"AN ASSESSMENT OF IMPACT OF DROUGHT ON PER HECTARE YIELD OF SUGARCANE IN MAHARASHTRA"

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Abstract:

The phenomenon of draught as natural hazard is not new to Indian agriculture, especially in the areas of marginal rainfall. Drought means "Annual precipitation is 75 per cent or less of normal precipitation and monthly precipitation is 60 per cent or less of normal monthly precipitation. There are number of consequences of drought. Direct impacts of drought include reduced crop, rangeland, and forest productivity. drought decreases per hectare yield of crops considerably, which affects on economic condition of farmers. Therefore attempt is made here to assess the impact of drought on sugarcane production in Maharashtra. The paper is mainly based on primary data sources. To examine the impact of decrease of rainfall due to drought on decrease of per hectare yield of sugarcane the coefficient of correlation, Coefficient of determination and regression equation technique of has been employed. The study reveals that decrease of one percent rainfall from normal causes for decrease of 0.728 percent per hectare yield of sugarcane in Maharashtra.

Key wards: drought, Rainfall, Per hectare yield of Sugarcane, Correlation, regression.

Introduction:

The phenomenon of draught as natural hazard is not new to Indian agriculture, especially in the areas of marginal rainfall. Droughts are usually defined as "period of dryness due to lack of rain", though the concept of droughts varies from place to place and time to time depending upon normal climatic conditions, available water resources, land use, agricultural practices and various other economic activities of the region. Bates (1935) defined that Drought means "Annual precipitation is 75 per cent or less of normal precipitation and monthly precipitation is 60 per cent or less of normal monthly precipitation. According to J. C. Hoyt (1936) drought means annual monthly rainfall less than 85 per cent of normal rainfall (Savindra Singh, 1998). According to U.S Weather Bureau –Drought is as lack of rainfall so great and long continued as to affect injurious the plant and animal life of a place to deplete water supplies both for domestic purpose and for the operation of power plants, especially in those regions where rainfall is normally sufficient for such a purpose (Navale,-2007). Drought remains till now as meteorological phenomena. This does not only occur depending on the annual rainfall, but also due to erratic spatial distribution of rainfall, seasonal concentration, availability of irrigation facilities, topography, socio-economic factors etc.(Patnaik & Routary,1983).

Direct impacts of drought include reduced crop, rangeland, and forest productivity, increased fire hazard, reduced water levels, increased livestock and wildlife mortality rates, and damage to wildlife and fish habitat. The consequences of these direct impacts illustrate indirect impacts. Many economic impacts occur in agriculture and related sectors, because of the reliance of these sectors on surface and groundwater supplies. In addition to losses in yields in crop and livestock production, drought is associated with insect infestations, plant disease, and wind erosion. Therefore it is hypothesized that higher the decrease of rainfall, more is the decrease of per hectare yield. In drought year production of crops decreases considerably particularly production of cash crops such as sugarcane, fruits and vegetable oilseeds, which resulted into poor economic condition and further suicide of farmers. Therefore attempt is made here to assess the impact of drought on sugarcane production in Maharashtra.

The Study Region:

The Mahrashtra lies in Southern part of India, which is a one of the advance States in the country. Absolute location of State is 17^0 45' to 21^0 6' North Latitude and 72^0 16' to 72^0 36' East longitudes. The adjoining States are Gujarath and Madyapradesh to it's North, Chhattishgad to it's East, Andra Pradesh , Karnataka and Goa to it's south, Arebian sea to it's Weast. The State is divided into 35 districts for administrative purpose. The geographical area of State is 307762 square Kilo meters, and it ranks fifth in area in the country. Out of total geographical area 92 per cent is under cultivation. The Maharashtra state has three brad physical divisions i.e. The Konkan Coast land, Westwrn Ghat and Plateau region. The Kokan coast land is characterized by rocky headlines and small crescent- shaped beaches. It is intersected by creeks and rivers. Western ghat runs a long chain of lofty hills for a stretch of 400 Kilometers. Thease have average elevation of about 800 to 1300 meters above mean sea level. The Plateau region have average height about 900 meters. The elevation of central portion is in between 300 to 400 meters (Sharama,2004). The State has wet and warm climate in western part, hot and dry climate in remaining part with an average annual rainfall ranging from 400 to 6000 mm. The population of state is 115997674. The occupational structure of state indicates that the agriculture is the main occupation of people in the State.

