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RESEARCH PAPER

An economic analysis on growth and instability analysis of grapes in India

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ABSTRACT

The study was conducted to assess the growth and instability in export of grapes. Compound growth rate and instability index were employed to analyse the time series data for 26 years collected from APEDA, FAO and NHB. The result showed that the area and production of grapes in India during pre-WTO period were growing significantly positive but productivity was negative with moderate instability index compared to a modest growth with moderate instability index was observed during post-WTO period. The growth rates and instability in area, production and productivity of grapes in Karnataka during pre-WTO period were significantly positive with moderate instability index compared to a modest positive growth in area and production and negative in productivity with reasonable instability index during post-WTO period. High priority need is to be given to increase the area and productivity of grapes to meet the increasing domestic demand on one hand and to build up a sustained supply to the international markets to earn precious foreign exchange.

KEY WORDS : Grapes, Compound growth rate, Instability index

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The income generation through effective horticulture farming is higher as compared to agriculture farming. Horticultural farming has also increased the sustainability of the small land holding, helping the small and medium farmers who form the majority of farmers in India, to increase their per capita income. This in turn has increased the disposal income of the rural population and helped the overall economic development of the country. The process of globalization initiated in the early nineties has resulted in free flow of goods including agriculture goods across international borders. The Indian farmer is being exposed to numerous challenges because of the growing phenomenon. However, if the challenges are overcome which opens up a great opportunity for horticulture exports from India since the country grows a variety of fruits of excellent quality. The Indian peasants need support from all the concerned stake holders to harness the growing opportunities for horticulture exports to different global markets.

Grape occupies the 9th position among all fruits production in the country accounting only 1.6 per cent of total fruit production. It is next only to Apple, Pineapple and Sapota in terms of production. The current area and production under grapes in India is estimated at 1.11 lakh ha with an annual production of 12.35 lakh tonnes. While 78 percent of grapes produced is used for table purpose, nearly 20 per cent is dried for raisin production and 2 per cent is used for manufacturing of juice and wine. Grapes exports from India started during 1970 with an export of only 3 tonnes to Asian countries. Remunerative prices offered by these countries led to an increase in grapes export, while import

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market for Indian grapes widened to European countries during 1990-91.

Total export of grapes during 2010-11 was 99,270 tonnes worth 411.98 crores, which amounts for 80 per cent of the total production of grapes as against 24 per cent of all fruits grown in India. The major importers of Indian grapes are Netherlands, Bangladesh, UK, UAE, Russia, Saudi Arabia, Belgium, Thailand, Sweden, Norway, Oman, Bahrain, Sri Lanka, Mauritius, USA, Singapore and Hong Kong etc. Indian fresh grapes are highly competitive in the International market because of cultivation of Thompson Seedless a highly preferred variety with higher productivity, and also lower cost of production (being a very labour intensive crop and the labour input being comparatively cheaper than other major grape producing countries). Also, grapes cultivation being largely in the hands of progressive and well-to-do farmers with better managerial abilities has made Indian grapes highly competitive. Hence, the present study was undertaken with the objectives of assessing growth and instability analysis of grapes in India.

METHODOLOGY

Secondary data for the study were collected from various published sources. Time series secondary data on area, production and yield of grapes for a period of 26 years from 1985-86 to 2010-11 were obtained from the publications of FAO, APEDA, NHB.

Growth rate on area, production and yield of grapes were computed for a period of 26 years from 1985-86 to 2010-11. This period is separated by phased manner such as pre-WTO (1985-86 to 1995-96) and post- WTO (1996-97 to 2010-11) and overall (1985-86 to 2010-11). The linear, log-linear, exponential and power functions were some of the important functional forms employed to study the growth rates. Different functional forms were tried in the past for working out growth rates in area, yield and production. Some of the important forms tried were the linear growth model ($Y = a + bt$), exponential function ($Y = ab^t$) and quadratic function ($Y = a+bt+ct^2$). However, it was found that the exponential form of the function $Yt = ab^t$ was the better and most frequently used one.

Growth rates in area, production and productivity of grapes were computed for a period of 26 years from 1985-86 to 2010-11. Growth rates were computed using the exponential growth function of the form:

$$Y = a\, bt\, e \quad \text{..... (1)}$$

where,

Y= Dependent variable for which the growth rate is estimated *i.e.*, area, production and productivity

a= Intercept

b= Regression co-efficient

t= Time variable

e= Error term.

