

Water Availability and Crop Suitability in Drought - Prone Tahsils in Jalgaon District of Maharashtra State, India

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Abstract - Proper assessment of the availability of water resources is the cornerstone for proper planning, development and management. Sustainable development of water resources is on the key problems of the 21st century. Floods, droughts, water quality, water-ecosystem and soil water- climate interactions, and the sustainability of water resources are important issues in water resources management. The complexity of the water system in the region can be understood by calculating the regional water balance in a distributed scale considering the factors that affect it. Sustainable water management in a drought-prone area requires knowledge of the water availability and water requirements in the present and future for various purposes. Knowledge of the water balance is the basis for the development of agricultural production, crop selection, and determination of cropping pattern (Oldeman and Frere, 1982 in Sujalu, 2000). Water balance is defined as 'the net change in water, taking into account all the inflows to and outflows from a hydrologic system'.

The study region is semi-arid and drought - Prone region. Erratic monsoon rainfall, within four month and remaining period of the year is dry, high temperature, acute shortage of water in the entire region. Lack of proper storage of water, absence of irrigation facilities and less underground retention of water has adversely affected the farming. This paper highlights period wise availability of water and suggests crop production given the constraints. The current study focuses on the estimation of water balance from a huge rainfall database for stations in and around the region.

Keywords: Crop suitability, water availability and Actual Evapotranspiration.

I. INTRODUCTION

Life on earth depends crucially on water; yet human civilization had deteriorated the quality of water resources (Zutshi and Kumar, 2013). The problems posed by ever increasing population and climate change will have serious consequences on water availability which in all likelihood will hamper economic growth and food security in future. Further, depletion of water quality will deteriorate environment and its living forms (Chattopadhyay, 2015). Water resources constitute the largest flow of natural resources but ever increasing demand for more water demands sustainable natural management (Hussain, 2006). Sustainable water resource management includes its supply and demand, policy implementation and participatory planning. It aims at achieving rational balance between supply and demand of water and also water management needs is a technical prerequisite.

The region is deficient in food productions and is dependent on import of most of the food and essential commodities.

Therefore, there is an urgent need to increase food production to make the region self-sufficient. With its diverse agro-climatic conditions, climate is one of the major factors influencing the distribution of the water resources to a great extent (Krishnaiah, 2011; Krishnaiah, 2014). Crop growth depends on water availability to each plant root zone and also that different crops require varying conditions of heat, light and water which are absorbed through leaves and roots (Merrett, 2002). Another important point is water holding capacity of soil between field capacity and permanent wilting point which is useful in planning irrigation schedule, land use, watershed management, water balance simulation, etc (Pandey et al., 2013).

Objectives

- ❖ To study the water balance for the drought prone tahsils.
- ❖ To determine period wise availability of water and suggests crop production for the study region.

II. STUDY AREA

The study area is located in the drought-prone tahsils of Jalgaon district of Maharashtra state. These drought prone tahsils are identified by V Subramaniam (1987), Review Committee appointed by the Maharashtra State Government. The tahsils are Amalner, Dharangaon, Erandol, Parola, Chalisgaon, Bhadgaon, Jamner and Muktainagar. There are 09 tahsils which are selected for present study which cover an area 6994.54 sq.km. The area under study is located south of the Tapi River in Jalgaon district. It lies between 20°11' to 21°13' North latitudes and 74°46' to 76°24' East longitudes (Fig. 1). The study region is a plateau area with variations of some uneven lands on the banks of rivers. The River Girna and Waghur is the architect of this plateau area.



III. DATABASE AND METHODOLOGY

Physiography of the region has been represented with the help of Survey of India topographical sheets on a scale 1: 50,000. The water balance elements are analysed using Thornthwaite and Mather (1955) method with the help of parameters like mean monthly temperature and mean monthly rainfall over a period of 31 years (1980 -2010) for about 09 rain-gauge stations. The researcher selected eight crop groups like Jowar, Bajara, Pulses, Oilseeds, Cotton, Sugarcane, Fruits and Other crops. Crop data collected from tahsil offices in Jalgaon district. On the basis of the available information, parameters such as actual evaporation (AE) potential evaporation (PE), water deficit (WD), and water surplus (WS) have also been calculated.

