Mausam, (1985), **36**, 2, 203-204

633.1 : 632.1

Crop productivity and environmental attributes in Jodhpur district of western Rajasthan

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(Received 3 May 1983)

सार — इस अध्ययन में वर्षा, औसत सापेक्षिक आर्द्रता तथा औसत तापमान के परिप्रेक्ष्य में पश्चिमी राजस्थान के जोधपुर जिले में बाजरा, खरीफी दलहनों तथा तिल की पैदावार पर विचार किया गया है। बाजरा, तिल तथा खरीफी दलहनों के अनुक्रम में उच्चतम अस्थिरता देखी गई जबकि माध्य सापेक्षिक आर्द्रता और माध्य तापमान अधिक स्थिर थे। बहुचर विश्लेषण से पता चलता है कि अध्ययन के अन्तर्गत सस्य उत्पादकता धनात्मक थी तथा उस पर वर्षा का उल्लेखनीय प्रभाव पड़ा था और बाजरा को छोड़ कर शेष फसलों पर माध्य तापमान का ऋणात्मक प्रभाव पड़ा था। माध्य सापेक्षिक आर्द्रता का सस्य उत्पादकता पर क्षीण प्रभाव था तथा निम्नस्तर पर उल्लेखनीय था। बाजरा और खरीफ की दलहन फसलों के लिए परिवर्तियों का अनुक्रम वर्षा, माध्य सापेक्षिक आर्द्रता तथा माध्य तापमान था जबकि तिलों के लिये यह अनुक्रम था, वर्षा, माध्य तापमान तथा माध्य सापेक्षिक आर्द्रता, इसलिये सस्य उत्पादकता बढ़ाने के लिये उर्वरकों तथा तापमान सहिष्णु एच. वाई. वी. बीजों के उपयोग को अधिक लोकप्रिय बनाना चाहिए।

ABSTRACT. The study deals with crop yields of bajra, kharif pulses and sesamum in relation to rainfall, mean relative humidity and mean temperature in Jodhpur district of western Rajasthan. Highest instability was observed in order to sesamum, bajra and kharif pulses, while mean relative humidity and mean temperature were more stable. Multivariate analysis showed that yield of crops under study were positive and significantly influenced by rainfall and negatively by mean temperature barring bajra crop. The mean relative humidity had weak influence on crop productivity and significant at lower level. The order of variables were rainfall, mean relative humidity and mean temperature, for bajra and kharif pulses while for sesamum order was rainfall, mean temperature and mean relative humidity. Therefore, to increase the yield of crops, technological changes like use of fertilizer and HYV seeds more tolerant to temperature should be popularized.

1. Introduction

Environmental attributes play an important role in determining the crop productivity in arid areas of western Rajasthan. Number of studies (Kalamkar and Satakopan 1940; Sharma 1964; Ram Dayal 1965; Sreenivasan 1973) have considered rainfall as one of the major environmental variables for the crop productivity. Only few studies considered other attributes like temperature and humidity (Nair and Bose 1945, Giri 1979). Apart from rainfall, humidity and temperature have also contributed substantially as supplementary independent variable in the productivity of kharif crops. This study is, thus an attempt to examine the effect of environmental attributes on the productivity of major crops when other variables remain constant.

2. Material and methods

Commensurate with the objective of the study productivity of crops under consideration was computed for last 22 years. Data pertains to Jodhpur district for a period from 1956-57 to 1977-78 were obtained from Rajasthan Statistical Abstracts. Department of Economics and Statistics, Jaipur. Data on rainfall, humidity and temperature for the growing seasons were obtained from *Daily Weather Report Bulletin*, Department of Meteorology, Pune. Temporal-variation was examined by using measures of central and dispersal tendencies.

Multivariate regression model of the following form was employed to determine the effect of environmental variables like rainfall, humidity and temperatures on crop productivity.

