CHAPTER - 2.

• RESEARCH METHODOLOGY •
Keeping in view the importance of agriculture, a quantitative assessment of the contribution of the various factors to growth at the state and district level is helpful in reorganizing the programmes and priorities of agricultural development, so as to achieve higher rate of growth. There are two main factors affecting the growth of crop output i.e. area under crop and per hectare yield (productivity) of crop, however, productivity of a crop is affected by a number of factors. These factors are Irrigated area under crop, area under High Yielding Variety Seeds, consumption of fertilizer, rainfall, cropping intensity, farm harvesting prices and agricultural implements.

We attempt to study the growth of rice during the period 1967-68 to 1988-89 in Madhya Pradesh.

2.2. NATURE AND SOURCE OF DATA :-

In order to apply the statistical methods to any type of research it is necessary that statistical data are collected. Clear decisions can only be made in terms of evidence. Collection of quantitative data is one of the ways of collecting necessary evidence for reaching clear and sound decisions. For the present study, the following data have been collected from published sources:-

(i) Area, yield and production of rice crop,
(ii) Rainfall Statistics,
(iii) Irrigated area under rice crop,
(iv) Area under HYVs of seeds,
(v) Consumption of fertilizers,
(vi) Crop intensity and;
(vii) Agricultural implements.
The principal sources of data relating to cropped area, yield and production have been derived from "Basic Agricultural Statistics", Commissioner Land Records, Gwalior, Madhya Pradesh.

Rainfall, HYV seeds area, consumption of fertilizers, crop intensity and other statistics are taken from various issues of "Agricultural Statistics", Directorate of Agriculture, Govt. of Madhya Pradesh, Bhopal.

2.3 STATISTICAL ANALYSIS

The following statistical techniques have been used in this study:

(1) Growth Rates,
(2) Coefficients of Variation,
(3) Index Numbers,
(4) Graphical Representation,
(5) Multivariate Regression Analysis,
(6) Zero Order Correlation Matrix,
(7) Student's "t" Test and
(8) Omnibus "F" Ratio.

(1) GROWTH RATES

A study of growth rates in agriculture is important in many ways: First, such a study would enable an assessment of the progress of agricultural development in terms of various components of agricultural structure and their positive and negative contribution to the growth of agriculture. Owing to differences in topography, soil, climate and weather availability between regions/districts, the development of agriculture is differ-
ent. Therefore, the knowledge of the relative performance of different regions in the past will be useful in deciding priorities for the future. Studies on growth in area, production and productivity are necessary prerequisites for suggesting the measures for improvement of a crop production.

One of the techniques used to form judgment on the growth rates i.e. a study of the end points of the series is wrong in procedure "not only because there by the measure of growth is unduly affected by the incidental or accidental circumstances of the end years but also on principle, measurement of growth over a period should take into account the entire series of observation over the period.¹" With a view to even out the annual fluctuations three year moving averages for area, production and productivity of rice crop are taken.

Even while it is agreed that the entire series of observations should be used for estimating the growth rate, there is the problem of choice of the function² which would adequately describe the series of outputs over time. The use of linear function for estimating growth of agriculture over time and to convert the linear rate of growth into a compound one, is considered in appropriate.

Exponential growth rates of area, production and yield of rice crop in selected districts have been computed to study the trend pattern. For computation of these growth rates the period of study has been divided into the following three periods :-
(A) 1967-68 to 1988-89 First Period
[Entire study period of Twenty two years].

(B) 1967-68 to 1977-78 Second Period
[First spell of eleven year duration] and;

(C) 1978-79 to 1988-89 Third Period
[Second spell of eleven year duration].

The growth rates are worked out by taking time as the independent variable and three yearly moving average value of area, yield and production of rice as dependent variable. The function chosen for this analysis is in exponential function of the form

\[ Y = AB^T \]

where,

\[ Y = \text{dependent variable} \]
\[ A = \text{slope} \]
\[ B = \text{intercept, describes the rate of change and} \]
\[ T = \text{time}. \]

Percentage Compound Growth rates (r)

It is computed by the following formula:-

\[ r = (B-1) \times 100 \]

(2) COEFFICIENT OF VARIATION

Magnitude and pattern of variability has been estimated by computing variability coefficients using the following expression :-

\[ C.V. = \left( \frac{r}{X} \right) \times 100 \]

Where,

\[ C.V. = \text{Coefficient of variation} \]
\[ X = \text{Arithmetic mean of the series} \]
\[ r \] = Standard deviation of the series.

