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Trends of Mango Cultivation among Indian States – An Economic Analysis

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Abstract:

Fruits and vegetables are considered to be the protective food because these help us to develop defense mechanisms in our body. Mango (Mangifera indica), which is the king of fruits for over 4000 years, is also our national fruit. There are more than thousand mango varieties in India. At present, India is one of the largest producers of mango; however, only about 30 varieties are grown on a commercial scale in different states. Important mango varieties are cultivated in different states of India in which Tamil Nadu cultivates the varieties like Banganpalli, Bangalora, Neelum, Rumani, and Mulgoa. More than 50 per cent of world mango production is contributed by India, The productivity of Mango in Tamil Nadu State was found to be low when compared to the National Average Productivity.

Key words: Mango cultivation, area, production, productivity.

Introduction

Mango (Mangifera indica) belongs to Family Anacardiaceae is the most important commercially full-grown fruit crop of the

country. It is called the king of fruits. Cultivation of mango is believed to have originated in South East Asia. Mango is being cultivated in southern Asia for nearly six thousand years. Many fruits and vegetables are a good source for the nutritional security the horticulture sector has in the past few years, proved to be the train of growth in agriculture for improving the productivity per unit area, source of generating employment, improving the economic well being of the farming community and the entrepreneurs involved in agriculture and horticulture and thereby enhancing exports and skilled of earning considerable foreign exchange. Fruits and vegetables are considered to be the protective food because it helps us to develop a defensive mechanism in the human system. The favorite was through all sections of people for its delicious taste, flavor, attractive color, nutritive value and superior fragrance. India is the topper in mango production in the world. The important mango producing states in India are Andhra Pradesh, Utter Pradesh, Karnataka, Bihar, Gujarat, Maharashtra, Tamil Nadu, West Bengal, Kerala and Orissa. The Productivity of mango found to be declining over the years. The National average productivity is found to be as low as 10 tonnes per hectare **(Biswas and Lalitkumar, 2011).** It has been proven that the horticulture crops for which the Indian topography and agro climatic conditions is well suited could be an ideal choice for achieving sustainability by small farmers with continued Governmental support. However, the importance of horticulture is not only in improving the productivity of land, but also providing nutritional security to the people **(Singh, 2010).** In India, several horticultural development initiatives are being taken up through the National Horticulture Mission (NHM) through the State Department of Horticulture and Plantation Crops. Different States in India are showing different level of productivity in respect of fruits and mango in particular. This has created a dark picture. Though National Horticulture Mission (NHM) has

initiated its efforts to develop the horticulture sector through the area expansion programs, existing level of production and productivity of fruits, particularly the Mango is yet to be documented clearly at the National and State level and the data found to be dismal in this regard. A sound data and its analysis

In Tamil Nadu, Major mango growing districts are Dharmapuri, Krishnagiri, Vellore, Dindigul, Thiruvallur and Theni. Mango is a tropical fruit. The perfect temperature range for successful mango cultivation is between 24^{o}C to 27^{o}C. It can be grown best in regions with a rainfall of 25 cm. High humidity, rain or rime during flowering is detrimental to mango cultivation. Higher temperature during fruit development and maturity gives better quality fruits. Regions with bright sunny days and moderate humidity during flowering are ideal for mango growing the economic life of mango is considered as thirty years.

In this condition the grade of increase of An Economic Analysis on Area, Production and productivity of Mango cultivation in Tamil Nadu and India with the following broad objectives: (i) to examine the growth in area, production and productivity of mango in India and Tamil Nadu. (ii) to measure the instability in area production and productivity of mango in India and Tamil Nadu. (iii) to examine the contribution of area and yield in production of mango in India and Tamil Nadu.

