e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.11, Nov.2022

AGRICULTURAL PRODUCTION REDUCES WITH INCREASE IN RAINFALL VARIABILITY IN DHULE DISTRICT MAHARASHTRA.

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Abstract

Economically, developing region like Dhule district mainly depends on climate sensitive activities such as agriculture for their livelihood and are particularly vulnerable to rainfall variability. Rainfall variability affects the production of traditional crops like Jowar, Bajara, Maize, Cotton, Oilseeds, Pulses crops, increases crop diseases incidence and causes drastic reductions in soil fertility. It has been reported; in many parts of the country that rainfall variability has been attributed to changes in production or will be responsible for future change in agricultural production dynamics. It is also observed that, in general, short rainy seasons and much more variable rainfall periods between June and September. The threat of food insecurity has increased as a result of the phenomenon of rainfall variability among many farm communities. Seasonal rainfall variability has a profound effect on soil moisture, availability especially for the crop production. Overall, the soil moisture reduces with high rainfall variability in the agricultural region like Dhule district where rainfed agriculture is predominant. In recent years, it is seen that in Dhule district, minor rainy seasons have become much drier and shorter which are unfavourable for agricultural development in the region. The crop production in the study region is predominantly rainfed, exposing this major livelihood activity to the variability or change in rainfall pattern. Generally, the effect of the amount of rainfall and variability on crop production varies with types of crops cultivates, types and properties of soils and climatic conditions of a given area.The fluctuations in amount of annual rainfall and their impact on yield of major crops have been studied in the present work

Keywords:.Rainfall variability, rainfed agriculture.

INTRODUCTION:

The abnormal pattern of rainfall over the past few years has caused great fluctuations in crop production. The performance of crops is directly related to rainfall received during the rainy season. The area under rabbi crops may be reduced due to low rainfall and early retreating monsoon season. The effects of rainfall on agriculture are obvious. According to Ayoade (2004), water in all its forms plays a vital role in the growth of plants and the production of all crops. It provides the medium by which food and nutrients are carried through the plant. All the climatic parameters affecting crop production and yield, moisture is the most important (Hodder, 1980). Moisture is primarily gotten from rainfall which is cyclic and fairly dependable (Ezedinma, 1986)

It is also seen that rainfall variability is maximum in the scanty rainfall zone, particularly central and southern part of Dhule district. It is also important to note that there is close association of rainfall variability with agricultural production. In other words, agricultural production reduces with increasing rainfall variability. Based on the past experiences of the farmers of the study region, the agricultural production is hampered with high rainfall variability of that particular year. For example, short duration crops like green gram, black gram, cowpea, are highly affected and their yield has been reduced considerably and it is also noticed that red gram, mat bean (Matki) and yields of other food crops like Jowar, Maize are reduced about 20% to 50% due to moderate to high rainfall variability in Dhule district

STUDY AREA

Dhule district is located in the northern part of Maharashtra state spread between 20 ^{0} 38'N to 21^{0}39'N latitudes and 73^{0} 50'E to 75^{0}13' E longitudes (Fig: 2.1)It encompasses an area of 8061sq.km. It covers Survey of Indiadegree topo sheet Numbers 46G, H, K, L and O. It is bounded by Nemad District of Madhya Pradesh state to the north, Jalgaon District to the east, Nandurbar District to the west and northwest Dang and Surat district of Gujarat State to the west.

Climate

Climate is one of the principal aspect of the natural environment that affects basically the life and economy of the people in any region. It denotes the average weather condition for long period of time of a particular region. The important weather elements that influence the climate of a particular region are solar energy, temperature, precipitation, wind direction and velocity, relative humidity and evaporation. The distribution

and intensity of these elements are greatly influenced by latitudinal extent, insolation, altitude, physiography, water reservoirs, distance from the sea coast etc. The climate varies from region to region due to variations of these factors. The climate plays a significant role in soil formation. Both, climate and soil together have a paramount influence on the type of farming practices in a particular region. Climate determines the quality and quantity of the agricultural production on a large extent. Temperature and rainfall is an important element of climatic condition which influence agricultural land use in a region. Each and every crop requires specific temperature for its successive growth. The temperature is not a big issue in respect of agricultural activities. But the amount and distribution of rainfall is most significant of during growing season but sometimes long duration of dry spells or wet spells during south-west monsoon season is the cause of crop failure which ultimately reduces crop yield per hectare in the concerned areas. Therefore there is close association between climate and yield of crops.