The compound growth rate was obtained from the logarithmic form of the equation (1) as below:

$$\ln y = \ln a + t \ln b$$

The per cent compound growth rate (g) was derived using the relationship:

$$g = (\text{Anti log of } b - 1) \times 100$$

Instability analysis:

The co-efficient of variation was used as measure to study the variability in production of grapes in India. The co-efficient of variation or index of instability was computed by using the following formula:

$$CV = \frac{\text{Standard deviation } (\pm)}{\text{Mean } (X)} \times 100$$

Linear trends were fitted to the original data of area, production and productivity of grapes, for the period for the time series data of 26 years from 1985-86 to 2010-11. This period was separated by phased manner such as pre-WTO (1985-86 to 1995-96) and post- WTO (1996-97 to 2010-11) and overall (1985-86 to 2010-11). The trend co-efficients were tested for their significance. Whenever the trend of series was found to significant; the variation around the trend rather than the variation around mean was used as an index of instability. The formula suggested by Cuddy and Della (1978) was used to compute the degree of variation around the trend. That is co-efficient of variation was multiplied by the square root of the difference between the unity and co-efficient of multiple determinations (r^2) in the cases where r^2 was significant to obtain the instability index.

$$\text{Instability index} = \frac{\text{Standard deviation } (\pm)}{\text{Mean } (X)} \times 100 \times \sqrt{1 - r^2}$$

r^2 = RSS/TSS=Goodness of fit

RSS = Regression sum of square

TSS = Total sum of square.

ANALYSIS AND DISCUSSION

Compound growth rates were computed to comprehend the trends in the area planted, production and productivity of grapes from the country. The study period of 1985-86 to 2010-11 was divided into two sub-periods, *viz.*, pre-WTO (1985-1995) and post-WTO (1996 to 2011) periods. The exponential growth functions and instability indices were employed to find the difference in growth rates and instability during the above mentioned periods.

The estimated growth rates and instability indices during pre-WTO, post-WTO and overall study period were presented in Table 1. Growth rate of grapes productivity during the pre-WTO period are negative (-0.53 %) and was associated with instability index of 10.99 per cent. But in

the same period a positive growth rate of area was observed (11.46 %) with instability index of 11.63 per cent, while a positive growth rate of production (10.86 %) with instability index of 14.82 per cent was observed for production. The average of area, production and productivity of grapes during this period were 27.90 thousand hectares, 492.87 thousand MT and 17.77 MT per hectare, respectively.

A negative and significant growth of -4.34 per cent was observed with the instability index of 19.49 per cent in the productivity of grapes during post-WTO period. Area and production of grapes during the period also grew at an impressive rate of 7.09 and 2.43 per cent, respectively. The instability indices for area and production were 10.72 and 20.70 per cent, respectively, indicating a stable growth in area as compared to production during the period in the country. The average of area, production and productivity of grapes during this period were 62.01 thousand hectares, 1327.74 thousand MT and 22.95 MT per hectare. This might have been triggered by the introduction of improved grape variety especially Thompson Seedless which had a high demand in the international market and the productivity of the variety was very high in India due to favourable climatic conditions.

In the overall period, total area under grapes increased from 12.50 thousand hectare during 1985-86 to 1, 11,000 hectare in 2010-11, at a compound growth rate of 6.92 per cent while instability index was 14.00 per cent. Production during the same period increased from 260 thousand tonnes to 1235 thousand tonnes at a compound growth rate of 7.28 per cent and the instability index was 21.80 per cent, while the productivity was almost stagnant with positive growth rate of 0.34 per cent during the same period and instability was also more (24.10%). The average of area, production and productivity of grapes during this period were 46.85 thousand hectares, 956.69 thousand MT and 20.65 MT per hectare, respectively.

The productivity of grapes in the mean time decreased at the rate of – 4.34 per cent during post-WTO (1996-97 to 2010-11) period while it decreased at the rate of -0.53 per cent during pre-WTO period. But for entire period it was improved at the rate of 0.34 per cent. Thus, even increased production of grapes in India during the study period was mainly due to expansion in the area and any further increase has to be area led as the productivity of grapes in the country seems to have peaked as indicated by the highest productivity of Indian grapes in India during 1996-97 and average productivity (20.75 t/ha) during entire study period. Similar area led increase in production of oilseeds in Assam during

Table 1: Compound growth rates and instability index in area, production and productivity of grapes in India during 1985-86 to 2010-11