Statement of the Problem

Mango was one of the most important tropical fruits of the world and it was popular both in its fresh and in its processed form. It is commercially grown in more than 80 countries of the world. The leading mango producing countries in the world are India, China, Mexico, Pakistan, Indonesia, Thailand, Nigeria, Brazil, Philippines and Haiti. Mango has been the main fruit of Asia and this fruit has developed its own importance all over

the world. Besides, because of its fine taste and several good qualities, it has been referred to as the king of all the fruits. Production was at one end of the food problem in India, and at the other end the problem was related to distribution. Therefore an analysis of mango cultivation in the study area, production and productivity of India and Tamil Nadu has deserved a special attention not only to understand the problems in respect of production, but also to identify the specific strategies that could be adopted to improve the performance of the mango.

Data and Methodology

The objective of this paper is to document the area, production, productivity of mango in India as well as Tamil Nadu. The data were collected through the secondary sources from both Central and State Government reports. Compound Growth Rate (CGR), Instability Index and Component Elements were used for data analysis.

(i) Estimation of Compound Growth Rate

Several methods are available to estimate growth rates. In this study exponential function was used to estimate the compound growth rate by making time as the independent variable and area, production and productivity as dependent per unit of time and they are termed as 'Geometric' or compound Growth rate.

Compound growth rates were estimated by fitting exponential trend equation of the following type.

$Y = ab^t$---------- (1)

Where,

Y = area / production / productivity

T = time variable in years

a = constant

and

b = (1+r)

Where

r = Compound Growth Rates

The equations (1) take the linear form by taking logarithms of both sides of equations as follows,

Log y = log a + t log b

The compound growth rate is compound using the following formula

Compound growth Rate (CGR) = (Antilog (log b) -1) X100

(ii) Instability Index

Coefficient of variation (C.V.) is the most commonly used index for measuring instability. Coefficient of variation has an easy interpretation in the context of measuring an overall variation in the data of a variable not showing any trend. But usually when we have a time series data of a variable showing some kind of trend which may be linear, nonlinear, coefficient of variation does not take into account any such time trend and over estimates instability. Thus, it is desirable to use an index of instability which should adjust the data for trend and measure instability. In this study an exponential trend was fitted and instability index was constructed based on the residual, as follows.

$$\sqrt{\frac{\sum_{i=1}^{n} e_i^2}{n-k}}$$

Where,

e_i = value of residuals of 'i'th observation.

n = number of observations.

K = numbers of variables.

An Analysis by Component Elements

The production of any crop will be increased by way of increasing either area under the crop or yield of crop, or both. The relative contribution of area, yield and their interactions in an increase in production of crop can be estimated using the following measure.

$$Q_0 = A_0 Y_0$$

$$Q_n = A_n Y_0$$

Also, $Q_n = Q_{0+\Delta Q}$, $A_n = A_0 + \Delta A$ and $Y_n = Y_0 + \Delta Y$

There for $Q_n = (Q_0 + \Delta_Q) = (A_0 + \Delta A)(Y_0 + \Delta Y)$

$$= A_0 Y_0 + A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y$$

Since $Q_0 = A_0 Y_0$

$$\Delta_Q = A_0 Y_0 + A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y$$

$$\Delta_Q = A_0 \Delta Y + Y_0 \Delta A + \Delta A \Delta Y$$

$$\leftrightarrow \quad \leftrightarrow \quad \leftrightarrow$$

Yield effect | Area effect | Interaction effect

The first term ($A_0 \Delta Y$) can be considered as the yield effect, the second term ($Y_0 \Delta A$) as the area effect and third ($\Delta A \Delta Y$) as the interaction effect. The total change in production can thus be decomposed into three effects viz., yield effect. Area effect and the interaction effect. Of course, it would be appropriate to indicate the limits of this technique. This technique of analysis is based only on the base and current periods information and as such. Do not necessarily reflect the actual trends for all the years in the series.

Results and Discussion

The results and discussion in the link with the objectives enshrined in the study in respect of mango are presented and discussed under the following major heads Area, Production

and Productivity of Mango in India and Tamil Nadu. Section I and II.