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + u \qquad (1)$$

where,

Y = Productivity of three selected crops (kg/ha) of the respective crops,

X_1 = Total rainfall (mm) in growing season,

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TABLE 1

Statistical attributes of related variables for Jodhpur district of Rajasthan (1956-78)

Variables	Mean	SD	CV	Range
Yield of other kharif pulses	201.52	140.36	69.65	11.00 - 446.00
Yield of bajra	163.71	124.93	76.31	12.00 - 528.00
Yield of sesamum	136.24	105.56	77.48	6.00 - 328.00
Rainfall (X_1)	348.06	159.45	45.81	199.00 - 640.60
Relative humidity (X_2)	64.86	5.91	9.11	56.00 - 74.00
Mean temperature (X_3)	30.17	0.95	3.14	28.70 - 32.00

TABLE 2

Regression coefficient standard error and coefficient of determinate of

Name of crop	Regression coefficient X_1	X_2	X_3	R^2
Other kharif pulses	0.4060*** (0.1390)	6.9853* (4.4614)	—91.4051** (33.3556)	0.7102
Bajra	0.7255**** (0.1658)	6.0718** (3.0957)	—1.1156 (24.1447)	0.8239
Sesamum	0.5469**** (0.1111)	1.5973 (2.0738)	—27.7545*** (12.5049)	0.8893

****Significant at 1% level of signifcance,

***Significant at 5% level of significance,

**Significant at 10% level of significance,

*Significant at 20% level of significance.

TABLE 3

Results of step (up)-wise regression

Crop	Contribution of variable	R^2	Rate of increment	F-value computed
Other kharif pulses	X_1	0.2578	—	6.5996
	$X_1 X_2$	0.4076	0.1498	6.1924
	$X_1 X_2 X_3$	0.7102	0.3026	13.8870
Bajra	X_1	0.5417	—	22.4576
	$X_1 X_2$	0.6294	0.0877	15.2849
	$X_1 X_2 X_3$	0.8239	0.1945	26.5120
Sesamum	X_1	0.6275	—	32.0067
	$X_1 X_3$	0.7505	0.1230	27.0721
	$X_1 X_3 X_2$	0.8856	0.1351	43.8671

X_2=Mean humidity (%) in growing season,

X_3=Mean temperature (°C) during the growing season,

u=Random variable.

In order to estimate the relative contribution of different variables individually and jointly in all possible combination in productivity performance of crops under study, step (up) wise regression analysis was employed.

3. Results and discussion

Statistical attributes : The kharif pulses have higher mean yield followed by bajra and sesamum. Mean relative humidity and mean temperature were more stable than mean rainfall. While in case of productivity of crops, maximum instability was observed in sesamum followed by bajra and kharif pulses (Table 1).

The estimated regression equation revealed that value of R^2 ranged from 0.8893 in sesamum crop to 0.7107 for kharif pulses. This indicates that the independent variable under consideration had adequately explained the variance in productivity of different crops to the tune of 89,82 and 71 per cent respectively for sesamum, bajra, and kharif pulses. Further, it is revealed that rainfall has exerted positive and significant influence on productivity performance of bajra, kharif pulses and sesamum whereas relative humidity influenced the crop productivity to only bajra and kharif pulses positively and significantly. Similarly temperature has exerted negative effects on productivity of different crop under consideration. But the statistical significance was only noted for kharif pulses and sesamum. It can thus be inferred that higher the temperature during crop growing period more the adverse effect on crop productivity while other, variables like rainfall and humidity showed positive relationship with crop productivity in the district (Table 2).

The results of step (up) wise regression analysis revealed that rainfall (X_1) explained the maximum proportion of variance in crop productivity of kharif pulses and bajra followed by percentage humidity and temperature. But in the sesamum the maximum proportion was explained by rainfall, followed by mean temperature and humidity. A study of R^2 showed that humidity caused a marginal increase in R^2 for bajra crop other variables indicated a clear cut increase in R^2 (Table 3).

4. Summary and conclusions

From the foregoing discussion, it may safely be concluded that yield of crops are influenced by rainfall positively and negatively by mean temperature barring bajra crop. The effect of mean relative humidity was weak as compared to other variables under consideration. The rainfall exerted a considerable influence on productivity of all the crops while mean relative humidity in kharif pulses and bajra. Temperature showed negative effect on crop productivity in case of all crops under study. Crop productivity was directly proportional to the rainfall and relative humidity in the district.

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