Description		Pre-WTO (1985-1995)	Post-WTO (1996-2011)	Overall period (1985-2011)
Compound growth rate (%)	Area(000 ha)	11.46*(0.013)	7.09*(0.006)	6.92*(0.004)
	Production(000 MT)	10.86*(0.011)	2.43(0.013)	7.28*(0.007)
	Productivity(MT/ha)	-0.53(0.011)	-4.34(0.017)	0.34(0.008)
Instability index (%)	Area(000 ha)	11.63	10.72	14.00
	Production(000 MT)	14.82	20.70	21.80
	Productivity(MT/ha)	10.99	19.49	24.10
Average	Area(000 ha)	27.90	62.01	46.85
	Production(000 MT)	492.87	1327.74	956.69
	Productivity(MT/ha)	17.77	22.95	20.65

Note: Figures in the parentheses indicate 'Standard error' *and ** indicate significance of values at P=0.01 and 0.05, respectively

Table 2: Compound growth rates and instability index in area, production and productivity of grapes in Karnataka during 1985-86 to 2010-11

Description		Pre-WTO (1985-1995)	Post-WTO (1996-2011)	Overall period (1985-2011)
Compound growth rate (%)	Area(000 ha)	7.07*(0.012)	7.02*(0.006)	5.41*(0.004)
	Production(000 MT)	1.48*(0.017)	3.11**(0.012)	4.58*(0.005)
	Productivity(MT/ha)	5.46(0.011)	-3.65* (0.011)	-0.78 (0.006)
Instability index (%)	Area(000 ha)	11.97	9.97	15.32
	Production(000 MT)	16.50	20.34	18.68
	Productivity(MT/ha)	10.86	18.79	22.96
Average	Area(000 ha)	5.25	10.83	8.47
	Production(000 MT)	121.70	219.94	178.38
	Productivity(MT/ha)	23.00	21.35	22.05

Note: Figures in the parentheses indicate 'Standard error' , *and ** indicate significance of values at P=0.01 and 0.05, respectively

1950-51 to 1988-89 which have been reported by Bhowmick and Ahemed (1993). However, most of the earlier studies especially conducted during the green revolution period in India have reported productivity led increase in production as observed by Acharya (1993) in the production of different pulses in India. This was because, there existed a scope for improving their productivity while the newly introduced grape variety in India being cultivated in most favourable areas mainly by elite farmers with good managerial ability and yield levels comparable to the best and offered little scope for increment in their productivity.

A positive and significant growth of 7.07 per cent was observed with the instability index of 11.97 per cent in the area of grapes during pre-WTO period in Karnataka. Production and productivity of grapes during the period also grew at the rate of 1.48 and 5.46 per cent, respectively. The instability indices for production and productivity were 16.50 and 10.86 per cent, respectively, indicating a stable growth during the period in the state. The average of area, production and productivity of grapes during this period were 5.25 thousand hectares, 121.70 thousand MT and 23 MT per hectare (Table 2). Growth rate of area under grapes during the post-WTO period was positive (7.02 %) and was associated with instability index of 9.97 per cent. While in the same period, a positive and significant growth rate of production was observed (3.11%) with instability index of 20.34 per cent, and a negative and significant growth rate of productivity (-3.65 %) with instability index of 18.79 per cent was observed. The average of area, production and productivity of grapes during this period were 10.83 thousand hectares, 219.94 thousand MT and 21.35 MT per hectare, respectively.

Total area under grapes increased from 4.80 thousand hectare during 1985-86 to 18.100 hectares in 2010-11, at a compound growth rate of 5.41 per cent while instability index was 15.32 per cent for the overall period. Production during the same period increased from 90.72 thousand tonnes to 330.30 thousand tonnes at a compound growth rate of 4.58 per cent and the instability index was 18.68 per cent, while the productivity was growing negatively (-0.78 %) during the same period with instability of 22.96 per cent. The possible reason for this could be inefficient use of water, nutrients and pesticides, which impaired soil and crop health. Hence, over the years soil health and fertility might be declining and another possible reason could be that the crop, which was introduced in 90's and there was a potential of crop yielding higher productivity as a newly introduced improved variety like Thomson Seedless but as the year rolled over the potentiality of yielding higher could have decreased. This might be also due to decline in the genotypic factors which yield potentially higher yield in the beginning and later on lower. The same case also holds good in post WTO period in the study period. The average of area, production and productivity of grapes during this period were 8.47 thousand hectares, 178.38 thousand MT and 22.05 MT per hectare, respectvely.

Conclusion:

High priority need to be given to increase the area and productivity of grapes to meet the increasing domestic demand on one hand and to build up a sustained supply to the international markets to earn precious foreign exchange.

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