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A CASE STUDY

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Forecast of banana - An economic analysis

M. UMA GOWRI AND B. KAVITHA

ABSTRACT : The banana is an edible fruit, botanically a berry, produced by several kinds of large her baceous flowering plants in the genus *Musa*. Banana is a globally important fruit crop with 97.5 million tones of production. In India it supports livelihood of millions of people with total annual production of 16.91 million tones from 490.70 thousand ha. with national average of 33.5 T/ha. Banana contributes 37 per cent to total fruit production in India. Forecasting tools was used study of banana in Tamil Nadu. According to the MAPE value ARIMA method is most appropriate method for forecasting in banana. The cost and returns analysis reveals that higher net returns was realized in Nendran variety.

KEY WORDS : Banana, Forecating tools, Exponential smoothing, ARIMA model

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INTRODUCTION

Banana is one of the oldest fruits known to mankind and also an important food for man. It is highly nutritive and very delicious (Surendranthan *et al.,* 2003). The probable origin of this crop is Southeast Asia. Banana is called “Apple of Paradise” and Christians mentioned this crop as “Tree of knowledge” (Apte,1969). Banana is the cheapest fruit and also a rich source of energy (104 cal/100gram) (Babhulkar, 1998). Banana is reported to be grown in 130 countries in the world with a total production of 79 million tones. However, production, as well as exports and imports of bananas, are highly concentrated in a few countries (Singh and Kahlon, 1994). Furthermore, India, China, the Philippines, Brazil and Ecuador alone produced more than 60 per cent of total world banana production (Baurah and Barman, 2001). India ranks first amongst the banana cultivating countries of the world with an annual production share of 27.74 per cent of the total harvest (Ladaniya *et al.*, 2004).The important banana growing states are Maharashtra, Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, Bihar and Gujarat (Indiastat). The present production of banana in the country however, is highly inadequate. It is estimated that, the present annual per capita consumption of banana in India is 50 kg per head (FAO) which is very low compared with other progressive banana growing countries such as Jamaica, Congo, Ecuador, and Uganda (Prasad, 2001). Thus, there is an immense scope of increasing banana production in the country. The present study was planned with the following objectives:

– To predict the future area, production of banana

– To predict the future banana price and

MEMBERS OF RESEARCH FORUM

Address of the Correspondence : **M. UMA GOWRI,** Centre for Agricultural and Rural Development Studies, Tamil Nadu Agricultural University, COIMBATORE (T.N.) INDIA

Address of the Coopted Authors : B. KAVITHA, Department of Agricultural Economics, P.G.P. College of Agricultural Sciences, NAMAKKAL (T.N.) INDIA

– To suggest suitable policy options for increasing productivity of banana.

EXPERIMENTAL METHODS

Tools of analysis :

Forecasting tools :

Forecasting is the process of making statements about events whose actual outcomes (typically) have not yet been observed. A commonplace example might be estimation for some variable of interest at some specified future date (Gujarati, 2003).

Exponential smoothing is a technique that can be applied to time series data, either to produce smoothed data for presentation, or to make forecasts. The time series data themselves are a sequence of observations (Dickey and Fuller, 1979). The observed phenomenon may be an essentially random process, or it may be an orderly, but noisy, process (Jaya, 1995). Whereas in the simple moving average the past observations are weighted equally, exponential smoothing assigns exponentially decreasing weights over time (Ghosh, 2000).

Single exponential smoothening :

$$F_{t+1} = \alpha Y_t + (1-\alpha)F_t$$

F_{t+1}= Forecast based on weighting more recent observation with α weight, F_t= Weighting most recent forecast with (1-α) weight.

Browns linear exponential smoothening :

Single smoothing statistic equation:

$$S'_n = \alpha Y_n + (1-\alpha)S'_{n-1}$$

Double smoothing statistic equation:

$$S'_n = \alpha S'_n + (1-\alpha)S'_{n-1}$$

Forecasting value Y_{n+m}:

The procedure to calculate forecasting m forward period with double exponential smoothing with brown method can be calculated from this equation (Mohapatra, 2001):

$$\hat{Y}_{n+m} = {}_{0n} + {}_{1n}m$$

This equation is similar to linear trend method, where:

$$\beta_{0,n} = 2S'_n - S'_n, \beta_{1,n} = \frac{\alpha}{1-\alpha}(S'_n - S''_n)$$

Holt's linear method

$L_t = \sim Y_t + (1-\sim)(L_{t-1}+b_{t-1})$, $b_t = \quad (L_t - L_{t-1}) + (1- \quad)b_{t-1}$, $F_{t+m} = L_t + b_t m$

L_t– An estimate of the level of the series at time t,

Bt – Trend of the series at time t

Ft+m – Forecast value.