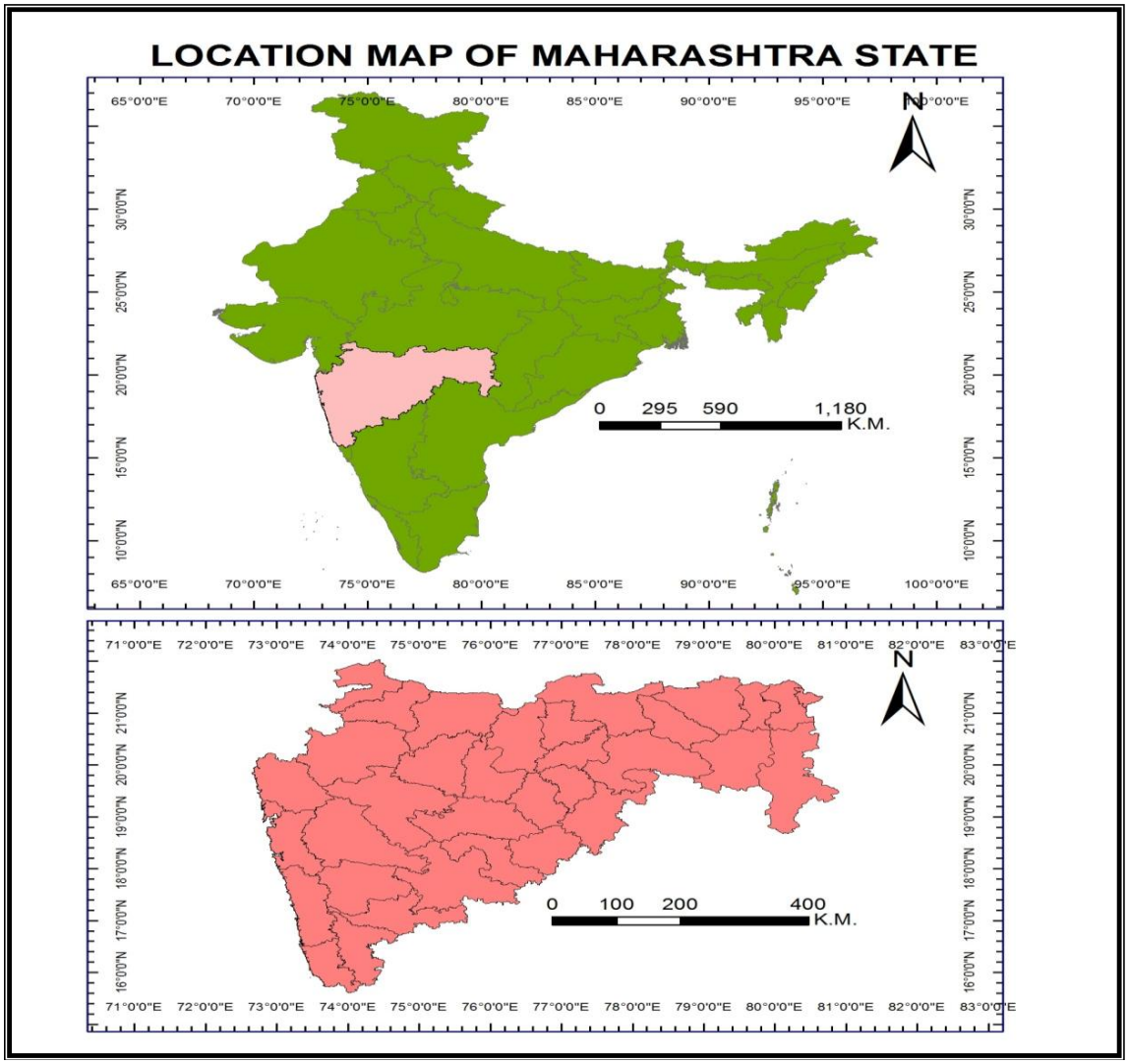

Figure-1

Objectives:

The main objective of this paper is to examine the impact of decrease of rainfall on the per hectare yield of sugarcane in the drought year 2012-13 and to estimate the rate of change of decrease in per hectare yield of sugarcane in relation to decrease of rainfall.

