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Future Prospects of Crop Productivity in Manipur State

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Abstract: Less than 10 percent area of Manipur state is used for cultivation due to geographical constraints. So, to mitigate the increasing demand of foods there has been great prerequisite to increase crop yield. Under this background it has become important to get a clear idea about the current status of agricultural and horticultural crop production. To know the overall growth status of crop productivity trend analysis is a very helpful tool. For this purpose we employ trend analysis to study the overall movement or the changing pattern of different agricultural and horticultural crops in Manipur state. We have considered ten agricultural and horticultural crops, namely, rice, maize, oilseeds, pulses, vegetables, pineapple, citrus, chillies, ginger and turmeric for the period of 1997 to 2016. From trend analysis it was observed that yield of rice, total oilseeds and turmeric follow a cubic polynomial trend, maize have a quadratic trend, total pulses and two fruit crops viz., citrus and pineapple follow a linear trend. Chilli and vegetables follow a compound trend.

Index Terms **- Yield, descriptive statistics, trend analysis.**

I. INTRODUCTION

Manipur is a state in North East India surrounded by hills and an oval shaped valley in its heart. Agriculture is the main occupation of the people of Manipur (Devi, 2012). Agriculture sector contributes a major share to the total state domestic product and provides employment to about 52.19 percent of the total workers in Manipur which is more than half of the working population. The cultivated area is about only 7.41% of the total geographical area of Manipur state. Out of the total cultivated area, 52% is confined to the valley. Therefore, half of the total valley area which accommodates 67% of the total population is occupied for agriculture purposes (https://www.globalsecurity.org/military/world/india/manipur-economy.htm). The agriculture practices in the state can be broadly categorized into two separate types viz., settled farming practiced in the plains, valleys, foothills, terraced slopes, etc. and shifting cultivation (Jhum) practiced on the hill slopes while the shifting cultivation leads to possible forest degradation in the foot hills across the state (Darlong, 2004, Devi and Choudhury, 2013).

Eighteen main crops are cultivated throughout the two seasons in the state. Rice cultivation leads all others crops. With the increase of the population, the necessity or demand of all crops has been increased. However the production of the crops has been decline. Therefore there has been the great requirement of adaptation of the high yielding varieties of seed over the traditional seeds. The adoption of high-yielding varieties (HYV) of different crops except paddy has been very slow in Manipur, especially in the hill districts.

Manipur is also famous for its suitability for the development of horticultural crops particularly vegetables (Chadha, 2009). There is a huge possibility for increasing or incorporating more land under horticulture cultivation in the plains as well as in the hilly areas. In the plains the soil conditions are very much conducive to production of horticultural products such as banana, citrus fruits like pineapple, oranges, peaches and also others like apricot, papaya, guava etc. Therefore the promotion of horticulture in Manipur is very much essential to develop horticultural market and to cater the needs of not only the domestic but also beyond the state to a larger market.

To know the overall growth status of agricultural and horticultural productivity in Manipur state we used trend analysis. Trend analysis is a technique to predict the future based on recently observed trend data (Haque, 2004, Sudha et al., 2013, Elbariki et al., 2014, Aysha et al., 2014). The present study discusses the nature of data, trends and patterns in agricultural and horticultural crops in Manipur state.

II. MATERIALS AND METHODS

The study was conducted for Manipur state which is nestled in the northeast corner of India (Fig. 1). The state lies between 92°58′E and 94°45′E long. and 23°50′N and 25°42′N lat. Altitude varies from 40 m (Jiribam) to 3114 m (Mount Iso) amsl. The hill and valley terrains in the state represent a distinct geographical entity. The central valley region is surrounded by hills all around along with isolated hillocks.

Fig 1: India map showing Manipur state

Source of data

For the present study secondary information of crop area and yield were collected from Department of Agriculture, Government of Manipur for the period of 1997 to 2016. Here we have considered ten crops including rice, maize, oilseeds, pulses, vegetables, pineapple, citrus, chillies, ginger and turmeric.

Methodology

Descriptive statistics

To examine the nature of the data series, each series has been subjected to get various descriptive statistics which provide simple summaries about the sample and describe the basic features of the data. Descriptive statistics are typically distinguished from inferential statistics, as it simply describes what is or what the data shows. In the present study we have selected some descriptive measures viz. mean, standard deviation, coefficient of variation, skewness and kurtosis to explain the behaviour of each series.