Holt – winter's additive trend and seasonality method :

Level: $L_t = \sim(Y_t - S_{t-s}) + (1-\sim)(Lt-1+b_{t-1})$, Trend: $b_t = \quad (L_t - L_{t-1}) + (1- ::: \,) b_{t-1}$

Seasonal: $S_t = ¥(Y_t - L_t) + (1- ¥)S_{t-s}$, Forecast: $F_{t+m} = L_t + b_t m + S_{t-s+m}$

S_t - Seasonal adjustment for time period t

Holt – winter's multiplicative trend and seasonality method :

$$L_t = \alpha\frac{Y_t}{S_{t-s}} + (1-\alpha)(L_{t-1} + b_{t-1}) \qquad b_t = \beta(L_t - L_{(t-1)}) + (1-\beta)b_{t-1}$$

$$S_t = \gamma\frac{Y_t}{L_t} + (1-\gamma)S_{t-s} \qquad F_{t+m} = (L_t + b_t m)S_{t-s+m}$$

ARIMA model :

The seasonal part of an ARIMA model has the same structure as the non-seasonal part: it may have an AR factor, an MA factor, and/or an order of differencing (Awal and Siddique, 2011). In the seasonal part of the model, all of these factors operate across *multiples of lag s* (the number of periods in a season).A seasonal ARIMA model is classified as an ARIMA(p,d,q)x (P,D,Q) model, where P = number of seasonal autoregressive (SAR) terms, D=number of seasonal differences, Q=number of seasonal moving average (SMA) terms.

In identifying a seasonal model, the first step is to determine whether or not a seasonal difference is needed, in addition to or perhaps instead of a non-seasonal difference (Behura and Pradhan, 1998). You should look at time series plots and ACF and PACF plots for all possible combinations of 0 or 1 non-seasonal difference and 0 or 1 seasonal difference. Caution: don't EVER use more than ONE seasonal difference, nor more than TWO total differences (seasonal and non-seasonal combined*)*. If the seasonal pattern is both strong and stable over time (e.g., high in the summer and low in the winter, or *vice versa*), then you probably should use a seasonal difference regardless of whether you use a non-seasonal difference, since this will prevent the seasonal pattern from “dying out” in the long-term forecasts (Rajput *et al.*, 2001).

EXPERIMENTAL RESULTS AND ANALYSIS

From the Table 1 the banana forecasted area for 2010-2011 in Tamil Nadu was 123.90 thousand hectare in single exponential smoothening model , 116.87 thousand hectare, 117.24 thousand hectare and 122.2 thousand hectare in holt’s linear smoothening, winter’s additive trend and seasonality method and winter’s multiplicative trend and seasonality method, respectively. According to the MAPE (Maximum Absolute Percentage Error) value winter’s additive trend and seasonality method is most appropriate.

From the Table 2 the banana forecasted production for 2010-2011 in Tamil Nadu was 7037.34 thousand tons in single exponential smoothening model, 7808.86 thousand tons, 6815.63 thousand tons and 8946.50 thousand tons in holt’s linear smoothening, winter’s additive trend and seasonality method and winter’s multiplicative trend and seasonality method, respectively. According to the MAPE value winter’s additive trend and seasonality method is most appropriate.

From the Table 3 the banana forecasted productivity for 2010-2011 in Tamil Nadu was 50.13 tons in single exponential smoothening model, 49.92 tons, 51.48 tons and 55.14 tons in holt’s linear smoothening, winter’s additive trend and seasonality method and winter’s multiplicative trend and seasonality method, respectively. According to the MAPE value winter’s additive trend and seasonality method is most appropriate.

