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Short communication

Crop planning based on probability of rainfall at Hawalbagh, Almora

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Rainfall is the most important climatic variable and the main determinant in the choice of crops. Performance of crops in the rainfed hill region is highly dependent on the distribution and variability of rainfall. Northwest Indian Himalayan region is one of the youngest mountain chains, which has a very fragile ecosystem, experiencing extreme events in high frequencies. Thus a scientific analysis of annual and seasonal rainfall will provide a general idea about the rainfall pattern of the region.

Daily rainfall data of 48 years (1964 to 2011) was collected from the meteorological observatory of ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan, Experimental Farm, Hawalbagh located at 1250 m amsl with 29°36´N longitude and 79°40´E latitude. The daily rainfall data were computed into annual, seasonal, monthly and weekly periods and the standard deviation, mean, highest and lowest values and the coefficient of variability (%) were worked out. A simple linear regression method, which is of parametric t-test, is used to analyse the long-term linear trend in annual and *kharif*/monsoon rainfall data after tested for serial correlation (Duhan and Pandey, 2013). Mann–Kendall (MK) test was used to estimate the trends in weather data. The slope of n pairs of data points was estimated using the Theil–Sen's estimator (Theil, 1950; Sen, 1968). The change percentage was computed according to Yue and Hashino (2003) and the probability of rainfall at various levels 20 to 90 % for the various periods as given by Weibull (1939). The onset and withdrawal of the effective rainy season was analyzed as per Ashokraj (1979).

Chances of dry spells:

The chances of getting dry spells during *kharif* and *rabi* seasons were worked out with two different criteria. Firstly, the week received less than half of the amount of normal rainfall of that particular week is characterized as drought. In the second criteria, a particular week was classified as drought when it receives less than 15 mm rainfall.

Crop planning

Crop planning in *kharif* and *rabi* was made according to the chance of rain at the particular time, start, end and length of monsoon, risk of dry spells and PET (potential evapo-transpiration) along with the different crops (with vaired crop

Table 1: Mean monthly rainfall and rainy days at Hawalbagh (1964 to 2011)

Month	Mean rainfall (mm)	Per cent of annual rainfall	S.D	CV (%)	Rainy days
January	41.1	4.0	33.0	80.3	3.4
February	51.7	5.1	35.7	69.0	3.7
March	44.5	4.4	39.6	88.9	3.9
April	32.4	3.2	28.9	89.2	2.9
May	65.2	6.4	44.9	68.9	5.6
June	135.1	13.3	72.7	53.9	9.1
July	237.2	23.3	92.1	38.8	14.3
August	216.2	21.3	69.7	32.2	13.2
September	141.8	14.0	100.9	71.2	8.0
October	23.8	2.3	38.9	163.9	1.6
November	6.5	0.6	13.2	203.5	0.6
December	20.9	2.1	25.7	123.4	1.4
Annual Average	1016.3		210.7	20.7	67.7

Table 2: Onset and withdrawal of southwest monsoon

Parameters	Start of rainy season		Withdrawal of rainy season		Duration/ length of rainy season	
	Day	SMW	Day	SMW	Days	Weeks
Mean	170	25	263	38	93	13
Range	148-207	22-30	231-289	33-42	51-136	8-20
Early	156	23	251	36	111	16
Late	184	30	275	40	69	10
SD	14.2	2.0	12.1	1.7	19.3	2.8
CV (%)	8.4	8.1	4.6	4.5	20.8	21.3

Table 3: Chances of getting dry spells 2, 3, 4 and >4 weeks duration during *kharif* season