\( X \) is computed by using the following formula

\[ X = \frac{\sum X_i}{N} \]

and \( r \) is computed by the following formula

\[ r = \frac{\sqrt{\sum (X_i - \bar{X})^2}}{N} \]

Where,

\[ \bar{X} = X_1 - \bar{X} \]

\( N \) = number of Items.

(3) INDEX NUMBERS

For getting trends of rice crop in selected districts and Madhya Pradesh as a whole, the techniques of index Number has been used in this study. " An Index Number may be described as a specialized average design to measure the change in a group of related variables over a period of time."

For computing Index Numbers the following formulae has been used:

\[ \text{Index Numbers} = \left( \frac{P_1}{P_0} \right) \times 100 \]

where \( P_1 \) = Value of Current Year and \( P_0 \) = Value of Base Year

(4) GRAPHICAL REPRESENTATION

To study the growth pattern one more technique i.e. graphical representation has also been used in the study. Simple line graphs have been drawn for the selected districts and the state as a whole. Area, yield and production of rice are
presented in one graph for each of the district and Madhya Pradesh as a whole.

(5) MULTIVARIATE LINEAR REGRESSION

(A) PRODUCTION MODEL

Production of a particular crop mainly depends upon two factors, area under the crop and per hectare yield (Productivity) of the crop. The following Bivariate Linear Regression model is used to find out the impact of different variables on production:

\[ Y = a + b_1X_1 + b_2X_2 + u \]

where, \( Y \) = production of rice crop,
\( a \) = constant,
\( b_1 \) and \( b_2 \) = elasticity of \( X_1 \) and \( X_2 \),
\( X_1 \) = area under rice,
\( X_2 \) = per hectare yield of rice and;
\( u \) = random variable.

(B) PRODUCTIVITY MODEL

Per hectare yield of a crop depends upon different factors or inputs which are used in agriculture.

The following Multivariate Linear Regression model is used to find the impact of different variables on productivity:

\[ Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + u \]

where,
\( a \) = constant,
\( b_1 \ldots b_6 \) = elasticity of concerning variable.
X1= Irrigated area,
X2= Area under HYV seeds,
X3= Estimated consumption of fertilizers(N.K.P,) during kharif,
X4= Annual rainfall,
X5= Cropping Intensity,
X6= Tractor intensity and
u= random variables.

(6) ZERO ORDER CORRELATION MATRIX

The simple coefficient of correlation between the two variables is termed as Zero Order Correlation Matrix. To study the correlation between different variables correlation matrix has been framed out.

(7) STUDENT'S "t"-TEST

The significance of different variables, growth rates and framed hypothesis has been tested by student's t test by employing the following formula :-

\[ t = \frac{b^*}{S.E.} \]

Where,

b^* = Co efficient of variable and
S.E= Standard error of b^*.

(8) OMNIBUS "F" RATIO

To examine the over all significance of regression omnibus "F" ratio has been calculate using the following formula :-
\[ \frac{R^2}{K-1} \]

\[ F = \frac{\text{-------------}}{(1-R^2)/(N-K)} \]

where,

\( K \) = number of beta coefficients(b) including intercept co-efficient,

\( N \) = number of observation in the sample and

\( R \) = co-efficient of multiple determination.

A schematic diagrammatic representation of the study is given over leaf
TEMPORAL AND SPATIAL ANALYSIS OF PRODUCTION AND PRODUCTIVITY OF RICE CROP IN MADHYA PRADESH

**OBJECTIVE-I**
To find out the trends in area, productivity and production of rice in M.P. and major rice producing dists.

**ITEM STUDIED**
1. Trends in area, production and yield of rice crop
2. Magnitude and pattern of variability

**SOURCE OF DATA**
PUBLISHED SECONDARY DATA

**ANALYTICAL TOOLS**
1. Compound growth rates
2. Coefficient of variation
3. Index numbers
4. Graphical analysis

**OBJECTIVE-II**
To examine the factors affecting rice production of rice crop in M.P. and major rice producing dists.

**ITEM STUDIED**
1. Factors affecting production: area(X1), yield(X2) of rice
2. Factors affecting yield: irrigated area(X1), HYV area(X2), consumption of fertilizer(X3), rainfall(X4), C.I.(X5), T.(X6)

**SOURCE OF DATA**
PUBLISHED SECONDARY DATA

**ANALYTICAL TOOLS**
1. Multivariate linear regression analysis
2. Zero order correlation analysis

**OBJECTIVE-III**
To suggest measures for improving rice yield in

SUMMARY, FINDINGS AND CONCLUSIONS

2. Rao, V.M. discussed all the four functional forms used for the trend equations i.e. linear, Exponential, modified trend equation and Gompertz trend equations.