Table: 1 Area, Production and Productivity of Mango in India during period 1997-98 to 2012-13

Year (1)	Area (ha) (2)	% change over previous year (3)	Production (tonnes) (4)	% change over previous year (5)	Yield (ha/kg) (6)	% change over previous year (7)
2003-04	1575.8	-	10020.2	-	6359	-
2004-05	1623.4	126.53	12733.2	117.78	7844	93.09
2005-06	1906.7	148.61	11490.0	106.28	6026	71.52
2006-07	1961.9	152.92	11605.2	107.35	5915	70.20
2007-08	2080.7	162.17	12663.1	117.13	6086	72.23
2008-09	2309	179.97	12749.8	117.93	5500	65.27
2009-10	2312.3	180.23	15026.7	138.99	6500	77.14
2010-11	2296.8	179.02	15188.4	140.49	6600	78.33
2011-12	2378.1	185.35	16196.4	149.81	6800	80.70
2012-13	2500.02	194.86	18002.3	166.52	7100	84.26
CGR	**5.19**	-	**5.69**	-	**0.38**	-
Instability Index	**0.05**	-	**0.06**	-	**0.10**	-

Source: Center for Monitoring Indian Economy

Table 1 shows that the area of mango has been increased from 1575.8 in hectare in 2003-2004 to 2500.02 in hectare in 2012-13 with some increased in the prime years. The compound growth rate was by 5.19 percent per annum that had positive and the instability index also positive 0.05 percent per annum during the reference period. This trend has fabulous invitation among mango farmers. In this aspect farmers to eager produce more mango production with the help of increasing cultivated areas. On the other side, the production of mango has been increased from 10020.2 in tonnes in 2003-2004 to 18002.3 in tonnes in 2012-2013 with some increased in the paramount years. Already mentioned, but here says that the compound growth rate of mango production was increasing the level of trend which denotes that has positive in terms of growth (5.69 percent) per annum during the reference period and same way Instability index also had a positive trend (0.06 percent) per annum during the reference period. When, area and production of mango increased that has been alternate their productivity level automatically. So in this table the productivity of mango has been increased from 6359 kg per hectare in 2003-2004 to

7100 kg per hectare in 2012-13 with some increased in the intervening years. Both The compound growth rate and Instability index represented the positive trend of productivity 0.38 per cent and 0.10 percent per annum respectively, during 2003-04 to 2012-13 periods.

Table 2: Area of Mango Cultivation in Major States of India during 1997-98 to 2012-13
(in hectares)

Year (1)	Andra-Pradesh (2)	Bihar (3)	Guja-rat (4)	Karna-taka (5)	Kerala (6)	Mahara stra (7)	Odisha (8)	Uttar-pradesh (9)	West Bengal (10)	Tamil Nadu (11)
2003-04	341.2	140	65.3	96.3	84	164.4	115.1	120.4	65.4	110.8
2004-05	370.3	140.1	69.9	117.4	86.3	181.2	120.3	125.8	66.4	112
2005-06	402.2	140.2	79.3	116.3	85.4	425.8	125.3	130.6	67.8	114.9
2006-07	391.9	140.8	89.7	117.5	85.4	432.7	140.1	144.8	69.1	118.4
2007-08	459.7	142.2	96	124.5	88	444.5	148.2	149.3	70.1	125.1
2008-09	497.7	144.1	115.7	141.3	89	457.0	164.3	158.9	86	206.2
2009-10	480.4	146	121.5	153.8	90	474.5	177.6	168.9	88.1	197.4
2010-11	391.1	147	130.1	161.6	92	477	190.1	191.4	89.5	194
2011-12	408.7	147.1	136.2	172.4	94.5	482	197.2	198.4	90.9	218.9
2012-13	489.6	147.7	141.2	178.8	96.8	482	197.5	198.9	92.5	218.4
CGR	2.75	0.69	9.64	6.78	1.49	11.12	7.03	6.33	4.73	9.81
Instability Index	0.10	2.82	0.05	0.04	0.01	0.28	0.03	0.02	0.05	0.12

