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TRENDS IN PRODUCTION OF CERTAIN AGRICULTURAL CROPS IN KERALA

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Production of most of the agricultural crops in Kerala have increased over the last two decades. The factors contributing to production are area cultivated and the level of technological development, that is, the efficient utilisation of inputs like quality seeds, fertilisers, irrigation facilities, plant protection measures and management practices. The technological factor is a continuous variate, exhibiting an increasing trend with time. It can be assumed that the rate of change in technological level at a particular time is directly proportional to the level of technological development upto that time, except when sudden and drastic improvements have been made possible through very fast adoption of improved technology, mostly high yielding varieties. This in turn implies that the contribution of technology in production also exhibits an increasing trend and that the rate of increase in production at any particular time will be directly proportional to the production at that time.

Deterministic models to explain growth have their own limitations. Hence a stochastic model is adopted to explain the trend in production of crops in Kerala.

Materials and Methods

Published data on production and coverage of crops, viz. rice, tapioca, coconut, arecanut, pepper, tea, coffee, rubber and cashewnut for the years 1952-53 to 1973 -74 have been utilised for the study.

The log normal process (Tintner and Patel - 1965) is used to represent the data. Production is always positive. The log normal model assumes that the logarithm of production is normally distributed and that the mean value is a function of time and area under the crop. The mean and variance of the logarithms of production are linear functions of time. This means that production has an exponential trend and that its variance is also an exponential function of time. The probability density function of production y_t, according to the process envisaged is,

$$P(y_t) = (2\pi a t y^2)^{-\frac{1}{2}} \exp. - (\log y_t - \log y_0 - b_1 t - b_2 (x)^t_o)^2 / 2 at,$$

where $(x)^t = \int_0^t x \, dt$. Here y_0 is the known and fixed value of production at some previous period of time and time is measured as deviation from this

Table 1

The trends of the yields in tonnes per ha of some important crops in Kerala (1952-53 to 1973-74)

Crop	Trend	Coefficient of determination
Rice	722.38 exp (.135401 t — ..131 x 10 S *)	0.81
Tapioca	2524 exp (.175432 t — .333 10^{-6} t x_1)	0.92
Coconut *	2978 exp (.091454 t — .26 $\times 10^{-7}$ t x_A.	0.72
Arecanut *	4448 exp (.097741 t — .67 x 1° 2 x_1)	0.92
Pepper	78.81 exp (—.110628 t + .1226 x 10^{-5} t x_1)	0.67
Tea	30.22 exp (.070020 t — .117 < 1° 2 x)	0.62
Coffee	5.11 exp (.052264 t ; .49 x 10^{-7} tc x.)	0.98
Rubber	19.26 exp (—.043249 t + .964 × 10 2 x.)	0.98
Cashewnut	54.75 exp (.057951 t —.308 x 10^{-6} t S x)	0.93

* la million nuts

base period. The expected value of y_t is $y_0 \cdot \exp\left((b_1 + a/2)\, t + b_2 (x)^t_o\right)$ and the variance of y_t is $y_0^2 \exp.2\left((b_1 + a/2)\, t + b_2 (x)^t_o\right)(\exp. at — 1)$ The estimates of the parameters using data for the periods from 0 to n are,

$$b_1 = \left(I(\log y_t - \log y_{t-1}) — b_2\, 2\, X\right)_t / n \quad (1)$$

$$b_2 = \text{Cov}\ x_t\ ,\ \log\left(\frac{y_t}{\quad}\right) / V(x_t) \quad (2)$$

$$a = (1/n)\,[S\,(\log (y_t / y_{t-1} \quad b^2_2\ S_{x-}\ -2b_2\ S\ x \log (y / y \quad)1 \quad - b_1^2 \quad (3)$$

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Table 2

Estimates of yield *in* tonnes per ha (1975-76 to 1977-78) and the geometric growth rates in area

Crop	1975-76	1976-77	1977-78	Yearly geometric growth rate in area
Rice	1392	1416	1440	1.008
Tapioca	6624	7003	7369	1.042
Coconut *	3806	3825	3843	1.300
Areeanut *	14710	15180	15640	1.021
Pepper	30.93	32.36	33.97	1.021
Tea	52.89	54.31	55.78	0.994
Coffee	17.44	18.41	19.44	1.052
Rubber	172.00	208.40	251.60	1.059
Cashewnut	126.40	128.80	130.90	1.057

* In million nuts

Tintner and Patel (1965) have applied the log-normal model to the data on National Income of India, using Government expenditure as the exogenous variable. Tintner and Malvika Patel (1969) have utilised the same model to explain the trend in per hectare yields of crops viz., rice, wheat and sugarcane in India, taking the proportion of irrigated area under the crop as the exogenous variable. The same method is adopted here to explain the trends in production of crops namely rice, tapioca, coconut, arecanut, pepper, tea, coffee, rubber and cashewnut in Kerala, taking the area under the crop as the exogenous variable. The base period is taken as the year 1952-53 and data from 1952-53 to 1973-74 have been utilised for all crops except tapioca which showed a drastic increase in production during 1962-63 and hence only data from 1963-64 to 1973-74 have been made use of, taking 1963-64 as the base period.

Results and Discussion

The trends in production of the crops given by the mean of for the various crops are shown in Table 1. The coefficient of determination computed for each model as a measure of the goodness of fit of the model to the data are also given alongside.

These models are used to predict the annual production of these crops for the periods 1975-76, to 1977-78. Here the estimates of x_t based on the exponential model for area have been used. The geometric rates of growth in area as well as the estimates of production are given in Table 2.

It is found that the stochastic model used, namely, the log-normal model gives reasonably close fit to the data and hence these can predict the productions of crops for the periods which are not very far removed from the year 1973-74, the data upto which have been used in the construction of the models.

Summary

The log-normal model is fitted to data on production of crops namely rice, tapioca, coconut, arecanut, pepper, tea, coffee, rubber and cashewnut in Kerala, for the period 1952-53 to 1973-74, except for tapioca for which data for the period 1963-64 to 1973-74 only have been utilised. It is found that the models give satisfactory fit to the data. Estimates of production for the period 1975-76 to 1977-78 have been obtained using these models.

സംഗ്രഹം

1952-53 മുതൽ 1973-74 വരെയുള്ള കാലയളവിൽ അരി, നാളികേരം, അടക്ക, കുരുമുളക്, ചായ, കാപ്പി, റബ്ബർ, കശുവണ്ടി മുതലായവയുടേയും 1963-64 മുതൽ 1973-74 വരെയുള്ള കാലയളവിൽ ffIro^.j9m1o!j)tssaj)o ഉല്പാദന പ്രവണത നിർണ്ണയിക്കുവാൻ ലോഗ്-നോർമ്മൽ മാതൃകയിലുള്ള ഫലനങ്ങളും ഉപയോഗപ്പെടുത്തിയിരിക്കുന്നു. ഈ മാതൃകകളും ഉത്പാദനങ്ങളെ തൃപ്തികരമായ രീതിയിൽ ആസന്നജനം ചെയ്യുന്നിരിക്കുന്നു. 1975-76 മുതൽ 1977-78 വരെയുള്ള കാലങ്ങളിലേക്ക് ഈ മാതൃകകളും ഉപയോഗപ്പെടുത്തി വിവിധ ഇനം വിളകളുടെ ഉല്പാദനം തിട്ടപ്പെടുത്തിയിരിക്കുന്നു.

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