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AGRICULTURAL PRODUCTIVITY—A MICRO LEVEL STUDY OF TWO VILLAGES (MAHARASHTRA)

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ABSTRACT : An attempt is made here to study the association between productivity of four selected crops and soil characteristics and economic factors at micro level. Soil samples and related data were collected from two villages, Bhadalwadi and Kuravli differing in physical and economic aspects. Results of the correlation and multiple regression analyses reveal that nitrogen is the only significant variable influencing the productivity of jowar in both the villages. In case of bajra, economic factors are significant in Bhadalwadi. In Kuravli only nitrogen has significant correlation with bajra. Productivity of wheat is significantly related to phosphorous, nitrogen and expenditure in Bhadalwadi. In Kuravli, phosphorous, irrigation and expenditure are the important factors. Lastly, sugarcane production in Bhadalwadi is associated with nitrogen and in Kuravli with income.

INTRODUCTION

Geographers have studied agricultural productivity at different levels of observations in India. The most popular unit of observation is the district. This is mainly because data regarding agricultural productivity are not published for tahsils, villages or farms. An attempt is made here to study the agricultural productivity and associated factors at micro level by generating farm level data. For this purpose two villages Bhadalwadi and Kuravli were selected from Indapur tehsil of Pune district (Maharashtra). Bhadalwadi (total area 2183 acres and population, 536 in 1981) is located on the divide between rivers Bhima and Nira and is covered by small hills, undulating terrain with coarse, shallow and medium deep soils. Kuravli, on the other hand is located on the left bank of Nira river with very gentle slopes and deep black soil. It covers an area of 1074 acres with a population of 2190 in 1981. In Bhadalwadi about twenty percent of N.S.A. is under irrigation while in Kuravli eighty percent of N.S.A. is irrigated. Both these villages receive very low amount of annual rainfall (below 500 mm).

In order to assess the importance of various soil characteristics and economic factors in relation to agricultural productivity, information was collected using fortynine samples from Bhadalwadi and forty five from Kuravli. This information relates to the yield of selected crops, the soil characteristics (physical and chemical) of the farm and economic characteristics of the land holder. The soil samples were analysed in the laboratory. Finally, correlation and multiple regression techniques were used in order to measure the significance of the variables and their association with productivity of four important crops grown in both the villages viz. jowar, bajra, wheat and sugarcane.

The variables chosen are :

Y_1 — Yield of crops,
X_2 — pH,
X_3 — Ece (mm),
X_4 — Sand (%),
X_5 — Silt (%),
X_6 — Clay (%),
X_7 — Saturation (%),
X_8 — Nitrogen (%),
X_9 — Phosphate Kg/Ha,

X_{10} — Potassium Kg/Ha,
X_{11} — Total income generated from agriculture,
X_{12} — Family size,
X_{13} — Size of holding,
X_{14} — Number of fragments,
X_{15} — Expenditure on fertilizers,
X_{16} — Irrigated area (%).

Among the independent variables, pH, Ece, sand, silt, clay and saturation indicate the physical characteristics of the soil, while the proportions of chemical elements like N, P and K tell as about the quantity of nutrients present in the soil. Other variables are chosen to indicate the economic factors influencing agricultural productivity.

CORRELATION ANALYSIS

The correlation analysis brings out certain significant associations. These are revealed in the correlation diagram (Figs. 1.1 to 1.4). In case of jowar the only significant variable at 0.05 level is nitrogen which has a negative correlation with yield in both the villages. Other variables follow a similar trend in both the villages and are less significant (Fig. 1.1).

The diagram for bajra depicts opposite trends of variables pH, Ece, sand, silt, clay, potassium and size of holding in Bhadalwadi and Kuravli. The significant variables (0.05 level) are nitrogen, total income, fragments, expenditure and irrigation (Fig. 1.2).

Wheat is an irrigated crop. The variables phosphorous and size of farm indicate opposite trends. Potassium, expenditure and irrigation are significant at 0.01 level and nitrogen and phosphorous are significant at 0.05 level (Fig. 1.3).