OBJECTIVES

Objectives of the present study are:

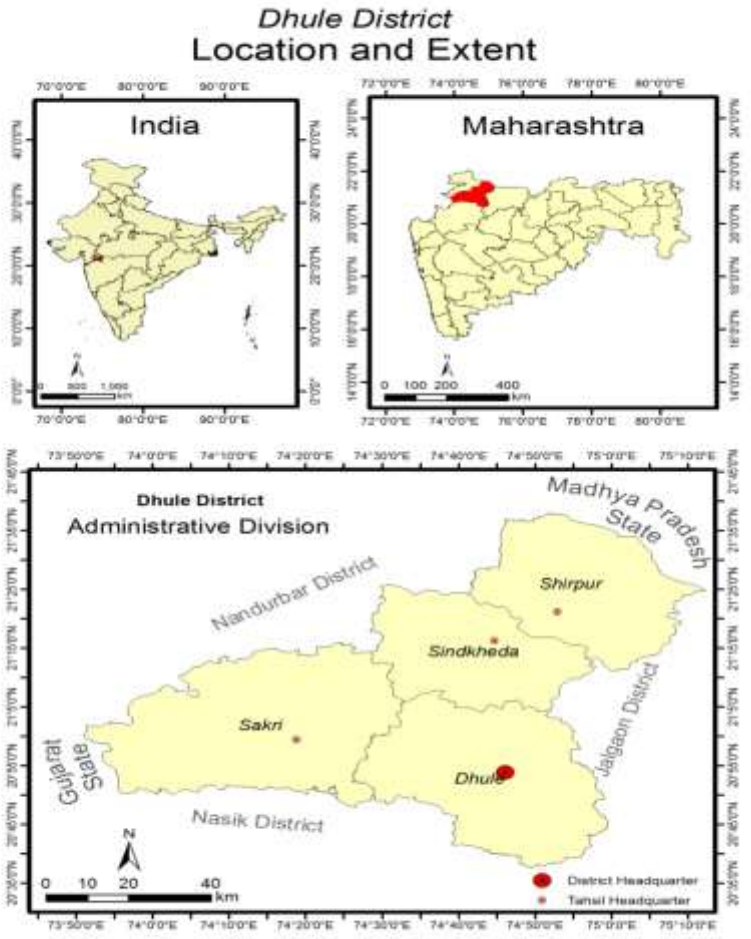
a) **To Know Rainfall variability and its adverse impact on agriculture**

ii) To Know **Impact of Fluctuation of Rainfall on Production of Rainfed Crops**

DATA BASE AND METHODOLOGY

For the present work, huge amount of numerical data regarding agricultural resources are being obtained from the secondary sources like District Census Handbooks, Tahsil records, Socio-economic Reviews etc. However, circle-wise data are procured from circle offices. Secondary data regarding agriculture and climatic elements are acquired from www.mahaagri.com.

To get detailed information about the climate of the study region, Spatio-temporal variation of weather elements have been studied which are necessary for the study of problems regarding agriculture. The data concern with rainfall, temperature, humidity has been collected from Indian Meteorological Department, Pune and college of agriculture, Dhule..



RESULTS AND DISCUSSION

.Rainfall is the major source of water which is essential for growth and development of crops, it can be excess, sufficient, scanty and untimely. Only the total amount of rainfall occurred in a season is not the criteria but its distribution over an area is critical. Heavy rains directly damage plants on impact or interfere with flowering and pollination. Also the top soil layers are hardened which prevents or delays emergence of germinating seeds.

Scanty rainfall can be synonym with "inadequate rainfall" or 'drought'. The influence of drought can be observed in many ways. Such as water limitation from seedling emergence to the maturity an all the cereals is very damaging. Water stress or drought condition during flowering reduces the size of inflorescence and finally has adverse effect on fertilization, grain filling and yield. Crops show wilting symptoms, Drought also affects nutrient absorption and reduces crop yield. Shading of leaves, fruits and seeds can be induced by plant water deficit during drought conditions.

Untimely, occurrence of rainfall is not favourable in respect of agricultural development. It refers to rainfall received too early or too late with high variability during the cropping season which result that normal agricultural operations are disturbed. Too early rains do not permit proper preparation of seedbed due to heavy rains. On the other hand, too late rains delay sowings and pest attack cause huge losses in crop production. Torrential rain occurred during flowering and harvesting stage, results in poor fertilization and subsequent loss in crop yield.

The sufficient amount of rainfall received with low variability during cropping season is favourable for obtaining better crop yield in that particular year, but unfortunately, such phenomenon occurs rarely in drought-prone region like Dhule district.