Trend models

A model can be described as a means of presenting a process or system. Statistical model generally trace the path of the process along with its statistical properties and implications. In the present context we are interested in studying the path and nature of the series under our preview through different models. Among the different class of statistical models (viz., parametric, non-parametric, semi-parametric) parametric models are known to be superior for their statistical properties. An attempt will be made through curve fitting approach to identify the appropriate trend equations over the period of time using parametric approaches.

The parameters of the linear models were estimated by ordinary least squares (OLS) method. Non-linear models with multiplicative error term were linearized by suitable transformation and OLS technique was applied to estimate the model parameters. These models also exhibit stability for predicting future values in respect of each factor.

Performance of the models

Model validation was done by Coefficient of determination (R^2) value. The result obtained from after fitting of these models was compared on the basis of parameters R^2. The model represents the high and significant R^2 with comparatively least number of parameters were considered best for that particular factor on available data. The formula of coefficient of determination (R^2) is as follows:

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y}_i)^2}$$

where, y is the actual value

$\hat{y}$ is the predicted value of y

$\bar{y}$ is the mean value of y

The above criterion was carried out with respect to data sets on productivity figures. The parameters of these models were estimated by OLS technique.

By comparing and judging judiciously the estimates of the parameters, summary statistics, viz. coefficient of determination R^2 fitted better models were screened primarily and tested for their adequacies with regard to the error properties. A best fitted parsimonious model is one which has the smaller number of parameters with high R^2 value in a set of competing best fitted adequate models.

III. RESULTS AND DISCUSSION

In consonance with the objectives of the study the collected data were analysed and interpreted. The results of the study were presented in this section under the following headings.

Descriptive Statistics

The descriptive statistics of area and yield data of various agricultural and horticultural crops were presented in table 1.

Table 1: Descriptive Statistics of area (MT ha^{-1}) and yield (Qt ha^{-1}) of the selected 10 crops in Manipur state during the year of 1997-2016

Name of the crops		Mean		SD		CV%		Skewness		Kurtosis	
Agricultural crops		Area	Yield	Area	Yield	Area	Yield	Area	Yield	Area	Yield
	Rice	241.77	2.27	76.66	0.55	31.70	24.53	0.79	-0.81	-0.75	-0.46
	Maize	20.34	2.15	4.82	0.65	23.71	30.31	0.59	0.92	-0.28	-0.73
	Oilseeds	31.81	0.73	8.86	0.1	27.85	12.93	0.13	-0.72	2.01	-0.06
	Pulses	26.82	0.83	6.54	0.09	24.39	11.67	2.15	-0.12	-1.45	8.42
Horticultural crops	Vegetables	14.43	9.15	7.40	1.48	51.28	16.26	0.32	0.24	-1.75	-1.25
	Pineapple	12.14	8.26	1.24	1.26	10.27	15.33	0.55	-0.07	-0.46	-1.33
	Citrus	6.15	6.39	3.78	1.65	61.40	1.132	0.37	1.5	-1.70	1.69
	Chilli	7.9	5.58	0.9	1.13	11.39	20.26	0.2	0.45	-0.62	-0.79
	Ginger	2.15	10.39	0.55	1.5	25.88	14.43	0.55	-0.13	-1.16	-1.70
	Turmeric	6.58	9.93	2.88	1.69	43.77	17.11	0.03	0.50	-1.86	-1.27

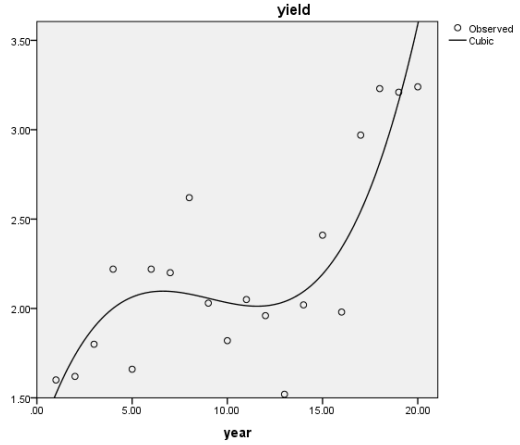
Trend Analysis

The results of trend analysis were presented in table 2 and figure 2. Here we have considered Linear, Logarithmic, Inverse, Quadratic, Cubic, Compound, Power, S, Growth, Exponential and Logistic equations. On the basis of R^2 value the best fitted models were obtained. From trend analysis it was observed that yield of rice, total oilseeds and turmeric follow a cubic polynomial trend, maize have a quadratic trend, total pulses and two fruit crops viz., citrus and pineapple follow a linear trend. Chilli and vegetables follow a compound trend.