Lastly sugarcane which is an entirely irrigated crop reveals opposite trends in

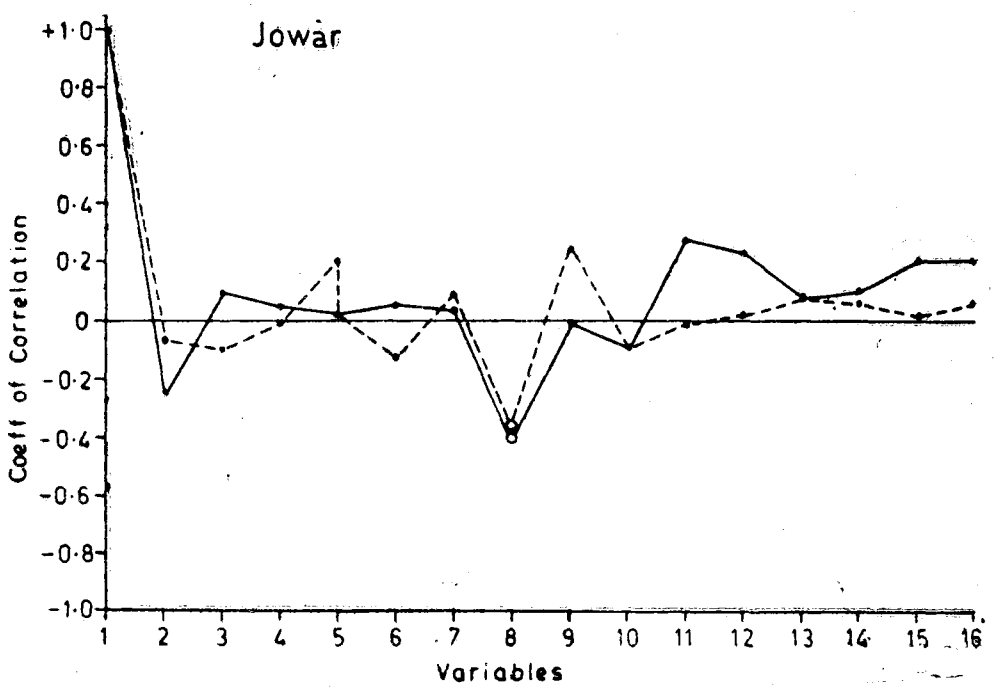

Fig. 1.1

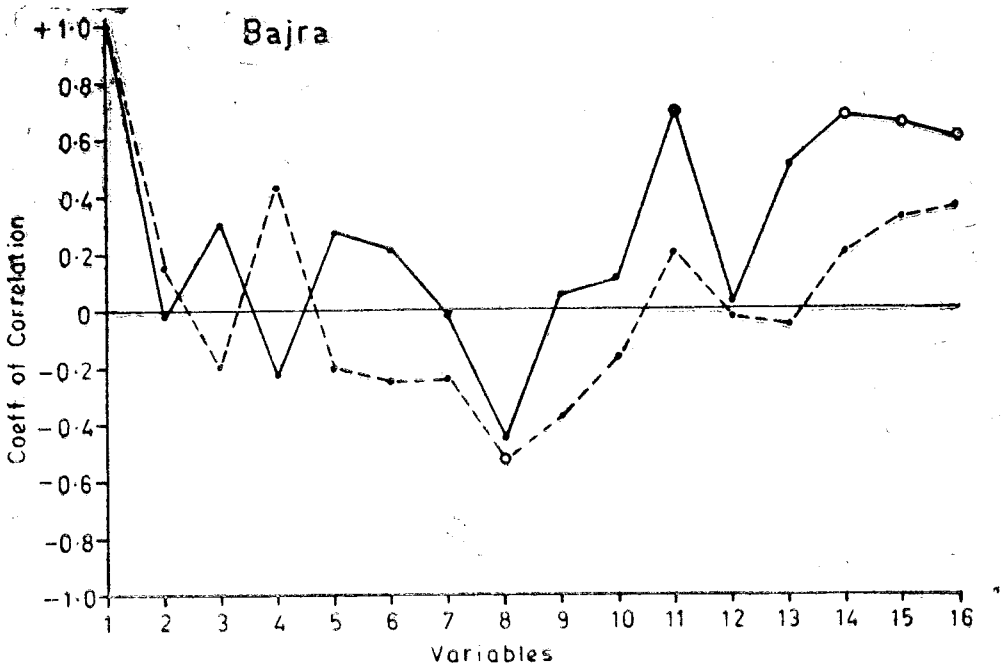
Bajra
+1·0
0·8
0·6
0·4
0·2
0
−0·2
−0·4
−0·6
−0·8
−1·0
Coeff. of Correlation
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Variables