From the Table 4 the banana forecasted price for

Table 1: Exponential smoothening models for future banana area - Tamil Nadu

Model	Factors	MAPE	Forecasted value(‘000ha)
Single exponential smoothening	α = 0.5	13.95	123.9
Holt’s linear smoothening	α = 0.1, = 0.6	15.31	116.87
Winter’s additive trend and seasonality method	α = 0.1, = 0.1 γ = 0.8	2.69	117.24
Winter’s multiplicative trend and seasonality method	α = 0.1, = 0.1 γ = 0.8	3.04	122.2

Table 2: Exponential smoothening models for future banana production – Tamil Nadu

Model	Factors	MAPE	Forecasted value (‘ooo tons)
Single exponential smoothening	α = 0.6	32.31	7037.34
Holt’s linear smoothening	α = 0.4, = 0.6	29.17	7808.86
Winter’s additive trend and seasonality method	α = 0.2, = 0.4 γ = 0.9	9.00	6815.63
Winter’s multiplicative trend and seasonality method	α = 0.2, = 0.4 γ = 0.9	8.97	8946.5

Table 3: Exponential smoothening models for future banana productivity – Tamil Nadu

Model	Factors	MAPE	Forecasted value (kg/ha)
Single exponential smoothening	α = 0.6	23	50130.8
Holt’s linear smoothening	α = 0.2, = 0.8	19.49	49928.2
Winter’s additive trend and seasonality method	α = 0.2, = 0.3, γ = 0.8	8.23	51482.9
Winter’s multiplicative trend and seasonality method	α = 0.2, = 0.3 γ = 0.8	9.44	55141.1

Table 4 : Results of exponential smoothening models for banana price

Model	Factors	Banana price (Rs./kg)
Single exponential smoothing	α = 0.6	MAPE = 13.94,F= 46.88
Holt’s	α = 0.9, = 0.1	MAPE = 12.52,F = 41.70
W.A.T.S.E.M	α = 0.1, = 0.1,γ = 0.9	MAPE = 5.72,F= 12.71
W.M.T.S.E.M	α = 0.1, = 0.1,γ = 0.9	MAPE = 5.58,F = 29.42
ARIMA	p = 0,d = 1,q = 0	MAPE = 5.45,F = 19.21