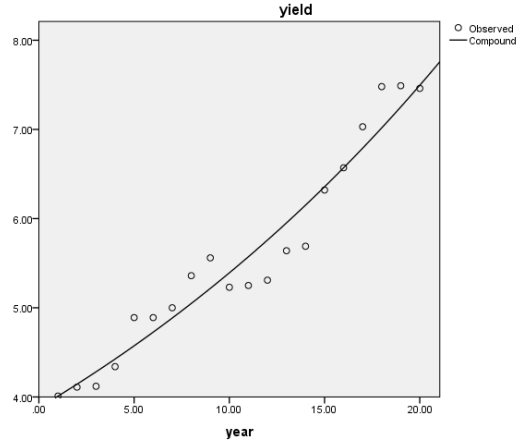
Table 2: Fitting of linear and non linear trends for the productivity of 10 selected crops in Manipur state

Name of the crops		Model	Parameter Estimates				R^2
Agricultural crops			Constant	b1	b2	b3	
	Rice	Cubic	1.238*	.321*	-.038*	.001*	.740
	Maize	Quadratic	3.659*	-.335*	.014*		.563
	Oilseeds	Cubic	.448*	.092*	-.008*	.000*	.838
	Pulses	Linear	.662*	.016*			.952
Horticultural crops	Vegetables	Compound	6.919*	1.026*			.865
	Pineapple	Linear	6.392*	.178*			.692
	Citrus	Linear	3.877*	.240*			.736
	Chilli	Compound	3.879*	1.033*			.945
	Ginger	Linear	7.831*	.244*			.926
	Turmeric	Cubic	8.660*	-.367*	.059*	-.002*	.972

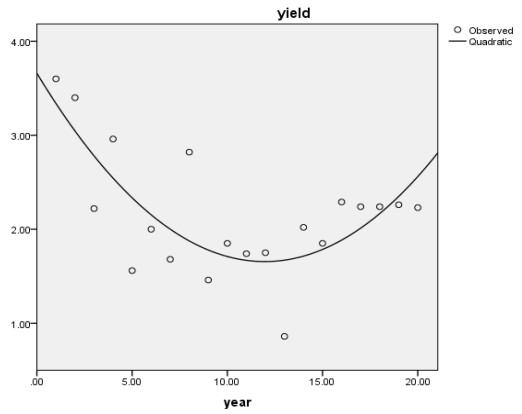
*sigificant at 5% level



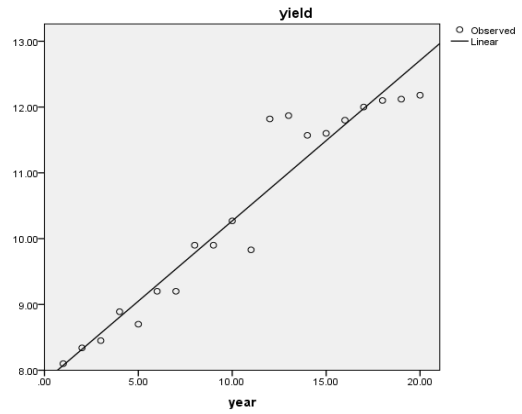
Trend fitting of Rice productivity in Manipur



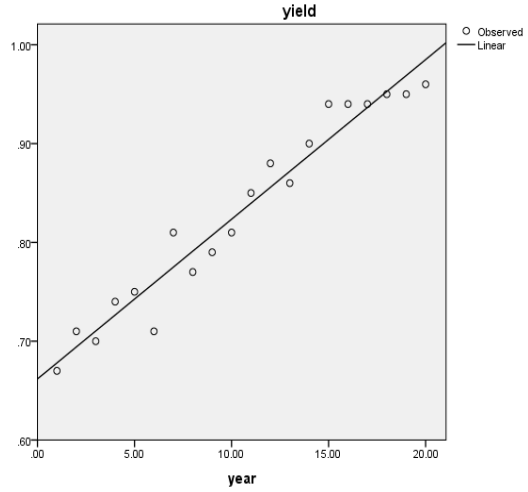
Trend fitting of chilli productivity in Manipurur