Source: Center for Monitoring Indian Economy

Table 2 insists about the details about area of mango cultivation in major states of country during the period of 1997 to 2013.From this data, we know that which states had huge areas for mango cultivations. At this point of view, Maharashtra had more compound growth rate 11.12 than other states, among the above mentioned groups with Instability Index was 0.28. In the list Tamil Nadu and Gujarat had more or less same compound growth rate 9.81 and 9.64 and Instability Index was 0.12 and 0.05 respectively. After that Odisha had a compound growth rate in 7.03 and on the other hand Instability Index was 0.03. Next to this, Karnataka and Uttar Pradesh had same compound growth rate was 6.78 and 6.33 with the Instability Index 0.04 and 0.02 respectively. Lastly West Bengal (Instability Index 0.05), Andhra Pradesh (Instability Index 0.10), and Kerala (Instability Index 0.01) states picked the places were continually in the list. Bihar had last placed in the above list that had compound growth rate was

below 1 per cent and Instability Index was 2.82, here mentioned states kept their area of cultivation of mango still now. In other aspects, Instability Index always indicated that when the compound growth rate rising Instability Index was affected some responsibilities among the states.

Table 3: Production of Mango Cultivation in Major States in India during 1997-98 to 2012-13
(in tonnes)

Year (1)	Andra-Pradesh (2)	Bihar (3)	Guja-rat (4)	Karna-taka (5)	Kerala (6)	Maha-rastra (7)	Odisha (8)	Uttar-pradesh (9)	West Bengal (10)	Tamil Nadu (11)
2003-04	2445.08	1540.1	457.6	255	259.8	559	406	4031.3	585	438.7
2004-05	2962.01	865.06	495.1	1098.2	305.5	615.9	416.3	2100.1	228.8	756.5
2005-06	3217.02	1222.7	595.2	1111.2	384.2	629.8	428.8	2200	406	615.4
2006-07	3135.02	1306.9	729.1	1105.9	384.2	634.3	431.4	2700.5	460.8	539.4
2007-08	3306.00	870.4	772.1	1236.8	511.1	638.6	251.8	3100.8	513.3	537.8
2008-09	2522.00	1329.8	299.8	1284.4	445.4	712.8	449.7	3465.95	548.9	821.4
2009-10	4058.03	995.9	856.7	1694	373.2	597	577.5	3588	578	636.3
2010-11	3363.04	1334.9	911.3	1778.8	380.9	331	642	3623.22	620.2	823.7
2011-12	3514.08	1241.8	966	1868.3	373.2	503	715.2	3655.55	625.3	889.6
2012-13	4406.92	1363.8	1003.7	1795.1	441.03	633	753.79	3991	658.7	714.08
CGR	4.47	0.90	8.47	16.32	3.63	-2.15	8.08	4.49	6.87	4.90
Instability Index	0.13	0.20	0.32	0.38	0.16	0.21	0.24	0.20	0.25	0.18

Source: Center for Monitoring Indian Economy

Table 3 denotes about the details about the Production of Mango Cultivation among the major states of India during the period of 1997 to 2013. By this data, we know that the states had huge areas for mango cultivations. At this point of view, Karnataka had more compound growth rate (16.32) with Instability Index was 0.38 here comparatively area was less but the production level increased due to various factors. In the list Gujarat and Odisha had more or less same compound growth rate 8.47 and 8.08 and Instability Index was 0.32 and 0.24 respectively. Comparatively, West Bengal had next compound growth rate in 6.87 with Instability Index was 0.25. Tamil Nadu had a compound growth rate was 4.90 with instability index was 0.18. Subsequently to this, Uttar Pradesh and Andhra Pradesh had same compound growth rate was 4.49 and 4.47 with the Instability Index 0.20 and 0.13 respectively. Kerala had a compound growth rate was 3.63 with Instability Index 0.16 and Bihar had less than 1 per cent of the compound

growth rate comparatively Instability Index 0.20. Finally, Maharashtra had low levels of compound growth rate was negative trend mentionable -2.15 with Instability Index 0.21) that picked last placed in the list. Here, the researcher mentioned Maharashtra had huge area of lands but production level was still decreasing level compare with other states.

