(Per cent)
			Productivity
Pre-NHM (1991-92 to 2005-06)	2.53*** (0.24)	4.33*** (0.31)	1.80*** (0.27)
Post-NHM (2006-07 to 2018-19)	3.41*** (0.24)	4.55*** (0.31)	1.14*** (0.27)
Trend break	0.88** (0.43)	0.22 ^{NS} (0.55)	-0.66 ^{NS} (0.48)
R ²	0.97	0.98	0.86

Figures in parentheses are standard errors.

***and ** Significant at 1 and 5 per cent levels.

NS: Non-significant.

Table 4. Growth in area, production, and productivity of fruits (1991-92 to 2018-19)

Periods	Area	Production	(Per cent)
			Productivity
Pre-NHM (1991-92 to 2005-06)	4.58*** (0.42)	4.08*** (0.31)	-0.49 ^{NS} (0.36)
Post-NHM (2006-07 to 2018-19)	2.41*** (0.42)	4.87*** (0.31)	2.47*** (0.36)
Trend break	-2.17** (0.75)	0.79 ^{NS} (0.55)	2.96*** (0.64)
R ²	0.93	0.98	0.70

Figures in parentheses are standard errors.

***and ** Significant at 1 and 5 per cent levels.

NS: Non-significant.

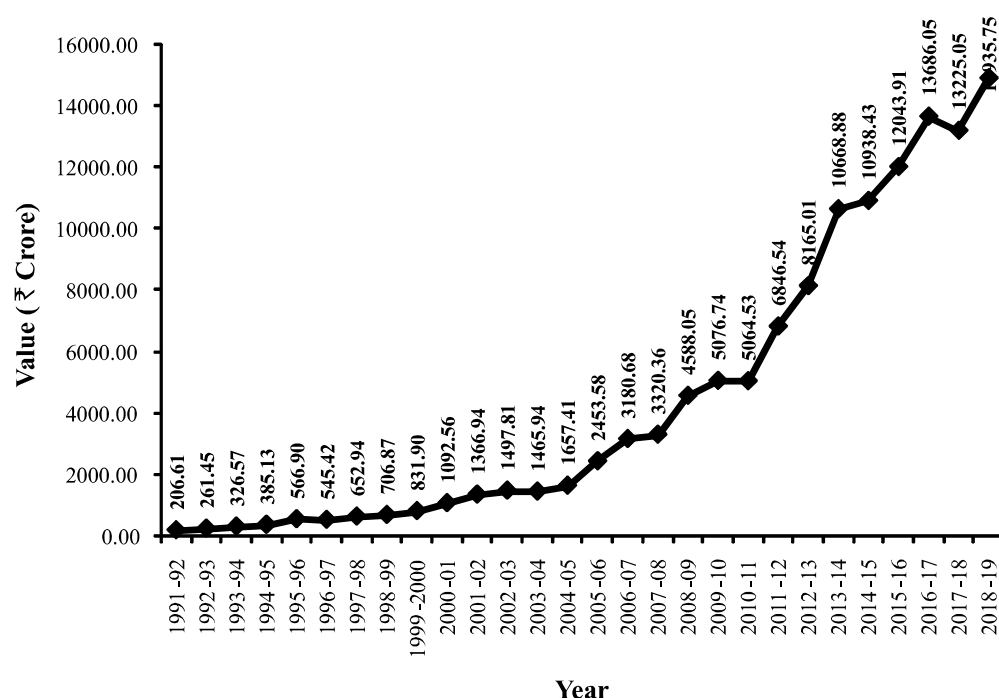


Figure 3. The export value of fruits and vegetables

have had a positive role in this direction. The result was in conformity with the research work carried out by Kadli, Sameer, Ravi & Hosali, (2014).

Instability Estimates

Agriculture growth and instability have always been a major concern to agricultural economists. Increasing crop production is the need of the hour both at national and international levels to meet the growing population's food and nutrition requirements. Increasing instability has adverse effects for several reasons. It up scales the production risks and affected the income of the farming community. It also restricted the cultivator from making the investment in farming and adopting high paying technologies. Instability in agricultural and food production was also important for food management and macroeconomic stability (Chand, Raju & Pandey, 2008).