Water availability days and months were worked out using monthly AE and PE ratio for each rain-gauge station using Raman and Srinivasa Murthy (1971) method. They are humid period (when AE = PE), wet period (when AE = 1/2th of the PE or more than 1/2th of the PE), moderately dry period (when AE = 1/4th of the PE or more than 1/4th of the AE) and dry period (when AE = 1/8th of the PE or more than 1/8th of the PE). Water availability periods are categorized into dry, moderately dry, wet and humid periods. Based on water availability days and water availability months crop suitability for the state has been proposed.

A. Discussion

The entire year is broadly divided into four periods namely humid, wet, moderately dry and dry; but in study region only dry periods dominate, the wet period is significant and remaining two periods are by and large absent.

B. Humid period

In humid period the water availability days vary from a minimum of 61 days in Parola station to a maximum of 92 days in Amalner, Bhadgaon and Chalisgaon rain-gauge stations. Water is available for 61 to 62 days in a year in stations such as Parola, and Dharangaon. 92 days of water availability in humid period is experienced rain gauge stations like Chalisgaon, Bhadgaon and Amalner (Table 1). The spatial distribution of humid period water availability shows extreme variation ranging from less than 0 - 61 days in west-southern part and north eastern part. 0 days in Erandol, Pachora, Muktainagar and Jamner included in the south western side and more than 62 to 92 days in the north part of the study region. Over 62 days water availability is seen in the northern part of the study area (Fig. 2).

Table.1: Water availability days

Rain-gauge station	Humid	wet	Mod dry	Dry
Amalner	92	61	0	212
Dharangaon	62	91	31	181
Parola	61	61	31	212
Erandol	0	152	31	182
Chalisgaon	91	62	31	181
Bhadgaon	92	62	30	181
Pachora	0	153	31	181
Jamner	0	213	0	152
Muktainagar	0	152	31	182
Region	44	112	24	185

Source: Computed by the author, 2019

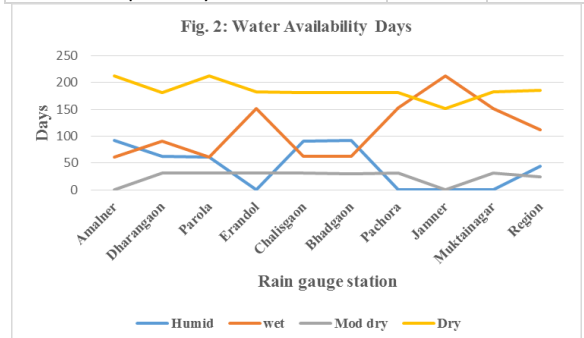
Wet period: The wet period water availability days vary from a minimum 62 days in Chalisgaon, Bhadgaon, Amalner and Parola rain-gauge stations to a maximum of 213 days in Jamner, 152days in Erandol, 153 days in Pachora and Muktainagar rain-gauge stations (Table 1). The wet period water availability varies from 61 to 213 days in southern and northern part rain-gauge stations. The spatial distribution shows that the minimum (91 days) water availability is confined to the northern part of the study region. Water availability increases continuously from the northern to southern part (152 to 213 days) and further increases from central to southern part (180 days) of the state (Fig. 2).

Monthly water availability: Month-wise analysis of water availability in the study region is limited to moderately dry and humid period. Whereas the wet period is significant but remaining dry period in a year remains maximum.

Table.2: Water availability months

Station	Humid period	Wet period	Mod. Dry period	Dry Period
Amalner	July - Sept	June & Oct	Nil	Nov - May
Dharangaon	July - Aug	June- Sept	Oct - Nov	Dec - May
Parola	July - Aug	June - Sept	Nil	Dec - May
Erandol	Nil	June - Oct	Dec	Jan - May - Nov
Chalisgaon	July - Sept	June - Oct	Nov	Dec - May
Bhadgaon	July - Sept	June & Oct	Nov	Dec - May
Pachora	Nil	June - Oct	Nil	Nov - May
Jamner	Nil	June - Dec	Nil	Jan - May
Muktainagar	Nil	June - Oct	Nov	Dec - May