Table 4: Productivity of Mango Cultivation in Major States in India during 1997-98 to 2012-13
(per ha/kg)

Year (1)	Andra-Pradesh (2)	Bihar (3)	Guja-rat (4)	Karna-taka (5)	Kerala (6)	Maha-rastra (7)	Odisha (8)	Uttar-pradesh (9)	West Bengal (10)	Tamil Nadu (11)
2003-04	8.0	11	7.1	9.6	4.5	1.5	3.5	10.1	6	5.4
2004-05	8.0	6.2	8.1	9.4	4.5	1.5	3.5	10.5	6.7	4.6
2005-06	7.2	8.7	8	10.6	5.8	1.4	3.4	10.1	7.3	4.3
2006-07	8.2	9.3	8.2	10.6	5.8	1.4	3.1	11.4	7	4.3
2007-08	8.6	6.1	8.5	9.1	5.8	1.6	1.7	12.7	7.7	5.5
2008-09	5.1	9.2	2.6	9.1	5.8	1.6	2.7	12.8	6.4	5.5
2009-10	8.4	6.8	7	11	5.9	1.3	3.3	13	6.6	4.8
2010-11	8.6	9.1	7	11	6.1	0.7	3.4	13.6	6.9	5.6
2011-12	8.6	8.4	7.1	10.8	5.8	1.0	3.6	14.9	7.3	5.9
2012-13	9.0	9.2	7.1	10	5.9	1.3	3.8	16	7.9	4.7
CGR	1.2	0.12	-1.94	0.99	2.77	-3.88	0.96	5.27	1.48	1.30
Instability Index	0.17	0.20	0.36	0.07	0.08	0.22	0.24	0.03	0.07	0.11

Source: Center for Monitoring Indian Economy

Table 4 represented that the Productivity of Mango Cultivation among the major states of Country during the period of 1997 to 2013. In this data explanation, the states had huge areas for mango cultivations at the same time production was made to order due to some agricultural crisis and circumstances. In India, Uttar Pradesh had a huge amount of productivity of the compound growth rate that shared 5.27 with instability Index was 0.03. After that Kerala had more productivity in numbers, especially the compound growth rate was 2.77 with instability index 0.08. Next to this, in the list West Bengal and Tamil Nadu had more or less same compound growth rate 1.48 and 1.30 and Instability Index was 0.07 and 0.11 respectively. Andhra Pradesh had a nearest productivity level after both West Bengal and Tamil Nadu that had compound growth rate was 1.2 and with Instability Index was 0.17. Here comparatively in the aspects of production, Karnataka, Odisha

and Bihar had below one per cent compound growth rate with Instability Index was 0.07, 0.24 and 0.20 respectively. Last but not least Gujarat and Maharashtra had negative productivity growth level compound growth rate that shared -1.94 and -3.88 with Instability Index was 0.36 and 0.22 respectively. Here, Scholar specified that always mango's productivity growth rate was changed due to an area of land and production and on the other hand productivity still changes due to environment and nature of mango cultivated land among the states.

Table: 5 Area, Production and Productivity of Mango in Tamil Nadu during 1997-98 to 2012-13

Year (1)	Area (ha) (2)	% change Over previous year (3)	Production (in Tonnes) (4)	% Change Over Previous Year (5)	productivity (Per ha/kg) (6)	% change over previous year (7)
2003-04	110.8	-	438.7	-	5.4	-
2004-05	112	101.08	756.5	172.44	4.6	85.19
2005-06	114.9	103.70	615.4	140.28	4.3	79.63
2006-07	118.4	106.86	539.4	122.95	4.3	79.63
2007-08	125.1	112.91	537.8	122.59	5.5	101.85
2008-09	206.2	186.10	821.4	187.24	5.5	101.85
2009-10	197.4	178.16	636.3	145.04	4.8	88.89
2010-11	194	175.09	823.7	187.76	5.6	103.70
2011-12	218.9	197.56	889.6	202.78	5.9	109.26
2012-13	218.4	197.11	714.08	162.77	4.7	87.04
CGR	9.81	-	4.90	-	1.30	-
Instability Index	0.12	-	0.18	-	0.11	-

Source: Center for Monitoring Indian Economy

Table.5 consist information of the performance of Tamil Nadu especially in terms of land holding in hectares, production and productivity of mango cultivation during the period of 2003-04 to 2012-13. In the aspect of the area holding Tamil Nadu had a compound growth rate was 9.81 with instability index was 0.12. On the other hand, production of mango in Tamil Nadu compound growth rate was shared in terms of 4.90 and instability index was 0.18. Lastly, the productivity level of mango cultivation in Tamil Nadu still low that shared 1.30 compound growth rates with instability index was 0.11 in a specific period of time. Further, Scholar suggested that Tamil Nadu had better, but she will improve her area and production and productivity level subsequently in nature.