Data collection and Methodology:

In order to meet these objective the relevant information and data regarding Normal rainfall, rainfall of 2012 are collected from http://www.mahaagri.gov.in/rainfall/index.asp, the data regarding per hectare yield of sugarcane of drought affected districts of

Maharashtra are collected from Ministry of Agriculture, Government of India, and Department of Agriculture, Government of Maharashtra and used for the year of 2007-07 to 2012-13 are mainly based on secondary sources. After data collection, the data is processed. To calculate normal per hectare yield of sugarcane as well as to avoid fluctuation and to get reliable result the five years average of per hectare yield of sugarcane in normal period i.e. 2007-08 to 2010-11 is taken into consideration. District is taken as the basic unit of investigation. Information regarding physiography and drainage collected from Gazetteers of Maharashtra.

After the collection of data different statistical techniques have been employed. To examine the impact of decrease of rainfall in drought year on decrease of per hectare yield of sugarcane the Karl Pearson coefficient of correlation technique of has been employed.

The functional form of linear relationship has been measured by using regression equation 'Y' on 'X' i.e. Y = a + bx. The rate of change in dependant variable has been estimated with the help of 'b' coefficient, which is the line of best fit. The 'T' test is used with the view to understand the confidence level. The analysis of the study has been made with the help of the statistical techniques and on the basis of this techniques result and conclusions are drawn.

Decrease of rainfall and per hectare yield of Sugarcane in Drought year in Maharashtra:

The table-1 indicates that the rainfall is decreased in the all ten districts of Maharashtra ranging in between 3.6 and 52.9 percent to normal rainfall in drought year of 2012. The high decrease of rainfall from normal rainfall is found in Aurangabad, Jalna, Beed, Osmanabad, and jalgaon districts i.e above 34 per cent of normal rainfall.

Table-1 Decrease of Rainfall and per hectare yield of Sugarcane from normal in drought year (2012-13) in Maharashtra.

District	Normal rainfall	Rainfall in 2012	2012 as % of Normal	decrease of rainfall in % to Normal	Average Per Hectare Yield	PHY 12-13	2012-13 as % of Normal of PHY of Sugarcane	decrease of PHY of S in % to Normal
Ahmednagar	497.1	383.3	77.1	22.9	81.3	71	87.37	12.63
Pune	830.1	676.6	81.5	18.5	93.7	101	103.4	-3.4

Solapur	559.7	412	73.6	26.4	88.6	67	75.62	24.38
Aurangabad	675.3	368.8	54.6	45.4	80.8	43	53.21	46.79
Jalna	688.1	324	47.1	52.9	75.5	63	83.5	16.5
Beed	668.5	434.9	65.1	34.9	79.8	55	68.91	31.09
Latur	788.6	760	96.4	3.6	65.1	66	100.96	-0.96
Osmanabad	741.7	390.6	52.7	47.3	72.4	43	59.38	40.62
Nashik	1073.9	863.4	80.4	19.6	76.5	76	99.37	0.63
Jalgaon	702.9	404.6	57.6	42.4	70.1	63	98.41	1.59

Source: Compiled by Authors based on http://www.mahaagri.gov.in/rainfall/index.asp, Ministry of Agriculture, GOI, and Department of Agriculture Maharashtra Govt.

The medium decrease is recorded in the district of Ahmadnagar, Solapur and Nashik districts ranging from 19 per cent to 34 per cent of normal rainfall, where as it is low in Pune and latur district i.e. below 19 percent. Considering decrease of per hectare yield of sugarcane from normal the high decrease of per hectare yield is recorded in Aurangabad, Beed, and Osmanabad Districts i.e. above 31 per cent from normal per hectare yield. The moderate decrease is registered in the district of Solapur and Jalana ranging from 16 to 31 per cent, while it is low in Ahmadnagar, Nashik and Jalgaon district. The table 1 also indicates that per hector yield of sugarcane is decreased as per decrease of rainfall but there are some exceptions that the district those have high decrease in rainfall but decrease in per hectare yield from normal is low. The table also indicates that there are some districts that have high per hectare yield than normal in drought year.