Agricultural production is affected by uncontrolled climatic factors, among them rainfall is a major factor, plays a vital role and proves as resource in crop production. The amount and temporal distribution of rainfall is generally the single most important determinant of rainfall in crop production. Rainfall in much of the country is, on the other hand often erratic and unreliable; and rainfall variability and associated droughts have historically been major cause of food shortages, famines (Wood, 1977, Pankhurst and Johnson, 1988). Impact of rainfall on crop production can be related to its total seasonal amount or its intra-seasonal distribution. The drought conditions with very low total seasonal amount of rainfall, crop production suffers the most. But more subtle intra-seasonal variations in rainfall distribution during crop growing periods, without a change in total seasonal amounts, can also cause substantial reductions in crop yields. Generally, the effect of the amount of rainfall and variability on crop production varies with types of crops cultivates, types and properties of soils and climatic conditions of a given area.

The fluctuations in amount of annual rainfall and their impact on yield of major crops have been studied in the present work.

1) Jowar

There is positive correlation between the annual rainfall and the yield of Jowar in the study region (fig 1). But this correlation is very low i.e.r=0.167. The line graph 4.4.a reveals that the yield per hectare of Jowar was increasing or decreasing according to the amount of rainfall received during growing season of Jowar in that particular year. Maximum yield of Jowar was observed in the year 1998-99, 2001-02, 2003-04 and 2006-07 when there was increasing trend of annual rainfall. But there is negative correlation noticed in the years 2010-11, 2013-14 and 2016-17. During these years, the low amount of rainfall recorded but the yield of Jowar is considerably increased. This indicates that rainfall variability may be low and other factors are also responsible for this trend. On the other hand, minimum yield of Jowar was in the years 1997-98, 1999-2000, 2000-2001, 2002-03, 2004-05, 2005-06, 2007-08, 2008-09 and 2015-16 in the district when there was less rainfall during the growing season.

Overall, the yield of Jowar increasing or decreasing is depended on the fluctuations in the amount of annual rainfall during the growing season. It is also important to note that intra- seasonal variations in rainfall distribution during crop growing period can also responsible for substantial reductions in yield of Jowar.

2) Bajara

Correlation between yield of Bajara and annual rainfall was similar as that of Jowar i.e. positive. The increasing or decreasing trend in the yield was influenced directly by the amount of rainfall an area received during the growing season of Bajara. The maximum yield was recorded in the year 2010-11 when there was less amount of rainfall. In the years 2000-2001,2002-03, 2005-06, 2008-09, 2009-10, 2013-14 the yield of Bajara is decreased according to occurrence of rainfall during the growing season of Bajara. The negative correlation between yield of Bajara and annual rainfall is observed during the years 1999-

2000, 2007-08, 2008-09, 2010-11, 2012-13, 2013-14, 2014-15 and 2016-17 because Bajara is the drought resistance crop.

Table 4.4 Annual Rainfall and Yields in kg./hectare of selected crops in Dhule district from 1996-97 to 2016-17

Year	Annual Rainfall(mm)	Jawar	Bajara	Maize	Red gram	Black gram	Green gram	G'nut	Sesame
1996-97	589.8	1494	1080	1917	726	771	758	945	281
1997-98	584.0	1301	1041	2027	522	804	887	935	376
1998-99	889.0	1401	1062	1956	372	813	585	870	260
1999-00	520.5	852	1060	1868	431	753	819	463	264
2000-01	394.8	546	400	1042	293	270	504	182	184
2001-02	512.3	1422	957	1883	368	894	989	640	303
2002-03	520.5	1070	724	1821	297	633	397	695	276
2003-04	833.0	1708	1086	2951	400	709	833	1034	427
2004-05	716.5	1474	1034	2417	411	443	505	960	305
2005-06	499.0	1042	618	1620	513	539	555	621	255
2006-07	943.0	1239	916	1897	645	480	577	758	276
2007-08	818.5	705	1191	2494	791	624	523	976	417
2008-09	513.0	292	1247	333	79	76	179	249	52
2009-10	718.0	940	579	1398	436	559	1164	642	217
2010-11	686.8	2143	1538	30	870	951	971	1331	517
2011-12	547.3	1473	1125	2427	579	547	360	886	287
2012-13	605.9	1474	1033	2551	583	470	479	741	348
2013-14	406.1	1680	1293	3234	770	529	456	981	183
2014-15	617.8	1094	815	2209	438	431	337	624	377
2015-16	532.5	902	647	1671	348	388	215	524	193
2016-17	412.9	1623	788	2925	520	514	513	764	274

3) Maize

Recently, the area under Maize is increased considerably in the study region. It is grown mainly during rainy season. The rainfall directly influenc the production of Maize which indicates positive correlation between them (fig 2). When there was sufficient amount of rainfall with low variability during the growing season of Maize, the yield was high. However, during low, irregular and untimely rainfall the yield of Maize was decreased significantly. The negative correlation is noticed in the years 2007-08, 2011-12, 2012-13, 2013-14 and 2016-17. On the other hand, the positive correlation between them is seen in the rest of the years in the study region.