Duration of dry spells	Sowing				Knee high		Flower and grain filling					
	SMW				SMW		SMW					
	19-22		22-25		25-28		28-31		31-34		35-39	
	I	II	I	II	I	II	I	II	I	II	I	II
0	4	3	9	9	6	16	17	27	12	25	2	3
1	15	6	13	11	20	16	14	15	20	15	8	8
2	14	12	14	15	13	11	12	6	12	7	13	12
3	9	16	10	12	8	4	4	-	4	1	12	15
4	6	11	2	1	1	1	1	-			11	9
5	-	-	-	-	-	-	-	-	-	-	2	1
Total PET (mm)	82.0		94.0		106.0		118.0		130.0		185.0	
Mean rainfall (mm)	61.7		106.9		182.5		224.5		204.9		170.5	

durations) and varieties (with different maturity periods). Based on the probability of rainfall and commencement of monsoon season, the expected monsoon is denoted as early, timely and late monsoon and crop varieties selected accordingly. The crop production strategies and crop varieties discussed here is based on the collective experience and expertise of the institution.

Rainfall occurrence

Annual rainfall (1964-2011) of the region was found to vary from 650.8 mm to 1496.0 mm with a mean of 1016.3 mm. Though the annual mean rainfall (1016.3 mm) falls under sufficient categeory, heavy concentration of rainfall during monsoon months results in water scarcity in lean periods. It was observed that rainfall of 24, out of 47 years was higher than that of the mean. The annual rainfall showed a long-term decreasing trend with the rate of 0.24 mm per year. Rainfall during the Southwest monsoon, summer, winter and post monsoon seasons contributed 71.9, 14.0, 11.2 and 3.0% of annual rainfall, respectively. The highest average rainfall of 730.3 mm was recorded during southwest monsoon followed by summer season. The rainfall during the winter season was recorded as 113.7 mm, whereas it was 30.2 mm during post monsoon.

Onset and withdrawal of rainy season

Mean date of onset of the rainy season at Hawalbagh (Almora) is 19th June (170th day of the year which falls in the 25th SMW) and the earliest and latest probable dates of onset of rainy season being 5th June (156th day) and 2nd July (184th day), respectively. Out of 49 years of study, the rainy season arrived later than the normal date of onset of the rainy season in 22 years. The mean date, earliest and latest probable dates of withdrawal of rainy season were 20th September (263 day of the year in 38th SMW), 8th September and 2nd October, respectively (Table 2).

Expected rainfall

The expected rainfall at 75 % probability level was 586.8, 154.3, 66.7, 89.8 and 5.5 mm during monsoon/ *kharif,* r*abi*, winter, summer and the post monsoon seasons, respectively. The expected annual rainfall at 75 % probability was 866.6 mm.

Expected monthly rainfall

The expected assured monthly rainfall at 75 % probability (June to September) varied from 53.1 in September to 182.2 mm in August. It is considered very good for agricultural production and suggests that irrigation is not

required much for *kharif* season crops. The expected rainfall at 75 % probability level ranged from (January to May) 13.2 mm in January to 37.5 mm in May. The chance of getting rainfall at 75 % probability during October to December months is almost nil except for a trace amount (1.0 mm) during October.

Expected Weekly rainfall

The expected rainfall at 75 % probability ranged from 2.0 (38th SMW) to 30.9 mm (31st SMW). The lowest assured weekly rainfall is very high in July and August at all probability levels. The meteorological water balance studies showed that the June to September rainfall was more than that of evaporation and it is regarded surplus period. Excess water in terms of runoff may be stored and used for crtical stages of *rabi* crops viz., presowing and crown root initiation (CRI) stage for wheat.

Planning of rabi crops:

The period between 39th to 51st SMW is very crucial for planning of *rabi* crops sowing due to very low reliability of rainfall. The mustard and *raya* crop should be sown just after harvesting of *kharif* crop during 38th to 42nd SMW. The wheat crop especially the long duration varieties like VL *Gehun* 616 and VL *Gehun* 829 should be sown during 42nd and 43rd SMW. The high temperature stress during early growth stages of wheat results in reduced tillering and leads to early flowering without proper growth. In order to utilize the residual moisture there is a need to develop wheat varieties which can be sown during 39th to 41st SMW which are not affected by higher temperature during germination and early vegetative stage. Another alternative is to sow wheat during 51st to 52nd SMW by selecting an appropriate cultivar such as VL Gehun 892.