In the context of objective the following findings have come to light.

1) The positive relationship between the decrease of rainfall (X) and decrease of per hectare yield of Sugarcane (Y) has been observed in the Maharashtra. The coefficient of correlation in this regard is at r = + 0.63088. It indicates that the moderate positive relationship between the variables 'X' and 'Y'. The degree of linear association between these two variables obtained by using the coefficient of determination (r2) is found to be at 0.39802, which reveals that the independent variable (X) i.e. the decrease of rainfall are explaining 39.80 percent of the total variations in dependent variable (Y) i.e. the decrease of per hectare

yield of Sugarcane of farmers in the drought affected districts of Maharashtra. It is a good explanation because more than 39 percent of the variations in (Y) decrease of per hectare yield of Sugarcane to be influenced by the variable (X) i.e. decrease of rainfall and about 60.2 per cent of the variation is left to be influenced by other variables i.e. variation in assurances of irrigation facilities, variation in soil type, variation in use of fertilizer, variation in types of seeds and variation in precaution of farmers.

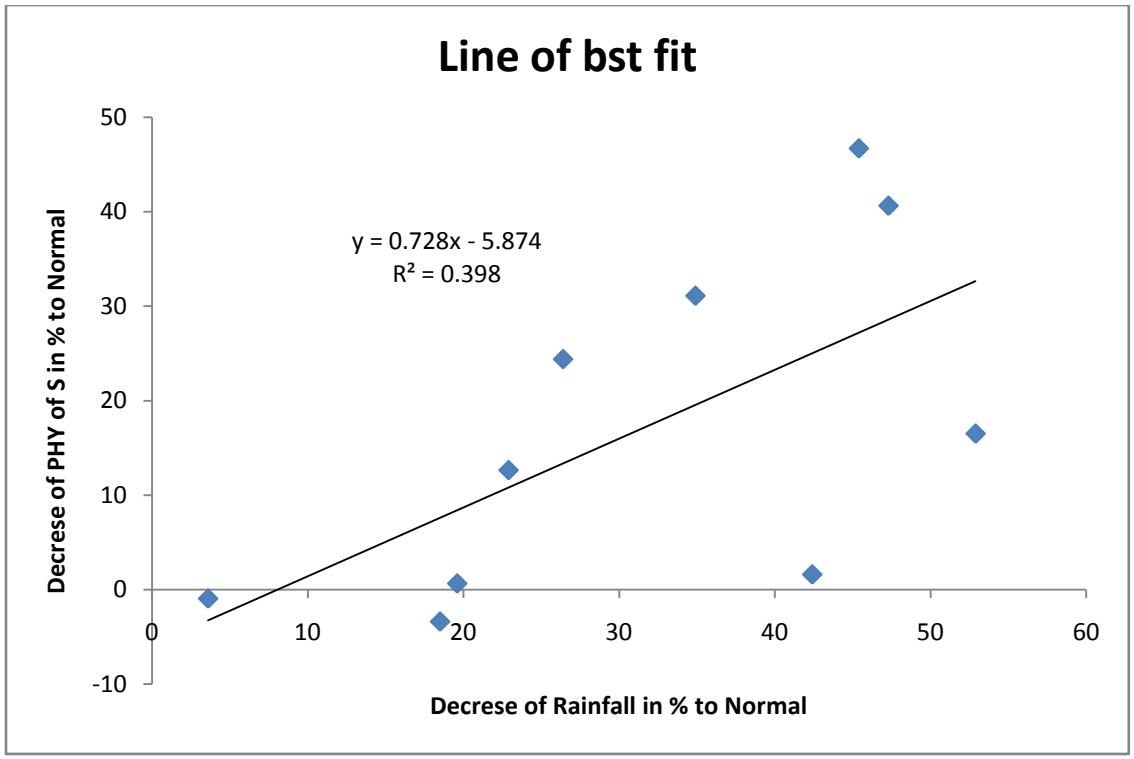

Figure-2

2) The functional form of linear relationship computed through the regression equation of Y on X found to be at Y = -5.874 + 0.728x. The line of best fit is shown in the figure-2. The regression coefficient indicates that decrease of 1 per cent rainfall causes for decrease of 0.728 percent per hectare yield of sugarcane from normal per hectare yield. By testing the significance of regression coefficient (a test of significance), the validity of this causal relationship has been confirmed,