Source: Computed by the authors



C. Humid period

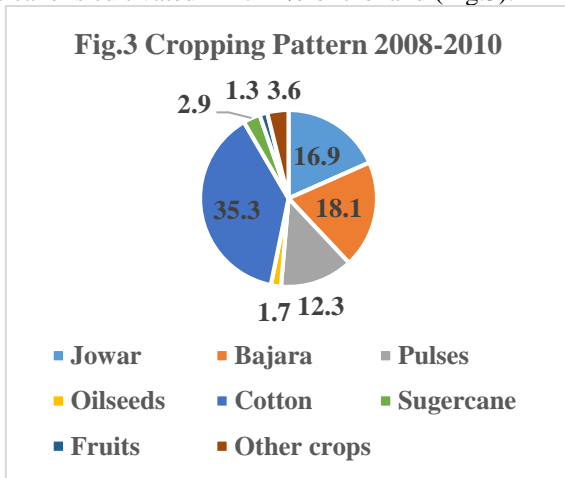
Analysis of monthly water availability reveals that Chalisgaon, Amalner and Bhadgaon rain gauge stations have humid period for three months from July to September. June - July (Two months) happens to be humid period in Dharangaon and Parola stations. Whereas remaining tahsil stations have zero humid period (Table 2).

D. Wet period

The period from June to September constitute wet period in Jamner, Bhadgaon, Chalisgaon, Amalner, Pachora and Muktainagar tahsil rain-gauge stations. In Jamner, Parola, Muktainagar and Pachora the wet period extends over the months of November till December. The wet period extends from October till November in Jamner (Table 2).

E. Cropping pattern, 2008 -10

The total cropped area of the study region during 2008 – 2010 constituted around 505894 hectares of land amounting 73.33 % of the total geographical area of the study region. Area under cotton cultivation has the highest coverage of 228031 hectares (41.90%) followed by Jowar (21.6%) of land under 117542 hectares. With 52293 hectares (9. 6%) of land under pulses cultivation, this crop is the third most important. Around 7.9 % cropped area is under Bajara while a little fewer than 4.2 % cropped area is devoted to cultivation of other crops. Area under fruits (3.4 %) cultivation of the cropped land and sugarcane is cultivated in 1.22 % of the land (Fig.3).



F. Inter Tahsil variation in cropping pattern, 2008 - 2010

Inter- tahsil variation in cropping shows the extent of variation in cropped area ranges from a minimum of 75.5 % in Jamner tahsil to a maximum of 79.8 % in Amalner tahsil in the period 2008 -10. Jamner tahsil is located in the extreme south - central part of the study region. The cropped area varies from 75.5 to 79.8 % in Bhadgaon, Erandol Dharangaon, Amalner and Muktainagar tahsils located mainly in the central and northern part of the study region. Cropped land falls below 79.0 % in Chalisgaon, Parola and Jamner tahsils confined to northern and south-eastern parts of the study region (Table 3).

G. Crop suitability:

Table 3: Study Region: Tahsil - wise variation in cropping pattern, 2008 -10

Sr. No	Tahsil	Cropped area in %
1	Chalisgaon	78.1
2	Bhadgaon	79.0
3	Pachora	76.4
4	Parola	77.4
5	Erandol	79.5
6	Dharangaon	79.3
7	Amalner	79.8
8	Jamner	75.5
9	Muktainagar	78.5

Source: Computed by the authors

Period wise water availability days and months in the study region permit an understanding of crop suitability. Based on these four parameters, it is suggested that double crop cultivation may be favourable during October, November, December and January months in moderately dry period. The two crops could be cultivated are Onion, vegetable, maize, mustard, small millet, soybean, ginger, wheat, and tur/arhar. During the wet period i.e. June, July, August and September could be favourable for cultivation of single crop that is Jowar, Bajara, Pulses, and Oilseeds, ginger, small millet, pea, beans and maize.

III. CONCLUSION

The water availability days and months were analysed for arriving at crop suitability given the two conditions in the context of drought – Prone tahsils in Jalgaon district of Maharashtra State. All the tahsils are characterized by humid and wet periods in a year though moderately dry and dry periods are absent. These are but two conditions only and the influence of other factors in identification of crop suitability cannot be ruled out.

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