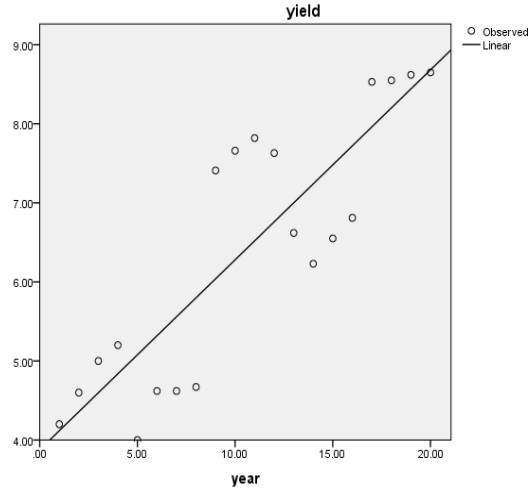
Trend fitting of Maize productivity in Manipur



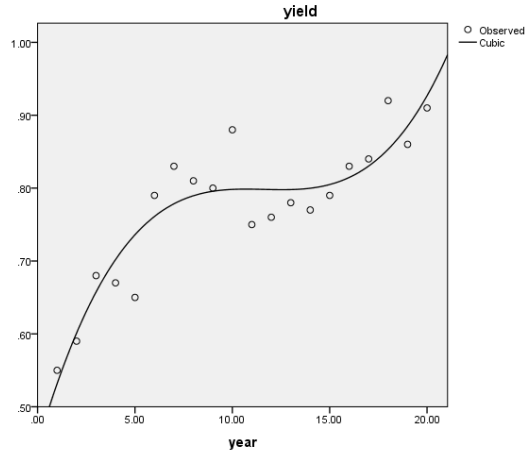
Trend fitting of ginger productivity in Manipur



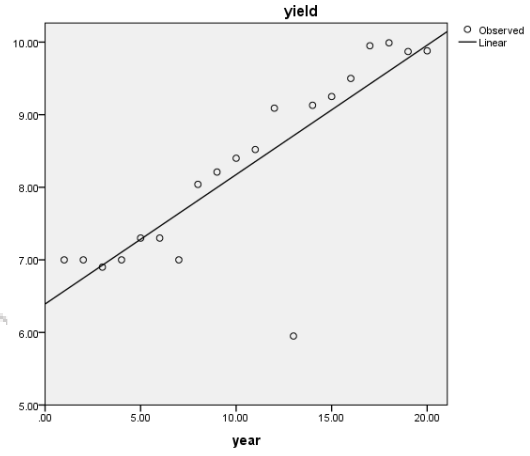
Trend fitting of total Pulses productivity in Manipur



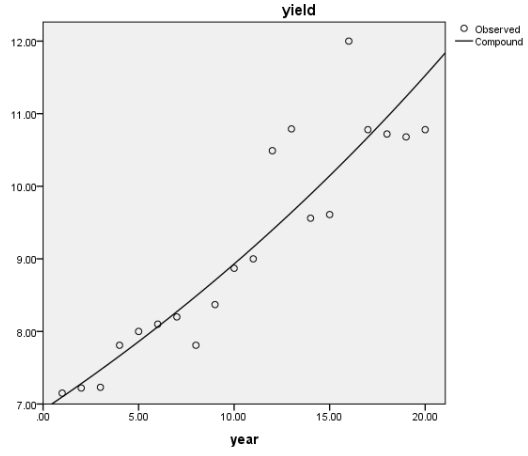
Trend fitting of citrus productivity in Manipur



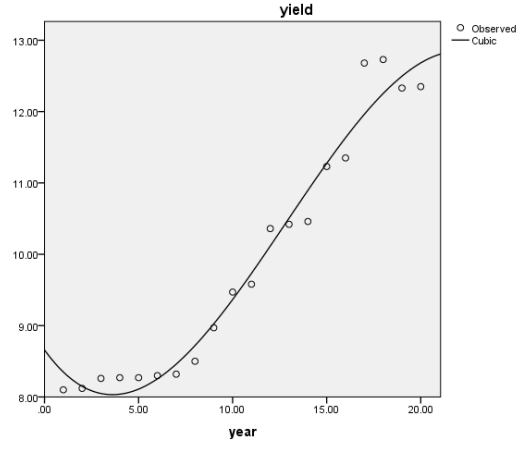
Trend fitting of total Oilseed productivity in Manipur



Trend fitting of Pineapple productivity in Manipur



Trend fitting of vegetable productivity in Manipur



Trend fitting of turmeric productivity in Manipur

Fig 2: Fitting trends for different crops productivity in Manipur state

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