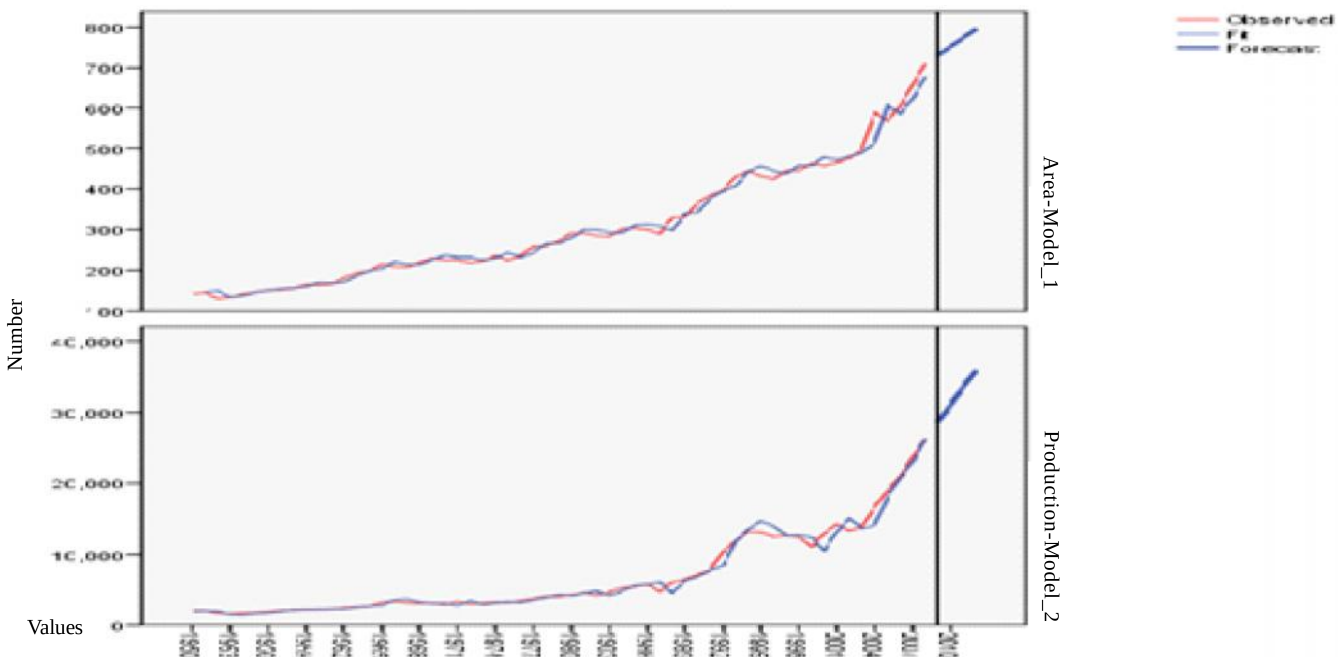

Fig. 1 : Fit of forecast values and actual

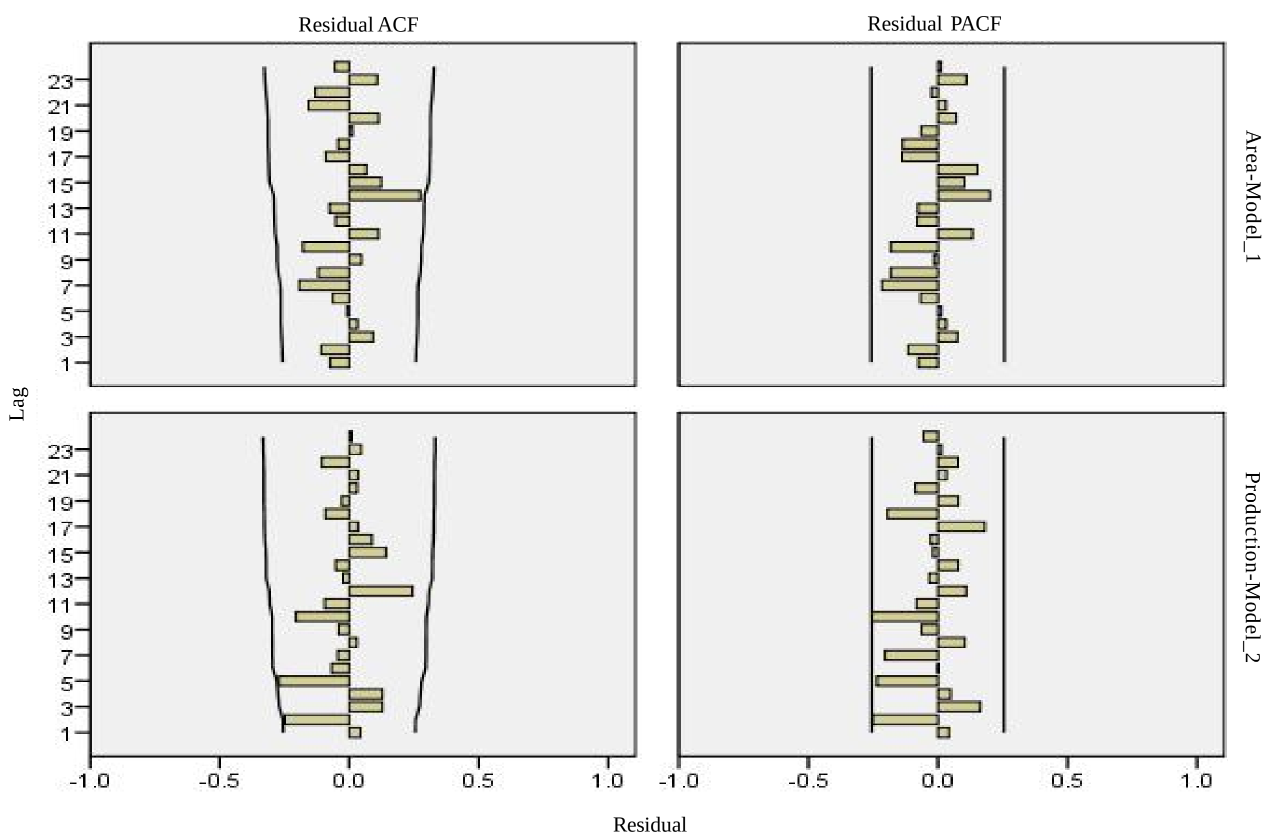

Fig. 2 : ARIMA- correlogram for area and production

2010-2011 in Tamil Nadu was Rs. 13.94 per kg in single exponential smoothening model, Rs.12.52, Rs.5.72, Rs.5.58 and Rs.5.45 per kg in holt's linear smoothening, winter's additive trend and seasonality method, winter's multiplicative trend and seasonality method and ARIMA method, respectively. According to the MAPE value ARIMA method is most appropriate.

Conclusion and policy implications :

–Improved technologies needed to enable farmers to grow more banana on limited land with reduced Cost of cultivation,

–The cost and returns analysis reveals that higher net returns was realized in Nendran variety,

–Varieties suitable for export, higher yield potential and better quality will help increase average yields,

–Higher price fluctuations can be avoided by going for proper storage facilities, monitoring, controlling movement of banana,

–Proper measures to be taken for stabilizing the price fluctuation, which will improve standard of living of farmers.

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