Fig. 1.2

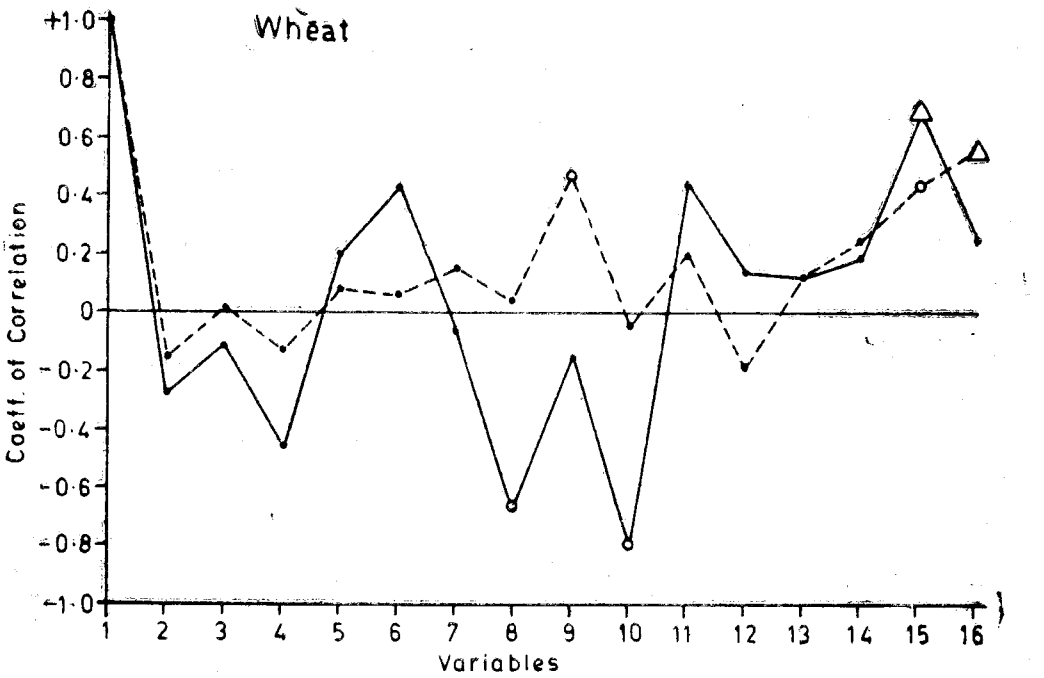
Wheat
+1·0
0·8
0·6
0·4
0·2
0
−0·2
−0·4
−0·6
−0·8
−1·0
Coeff. of Correlation
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Variables
Bhadalwadi
Kuravli

Fig. 1·3

sand, clay, income and irrigation. The significant variables are income (0.01 level) and saturation and nitrogen (0.05 level) (Fig. 1.4).