The results of instability analysis for vegetables and fruits in India during pre and post-NHM are presented in Table 5. The findings revealed that instability indices of area, production and productivity were comparatively high during the pre-NHM period than that of the post-NHM period for both the crop groups. Higher stability during the post-NHM period might be due to the adoption of new cultivation technologies, technologies for post-harvest management, and increased cold storage facilities after the implementation of NHM throughout India.

Decomposition Analysis of the Production of Vegetables and Fruits

The analysis of the factors influencing the production of vegetables and fruits are presented in Table 6. The results pointed out that the area effect was more (52.67 per cent) in the case of vegetables during 2005-06 over 1991-

Table 6. Decomposition of production growth of vegetables and fruits in India

Particulars	(Per cent)	
	Vegetables	Fruits
2005-06 over 1991-92		
Area effect	52.67	4.68
Yield effect	32.07	91.33
Interaction effect	15.26	3.99
2018-19 over 2006-07		
Area effect	33.60	59.67
Yield effect	55.38	29.13
Interaction effect	11.03	11.21

92. In the case of fruits, it was yield effect (91.33 per cent). Nevertheless, during the period 2018-19 over 2006-07, yield effect was maximum in case of production of vegetables, and for fruits, the effect of the area was observed to be larger 59.67 per cent in case of production of fruits in India. The findings of this investigation are in agreement with the findings of the study regarding growth, instability and decomposition of horticultural crops in India for the period covering 1991-92 to 2009-10 conducted by Agarwal, Yadav, Kumar, and Pandey (2016).

CONCLUSIONS

The growth rates of acreage under vegetable cultivation and production of vegetables increased during the post-NHM period in the country. However, the productivity of the vegetables marginally decreased during the same period. In the case of fruits, the growth rate of area under fruits during pre-NHM was observed to be more than that of the post-NHM period, but the growth rates of production and productivity were found to be more during the post-NHM period. The instability analysis indicated that the area, production, and productivity of both crop groups were more stable during the post-NHM period. The decomposition analysis indicated that the production of vegetables increased due to the increase in yield, whereas the production of fruits was adversely affected by the productivity effect on the whole. Due to population pressure, the area under cultivation, in general, is shrinking and hence, there is a need for further augmenting the productivity of vegetables and fruits in the country to meet the nutritional security of the nation.

REFERENCES

- Agarwal, P.K., Yadav, P., Kumar, S., & Pandey, D. (2016). Horticultural crops in India: Growth, instability and decomposition approach. *Agricultural Situation in India*, 73(1), 26-30.

Table 5. Indices for instability in the area, production and productivity of vegetables and fruits, 1991-92 to 2018-19

Periods	Vegetables		
	Area	Production	Productivity
Pre-NHM (1991-92 to 2005-06)	4.93	6.41	5.56
Post-NHM (2006-07 to 2018-19)	2.38	2.88	2.98
Periods	Fruits		
	Area	Production	Productivity
Pre-NHM (1991-92 to 2005-06)	7.28	5.81	7.70
Post-NHM (2006-07 to 2018-19)	5.97	2.20	4.30