TABLE: 6 Area and Productivity of Mango in India during Period 1997-98 to 2012-13

Year (1)	Area (ha) (2)	Yield (ha/kg) (3)
2003-04	1575.8	6359
2004-05	1623.4	7844
2005-06	1906.7	6026
2006-07	1961.9	5915
2007-08	2080.7	6086
2008-09	2309	5500
2009-10	2312.3	6500
2010-11	2296.8	6600
2011-12	2378.1	6800
2012-13	2500.02	7100

Source: Center for Monitoring Indian Economy

The relative contribution of area and yield in the change in production of mango three periods as indicated in section.

$$AQ = Ao\,\Delta Y + Yo\,\Delta A + \Delta A\,\Delta Y$$

$$\leftrightarrow \quad \leftrightarrow \quad \leftrightarrow$$

Yield Effect — Area Effect — Interaction Effect

$$= (157)(75) + (635)(93) + (75)(93)$$

$$= 11775 \quad 59055 \quad 6975$$

Table.6 shows the area and yield effect of mango in India from 1997-98 to 2012-13. The area of mango was found effected (11775) in India during the reference period. The yield of mango was found effected (59055) and the interaction effect of mango was found 6975 in India during the period of 1997-98 to 2012-13.

Table: 7 Area Effect, Yield Effect and Interaction Effect of Mango in during 1997-98 to 2012-13

State (1)	Area Effect (2)	Yield Effect (3)	Interaction Effect (4)
Andra- Pradesh	1187.2	341.2	148.1
Bihar	64.7	252	13.86
Gujarat	538.8	65.3	75.9
Karnataka	792	38.52	33
Kerala	57.6	117.6	17.92
Maharashtra	476.4	32.88	63.52
Odisha	288.4	34.53	24.72
Uttar-Pradesh	792.85	710.36	463.15
West Bengal	162.6	124.26	241.49
Tamil Nadu	581.04	77.56	75.32

Source: Center for Monitoring Indian Economy

Table. 7 shows that area under mango was maximum effect in the case of Andra Pradesh (1187.2) which was followed by Uttar Pradesh (792.85) and Tamil Nadu (581.04) and minimum affected was in Kerala (57.6) and Bihar (64.7). The yield effect of mango was highest in Uttar-Pradesh (710.36) followed by Andra Pradesh (341.2) and West Bengal (124.26) and lower effect in Maharashtra (32.88) and Odisha (34.53). The interaction effect of mango was found maximum in Uttar Pradesh (463.15) which was followed by West Bengal (214.49) and Andra Pradesh (148.2) and minimum was found Bihar (13.86) and was followed by Kerala (17.92) and Odisha (24.72). Further, Scholar suggested that all states had better, but she will improve her area effect, Yield effect and Interaction effect level consequently in the natural world.

Summary and Conclusion

To improve the productivity of the mango the government should provide expert advice and training to the farmers to overcome their problems in mango cultivation. The farmers also faced the problem of cold storage facilities. Since the farmers could not afford to make the cold storage facility on their own, the government should come forward to provide them cold storage facility. The rate of mango is highly irregular and fluctuating over time. Government create the regulated market for them. The study concludes that the production is highly fluctuating over the years. Though, the variation in production, productivity and area is increasing every year, there is still scope for further improvement in mango. It is necessary to cultivate mango to the extent of feeding millions of people of sustaining food security. Therefore, the central government and state governments should take necessary steps to increase the area under mango thereby the price of mango will be kept under control.

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