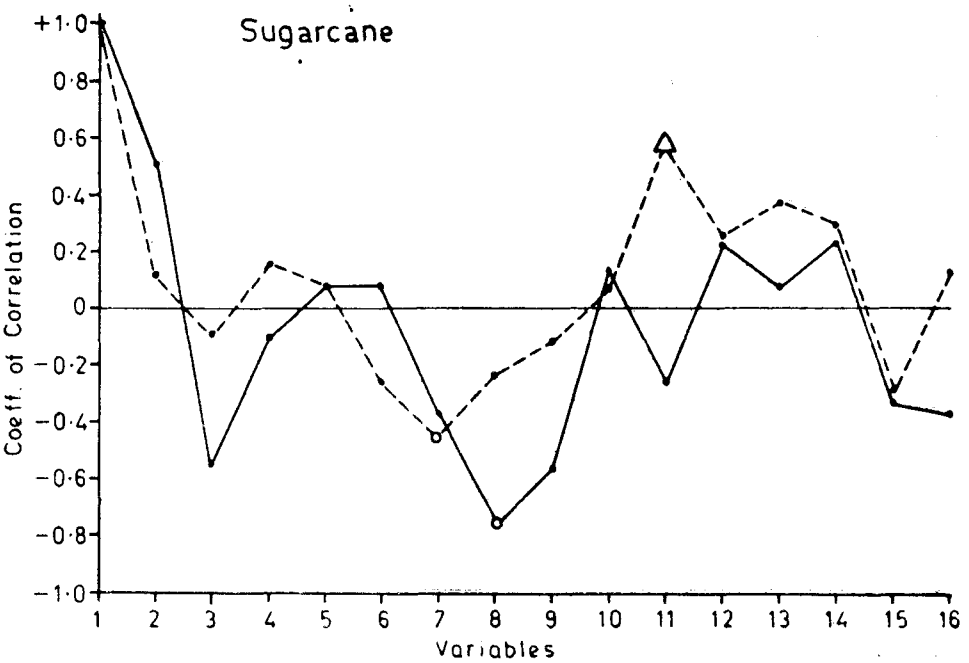

Fig. 1·4

MULTIPLE REGRESSION ANALYSIS

In this exercise in all eight multiple regression equations were derived in order to estimate the influence of physico-economic variables on the agricultural productivity in Bhadalwadi and Kuravli. The partial correlation coefficients derived indicate the inter-correlation of one independent variable with the dependent variable, with all other independent variables held constant. Thus, these coefficients indicate the relative importance of each independnent variable in explaining the total variance. The significance of individual multiple regression coefficient was tested at 0.01 and 0.05 levels of significance. Lastly the level of explained variation indicated by R^2 was calculated. The results of the analysis and regression equations are given below :

(1) *Jowar—Bhadalwadi*

$$Y_1 = 11.070 - 0.990 X_2 - 2.302 X_8 + 0.00002 X_{11} + 0.057 X_{12} + 0.0009 X_{15} + 0.001 X_{16}$$

$$R^2 = 0.317$$

Among the variables included in the regression set none of the independent variable is important at any level of significance. When other variables are kept constant the partial correlation value for percentage of nitrogen ($Y_1 . X_{8, 2, 11, 12, 15, 16}$ r =0.38) is almost significant at 0.5 level. This is followed by pH, familysize, total income, expenditure and irrigation.

The regression coefficient is negative for pH and nitrogen. Very small amount of variation (31%) is explained by these six variables listed above.

(2) *Jowar—Kuravli*

$$Y_1 = 4.908 + 0.017 X_5 - 5.051 X_8 + 0.037 X_9$$

$$R^2 = 0.232$$

Among the variables included in the regression set nitrogen appears to be the most important one which has partial correlation value significant at 0.05 level ($Y_1 . X_{8, 5, 9}$, $r = -0.41$). This is followed by phosphorous ($Y_1 . X_{9, 5, 8}$ $r = 0.23$) and silt ($Y_1 . X_{5, 9, 8}$ $r = 0.12$). The regression coefficient is negative for nitrogen. About twenty three percent of the total variation is explained by these three variables.

(3) *Bajra—Bhadalwadi*

$$Y_1 = 1.219 - 1.312 X_8 + 0.00009 X_{11} - 0.06 X_{13} + 0.358 X_{14} + 0.0037 X_{15} - 0.0311 X_{16}$$

$$R^2 = 0.8982$$

Here, expenditure on fertilizer appears to be the most important independent variable. When other variables were kept constant the partial correlation value ($Y_1 . X_{15, 8, 13, 14, 16}$ $r = 0.76$) was significant at 0.05 level. This is followed by nitrogen ($Y_1 . X_{8, 11, 13, 14, 15, 16}$ $r = -0.67$), total income ($Y_1 . X_{11, 8, 13, 14, 15, 16}$ $r = 0.56$), number of fragments ($Y_1 . X_{16, 8, 11, 13, 15, 16}$ $r = 0.47$) and irrigation ($Y_1 . X_{16, 8, 11, 13, 15, 16}$ $r = -0.53$). The regression coefficient is negative for nitrogen, size of holding and irrigation. About ninety percent of the total variation is explained by these six variables.

(4) *Bajra—Kuravli*

$$Y_1 = 3.1649 + 0.0077 X_4 - 0.005 X_6 - 1.672 X_8 - 0.0031 X_9 + 0.0031 X_{15} + 0.006 X_{16}$$

$$R^2 = 0.4814$$

None of the variables included in the regression set is significant, but the variables phosphorous with partial correlation value ($Y_1 . X_{9, 4, 6, 8, 15, 16}$ $r = -0.74$) is almost significant at 0.05 level of significance. Other relatively important variables are nitrogen ($Y_1 . X_{8, 4, 6, 9, 15, 16}$ $r = -0.70$) and expenditure ($Y_1 . X_{15, 4, 6, 8, 9, 16}$ $r = 0.57$). The regression coefficient is negative for clay, nitrogen and phosphorous. About forty eight per cent of the total variation is explained by six variables.