4) Red Gram

Red gram is an important pulses crop grown in the study region. This crop is long duration crop, about 6 month period. The amount of rainfall and its variability in different month of growing season determine the yield of crop. The line graphs 3 indicatesthat most of the year, the yield of Red gram is affected by the amount of rainfall received in the study region. Overall, there is positive correlation is noticed between amount of rainfall and yield of Red gram i.e. r=0.21. The negative correlation is also observed in the year 2007-08, 2010-11, 2013-14, 2014-15, and 2016-17. In these years the yield of Red gram was increased even though the rainfall is comparatively less. Rest of the years, the yield of Red gram was fluctuated according to the occurrence of the rainfall during the growing season of Red gram. This crop is also drought resistance leguminous crop.

5) Black gram

The Black gram is rainfed pulses crop grown during rainy season in the study region. Generally, it is grown as a mixed crop. This crop is highly sensitive to climate change, particularly, rainfall. The (fig 4) reveals that there is positive correlation between amount of rainfall and yield of Black gram, i.e.0.27. It means the rainfall directly influenced the yield of crop. But in some years, particularly, in 2007-08, 2010-11, and 2016-17, the yield of crop is comparatively higher in respect of occurrence of rainfall during the growing season. It may be due to, in these years, sufficient amount of rainfall with low variability in the study region. Rest of the years, the yield of Black gram was fluctuated according to the amount of rainfall received during the growing season.

6) Green gram

The Green gram is a major pulses crop grown in the central Tapi valley fertile region. This crop is short duration crop, highly sensitive to climate change, particularly, amount of rainfall, its variability and occurrence of fog during flowering stage. There is positive correlation between the amount of rainfall received in a particular year and yield of green gram in that year. The correlation between them is about r=0.253(fig 6). During 21 years period (1996-97 to 2016-17), only one year indicates negative correlation

between rainfall and yield of Green gram. For example, during 2016-17 the yield of Green gram is increased even though there is less amount of rainfall received. Remaining 20 years period (1996-97 to 2016-17), the yield of Green gram fluctuates according to the amount of rainfall received during growing season.

Fluctuations of rainfall and crop Yield

7) Groundnut

Groundnut is oil-seed crop grown in medium black soil areas particularly, during rainy season. This crop is also grown during summer season where perennial source of water is available. The rainfall directly influence the yield and production of Groundnut which shows positive correlation between them i.e. r=0.4479 (fig 4.4.g-). Out of 21 years period, only six years have been reported negative correlation between amount of rainfall and yield of groundnut. In these years 2006-07, 2010-11, 2012-13, 2013-14, 2014-15,and 2016-17 the amount of rainfall is comparatively less but the yield of groundnut is significantly high (fig7). In the rest of the year the yield of Groundnut fluctuates according to amount of rainfall received in those years.

8) Sesame

Sesame is also an important oil-seed crop grown throughout the study region but particularly, in the central Tapi valley region. It requires moderate amount of rainfall with evenly distributed during the months of growing period. It is also highly sensitive to amount of rainfall and long duration of dry spell prevailed in the growing season. And hence, the rainfall directly influences the yield of Sesame which shows positive correlation between them i.e. r= 0.436 (fig 8). During the year 2006-07 and 2009-10, the yield of Sesame is increased satisfactorily even though there is less amount of rainfall received in those years. In most of the years, the yield of Sesame fluctuates according to the amount of rainfall received during the growing season of sesame.

CONCLUSION

The trend of simple regression line shows the remarkable variations in rainfed crops grown in the study region. The fluctuations in the yield of these crops in Dhule district might be due to many factors but rainfall is the main factor. The uncertainty and erratic nature of the rainfall is associated with climate change prevailed in the study region. This key risk factor is associated with the yields of crops. The fluctuations in amount of rainfall determine the yield of rainfed crops. The present analysis reveals that the fluctuation in the yields of rain fed crops was noticed according to the amount of rainfall received during the growing season of these rainfed crops. Therefore, there is positive correlation observed between them in most of the years. However, during some years, negative correlation is also seen. During 2016-17, negative correlation between yield of all rainfed crops and amount of annual rainfall is observed. In this year, yields of all rainfed crops are increased significantly even though the amount of rainfall is less. It may be due to the sufficient rainfall along with minimum rainfall variability. During the year 2008-09, the yields of all crops are reduced drastically because of drought condition (Scanty rainfall) prevailed

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