- Ahmad, N., Sinha, D.K., Singh, K.M. & Mishra, R.R. (2018). Comparative production performance of vegetable crops in the country vis-à-vis Eastern India. *Vegetable Science*, 45(2), 238-243.
- Birthal, P.S., Joshi, P.K., Chauhan, S., & Singh, H. (2008). Can horticulture revitalise agricultural growth? *Indian Journal of Agricultural Economics*, 63(3), 310-321.
- Boyce J.K. (1986). Kinked exponential model for growth estimation. *Oxford Bulletin of Economics and Statistics*, 48(4), 385-391.
- Chand, R., Raju, S.S., & Pandey, L.M. (2008). Progress and potential of horticulture in India. *Indian Journal of Agricultural Economics*, 60(3), 299-309.
- Choudhary, K., & Kundal, R. (2015). A study in the area, production and productivity of tomatoes in India from 2002-2011. *International Journal of Advanced Research in Computer Science and Management Studies*, 3(7), 90-94
- Cuddy, J.D.A., & Della, V.P.A. (1978). Measuring instability of time series data. *Oxford Bulletin of Economics and Statistics*, 40(1), 79-81.
- Galanopoulos, K., Nilsson, F.K., Wajnbloom, O.L., & Emma Surry, Y. (2009). Fruit and vegetable production in the new millennium: Will Mediterranean production satisfies increasing European demand? *Outlook on Agriculture*, 38(3), 11-19.
- Government of India (2014). Situation Assessment Survey of Agricultural Households, January - December 2013, NSS 70th Round, National Sample Survey Organization - Ministry of Statistics and Programme Implementation (MOSPI), Government of India.
- Horticulture Statistics Division. (2017, 2018). *Horticultural statistics at a glance*. Ministry of Agriculture & Farmers' Welfare, Department of Agriculture, Cooperation & Farmers' Welfare, Horticulture Statistics Division, Government of India.
- Joshi, P.K., Gulati, A., Birthal, P.S. & Tewari, L. (2004). Agriculture diversification in south Asia: Patterns, determinants and policy implications. *Economic and Political Weekly* 39(24): 2457-2467.
- Kadli, Vinayaka., Sameer, Lokapur., Ravi, Gurikar., & Roopa, Hosali. (2014). Growth and instability of fruits in India-An economic analysis. *Journal of Environmental Science, Computer Science and Engineering and Technology*, 3(4), 1808-1813.
- Kandeeban, M., Mahendran, K., & Lavanya, M.S. (2020). A comparative evaluation of trends in area, production and productivity of cashew in western and eastern regions of India. *Indian Journal of Economics and Development*, 16(4), 565-571
- Kumar, P., & Mruthyunjaya. (2002). Long term changes in food basket in India. Paper in the International Workshop on *Agriculture Diversification and Vertical Integration in South Asia*, Organised by FCCI-ICRISAT-IFPRI, 5-6 November, New Delhi, India, 2002.
- Mehta, N. (2012). Performance of crop sector in Gujarat during high growth period: Some explorations. *Agricultural Economics Research Review*, 25(2), 195-204.
- Ministry of Agriculture and Farmers' Welfare. (2018). *Horticultural statistics at a glance 2018*. Ministry of Agriculture & Farmers' Welfare, Department of Agriculture, Cooperation & Farmers' Welfare, Horticulture Statistics Division, Government of India, New Delhi
- Mohapatra, S., Mohapatra, U., & Mishra, R.K. (2017). Diversification towards vegetables: A good option for doubling the farmer's income. *Journal of Experimental Agriculture International*, 18(4), 1-17.
- Patil, B.O., & Hosamani, S.B. (2017). Performance of national horticulture mission (NHM) scheme and its impact on horticulture development in Karnataka. *Journal of Farm Sciences*, 30(4), 485-490.
- Reddy, G.P., Murthy, M.R.K., & Meena, P.C. (2010). Value chain and retailing of fresh vegetables and fruits, Andhra Pradesh. *Agricultural Economics Research Review*, 23, 455-460.
- Sarial, A.K. (2016). Doubling farmers' income: A model for the hilly mountainous region. *Himachal Journal of Agricultural Research*, 42(2), 101-114.
- Senapati, A.K., & Goyari, P. (2019). Growth and instability in agricultural productivity in Odisha. *Agricultural Economics Research Review*, 32(1), 55-65.
- Sudha, M., Gajanana T.M., & Murthy, D.S. (2006). Economic impact of commercial hybrid seed production in vegetables in farm income, employment and farm welfare- A case of tomato and okra in Karnataka. *Agricultural Economics Research Review*, 19(2), 251-268
- Suvagiya, D., Shilpa, V.C., Shah, P., & Ardeshta, N.J. (2017). Growth performance of major vegetable crops in Gujarat State. *Agricultural Economics Research Review*, 30(1), 139-149.
- Verma, V. K., Jha, A.K., Chaudhury, P., Singh, B.K., & Roy, A. (2016) Comparative analysis of production and profitability of seasonal vegetable, tuber and spice crops under the mid-hills of Meghalaya. *Vegetable Science*, 43(1), 87-90.