(5) *Wheat—Bhadalwadi*

$$Y_1 = 3.387 + 0.0055 X_4 - 1.809 X_8 - 0.0016 X_{10} + 0.0035 X_{15}$$

$$R^2 = 0.932$$

Expenditure on fertilizers and manures appears to be the most important variable with partial correlation value ($Y_1 . X_{15, 4, 8, 10}$ $r = 0.90$). This is followed by potassium ($Y_1 . X_{10, 4, 8, 15}$, $r = 0.60$), nitrogen ($Y_1 . X_{8, 4, 10, 15}$

r = 0.47) and sand ($Y_1 . X_{4, 8, 10, 15}$ r = 0.19), according to importance. Ninety three percent of the total variation is explained by these four variables.

(6) *Wheat—Kuravli*

$$Y_1 = 1.2695 + 0.045 X_9 - 0.00007 X_{11} + 0.0407 X_{14} + 0.0006 X_{15} + 0.0415 X_{16}$$

$R^2 = 0.508$

In this regression set irrigation is the most important independent variable with partial correlation value ($Y_1 . X_{16,9, 11, 14, 15}$ r = 0.47) which is significant at 0.05 level. Other relatively important variables are phosphorous ($Y_1 . X_{9, 11,14,15,16}$ r = 0.44), total income ($Y_1 . X_{11,9,14,15,16}$ r = − 0.30) and number of fragments ($Y_1 . X_{15,9,11,14,16}$ r = 0.27). Fifty percent of the total variation is explained by the five variables listed above. The regression coefficient is negative for total income only.

(7) *Sugarcane—Bhadalwadi*

$$Y_1 = - 60.122 + 11.565 X_2 + 11.978 X_3 - 43.800 X_8 - 0.186 X_9$$

$R^2 = 0.7825$

Among the variables included in the regression set none is statistically significant. Nitrogen with partial correlation value ($Y_1 . X_{8,2,X_3,9}$ r = 0.68) is very close the 0.05 significance level. This is followed by phosphorous ($Y_1 . X_{9,X_2,3,8}$ r = − 0.61), Ece ($Y_1 . X_{3, 2, 8, 9}$ r = 0.55) and pH ($Y_1 . X_{2, 3, 8,9}$ r = 0.55). Seventy eight percent of the total variation is explained by these four variables.

(8) *Sugarcane—Kuravli*

$$Y_1 = 88.9216 - 0.111 X_6 - 0.807 X_7 - 7.397 X_8 + 0.0014 X_{11} + 0.1979 X_{12} - 1.261 X_{13} + 1.511 X_{14} - 0.034 X_{15} - 0.034 Xtt$$

$R^2 = 0.6114$

Here, total income is the most important independent variable with partial correlation value ($Y_1 . X_{11,6,7,8,12,13,14, 15}$) significant at 0.05 level. Other important variables are expenditure, saturation, and size of holding. Remaining variables like clay, nitrogen, size of holding and number of fragments are less significant. In all sixty one percent of the total variation is explained by these eight variables.

CONCLUSION

The results of the correlation and multiple regression analyses bring out the importance of some variables indicating soil and economic characteristics and their association with the productivity of the selected crops.

Nitrogen (-ve) is the only significant variable influencing the productivity of jowar in both the villages as revealed by the results of correlation and regression analyses.

In case of bajra, economic factors like income, no. of fragments, expenditure on fertilizers and irrigation are significant in correlation analyses and expenditure in multiple regression analysis in Bhadalwadi. In village Kuravli nitrogen (-ve) is significant in correlation analysis but none of the variables is significant in regression analysis.

Productivity of wheat in Bhadalwadi is significantly related to phosphorous (-ve) nitrogen (-ve) and expenditure. It has significant correlationship with irrigation, phosphorous and expenditure in Kuravli according to correlation analysis. The multiple regression analysis reveals that expenditure is the only significant factor in Bhadalwadi while irrigation is important in Kuravli.

Lastly, sugarcane production in Bhadalwadi is highly associated with nitrogen (-ve) and in Kuravli with income and saturation (-ve). In multiple regression analysis none of the variables is significant in Bhadalwadi but income is significant in Kuravli.

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