The equation used $t = (b-\beta)\sqrt{(n-2)\Sigma(Xi-\bar{X})^2} \div \Sigma (Yi-yi)^2$

The calculated value of 't' in this exercise is found at 7.26. It is observed that this calculated value is higher than the tabulated value of 't' (3.36) at the 8degree of freedom

(df = n –2, where 'n' is 10) even at 1 per cent level of significance.

3) In order to understand the degree of fit of regression equation and the accuracy level of predicted values (y) for the district of Maharashtra the standard error (SE) of estimate is being done with the equation SE (Y) = SY √1-r2, where SE (Y) is the standard deviation of residuals (Y-y); and 'SY' is the standard deviation of 'Y'.

The confidence interval of the predicted values are worked out at Y = Y ± SE (Y) (The SE (Y) for the present exercise is 14.06 and SY is the 18.123). Thus it is assumed that if the values of 'Y' (Y-y) lie within the range of Zero to ± SE, the prediction could be expected to be accurate. In other words, the role of independent variables in explaining the change in dependent variable can be accepted as correct.

Table -2 Residuals from regression of percentage of decrease of per hectare yield of sugarcane from normal yield.

Districts	Y	y	Y-y
Ahmednagar	12.63	10.80	1.83
Pune	-3.4	7.59	-10.99
Solapur	24.38	13.35	11.03
Aurangabad	46.69	27.18	19.51
Jalna	16.5	32.64	-16.14
Beed	31.09	19.53	11.56
Latur	-0.96	-3.25	2.29
Osmanabad	40.62	28.56	12.06
Nashik	0.63	8.39	-7.76
Jalgaon	1.59	24.99	-23.40

Source: Compiled by Researcher on the basis of Ministry of Agriculture, GOI, and Department of Agriculture Maharashtra Govt. and used for the year of 2007-08 to 2012-13

In this context it has been observed that the predicted values (given in table- 2) of 07 districts out of 10 districts in the present study lie within the range of ± SE, and 3 within ± SE to ± 2 SE. Now the obvious inference is that the 70 per cent of the total number of observation (n is 10) the regression is a good indicator meaning there by that the variations of percentage of decrease of per hectare yield of sugarcane

from normal is the function of the variations of percentage of decrease of rainfall from normal. In the case of other districts with residuals between > ± SE to ± 2 SE the situation is different because here the regression is a poor indicator. It clearly indicates that these are the districts whom the influence of variables other than the independent one. The variations of decrease of per hectare yield of district in the latter case may be due to the variation in assurances of irrigation facilities, variation in soil type, variation in use of fertilizer, variation in types of seeds and variation in precaution of farmers.

Conclusions:

This study reveals that there is medium positive correlation between decrease of rainfall and decrease of per hectare yield of sugarcane in Maharashtra in drought prone year. The coefficient of determination reveals that the independent variable (X) i.e., the decrease of rainfall are explaining 39.80 per cent of the total variations in dependent variable (Y) i.e. the decrease of per hectare yield of sugarcane of drought affected district in the Maharashtra. It is a good explanation because more than 39 percent of the variations in (Y) decrease of per hectare yield of sugarcane to be influenced by the variable (X) decrease of rainfall and about 60.2 percent of the variation is left to be influenced by other variables i.e. in assurances of irrigation facilities, variation in soil type, variation in use of fertilizer, variation in types of seeds and variation in precaution of farmers. The percentage of decrease of rainfall is found to be effective than the other variables considering decrease of percentage of per hectare yield of sugarcane from normal. It is found that decrease of one per cent rainfall from normal causes for decrease of 0.728 per cent per hectare yield of sugarcane from normal in drought affected districts of Maharashtra. Therefore public awareness should make regarding artificial recharge, use of drip irrigation and other means of water saving in the society to maintain per hectare yield of sugarcane.

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