Planning of kharif crops

Paddy is cultivated as direct seeded *Chethi* (March-April sown) and *Jethi Dhan* (June sown) and transplanted paddy. The PET and normal rainfall are recorded as 730 mm and 806.0 mm during *Chethi Dhan* growing period (April to September). The *Chethi Dhan* water requirement was estimated as 794.0 mm, which indicates a risk of growing of rice in the mid hill region at times of below normal rainfall. The rainfall deficit in comparison of PET is confined to 13th to 22nd SMW. After 23rd SMW to 38th SMW normal rainfall was recorded more than the PET. It means the crop will get sufficient rains to meet crop water requirement during the entire crop season except vegetative stage. It is advisable that harvested rain water could be utilized for irrigating the paddy during intermittent dry spells. As it is observed that out of 48 years, 26 to 39 years have 2 to 4 weeks were dry weeks during sowing and early vegetative stage (Table 3). Thus direct seeded June sown paddy (a short duration crop) could be a viable alternate to *Cheti Dhan* (long duration).

The other *kharif* crops like finger millet, barnyard millet, horse gram and soybean are sown at the time of onset of monsoon. But it is advisable that the field preparation should be started in May by utilizing summer showers. The dry sowing of cereals during May is one of the most valuable practices to properly utilize the monsoon rainfall.

REFERENCES

Ashokraj, P.C. (1974). Onset of effective monsoon and critical dry spells. A computer based forecasting technique. Research bulletin No.11 (New series) IARI, New Delhi.

Banjare, S., Rawat, S. and Gautam, S. (2019). Rainfall probability analysis for crop planning in Allahabad district of eastern Uttar Pradesh. *J. Agrometeorol.,* 21(1) : 112-113

Bhale, V.M., Tupe, A.R., Karmore, J.V. and Kale, M.A. (2012). Crop planning in relation to climate change in rainfed regions. *J. Agric. Tech*., 8(2): 443-452.

Duhan, D. and Pandey, A. (2013). Statistical analysis of long term spatial and temporal trends of precipitation during 1901-2002 at Madhya Pradesh, India. *Atmospheric Res.,* 122: 136-149.

Kendall, M.G. (1975). Rank Correlation Methods. Griffin: London.

Mann, H.B. (1945). Nonparametric tests against trend. *Econometrica,* 13: 245-259.

Panday, S.C., Singh, R.D. and Gupta, H.S. (2000). Probability analysis of rainfall of Hawalbagh (Almora), U.P. for crop planning. *In*: International Conference on Managing Natural Resource in the 21st century, New Delhi; 620-621.

Panday, S.C., Singh, R.D. and Gupta, H.S. (2002). Analysis of meteorological drought based on rainfall data of Hawalbagh, Almora. *Indian J. Soil Conserv.,* 30(2): 186-189.

Pattanaik, D.R. (2007). Analysis of rainfall over different homogeneous regions of India in relation to variability in westward movement frequency of monsoon depressions. *Nat. Hazards,* 40(3): 635-646.

Sen, P.K. (1968). Estimates of the regression coefficient based on Kendall's tau. *J. Amer. Stat. Assoc*., 63: 1379-1389.

Theil, H. (1950). A rank invariant method of linear and polynomial regression analysis, Part 3. *Nederlandse Akademie van Wetenschappen,* 53: 1397-1412.

Weibull, W. (1939). A statistical theory of strength of materials. *Ingeniors Vetensk Apsakademiens Handlingar,* 151: 1-45.

Yue, S and Hashino, M. (2003). Temperature trends in Japan: 1900–1990. *Theor. Appl. Climatol.,* 75: 15-27.

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