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Short communication

Rainfall analysis for crop planning in Kashmir valley

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Srinagar district is located between 74° 83' E longitude, 34 °08' N latitude and at elevation of 1587 m above msl in temperate, sub humid region of Jammu and Kashmir. The high altitude temperate zone known as Kashmir Valley is characterized by a sub-microthermic regime with marked winter and spring concentration of precipitation. The entire valley region is a mass of mountain range which yields only a fraction of total geographical area located at plain areas of valleys for cultivation of crops. The valley is endowed with abundant precipitation, intense solar radiation and favorable temperatures for good farming. The soils prevailing in the region are fertile, less eroded and fairly permeable which suited best for high value fruit crops like apple, pear, plum, cherry, almond and walnut. Precipitation is one of the most important factor deciding success of rainfed agriculture in valley, where only 10 % area is under irrigation therefore, its distribution is very important for crop planning, drainage management and hydrological design of structures. Due to variation in rainfall distribution, it is imperative to determine the probability of rainfall recurrence. Weekly, monthly and seasonal probability analysis has been attempted by Mohanty *et. al.* 2001. Rainfall at 70 % probability can be safely taken as assured rainfall, while 50% chance can be considered as the maximum limit for taking any risk (Gupta *et. al.* 1975).

The valley receives nearly 947 mm of average annual precipitation, out of which 340 mm falls as snowfall and rest 607 mm as rainfall. The region receives about 70 percent of annual precipitation in the form of snowfall and rainfall both during the months December-July respectively. Snowfall is important form of precipitation in valley that helps to maintain moisture supply during summer. In spite of this high spell several parts of this region experiences severe shortage of water during summer months. Even though the soils of this region are fairly permeable but because of steep slopes water does not get enough time to percolate down. Considering these problems under rainfed situation and to identify the highest probability weeks for timely sowing of field crops, an attempt has been made in this study about the frequency analysis of weekly rainfall for different return periods at Srinagar region of Kashmir Valley.

Daily precipitation data of nineteen years (1985-2003) were collected from meteorological observatory situated at college of post graduate studies, Shalimar Campus of SKUAST-K Srinagar and

Table 1: Monthly and seasonal expected rainfall (mm) at different probability levels at Srinagar, Kashmir Valley.

Months	Probability (%)					Coefficient of variation
	90	80	70	60	50	
January	10.0	13.3	25.9	35.6	40.5	70
February	33.2	40.8	54.0	59.2	75.0	56
March	52.8	57.7	65.9	94.4	107.7	55
April	26.8	62.8	71.0	73.3	114.2	56
May	24.4	30.9	36.7	62.8	65.1	76
June	16.8	17.2	20.5	26.0	38.2	97
July	18.6	30.9	46.4	47.4	64.3	83
August	21.9	33.2	48.2	66.4	68.6	79
September	6.4	7.8	13.5	18.6	28.6	131
October	0.0	0.0	8.8	16.4	22.8	128
November	0.0	0.0	4.1	10.9	32.5	117
December	0.0	9.8	19.2	23.7	44.2	110
Kharif (Apr-Sept)	216.1	275.2	321.8	377.6	402.9	--
Rabi (Oct-Mar)	240.2	267	300.1	313.7	358.6	--
Annual	456.4	622.5	681.7	727.7	766.3	51

analyzed. The weekly rainfall at different probabilities levels were worked out with the help of 'Weibull' formula;

$$P = (m/(n+1)/100)$$

Where, P is plotting percentage, m is the rank of observed rainfall values when arranged in descending order of magnitude and 'n' is the total number of years of record. The recurrence interval of rainfall values can be calculated as the reciprocal of 'P' values.

The year was divided into two cropping seasons i.e. April to September, (*Kharif*) and October to March (*Rabi*). Due to severe and prolonged snowfall in

winter only these two seasons prevail in Kashmir valley as compared to other areas. However the crops sown in October are harvested in mid of May but subsequently field preparation and sowing of *Kharif* crops starts in early April.

The probable occurrence of weekly and monthly rainfall, mean and coefficient of variation have been worked out and are presented in Table 1 and 2. The annual average rainfall of Srinagar region of Kashmir valley 946.5 mm. it varied from 446.3 mm to 2095.1 mm. The average rainfall of *Kharif* and *Rabi* season are 527.0 and 413.1 mm respectively. The maximum average monthly rainfall is received during the month of March and minimum is received during the month of November. The snowfall was highest even at 90 percent probability level in the month of March indicating March snowfall as more assured.

The major *kharif* crops of the valley are paddy maize, soybean, cowpea and rajmash which is cultivated almost under rainfed conditions. The seasonal distribution of rainfall data indicates that expected rainfall at 70% probability level during April to September (*Kharif*) is 321.8 mm. This may be considered safe for production of field crops, if supplemental irrigation is provided. At 70% probability level the expected snowfall in months February and March are more than 50 mm whereas September, October, November and December should be considered as critical months of *Rabi* season. This shows erratic and uneven distribution of rainfall over a short span of period in Kashmir Valley.

The monthly coefficient of variation (CV) ranged between 54.7 to 131.5 per cent (Table1). The CV for *Kharif* season ranges between 56.2 to 131.5 per cent while that of *Rabi* season 54.7 to 127.8 percent. The weekly CV for *Kharif* season (14-39 SMW) varied between 79-144 percent, while that of *Rabi* season (40-13 SMW) ranged from 86-175 percent. The highest amount of rainfall i.e. 34 and 32 mm was received in 13th and 17th SMW (Fig.1) with relatively lower CV (90-100 %) during *Kharif* season. In *Rabi* season particularly in 8th and 12th SMW the snowfall was 30.9 and 32.6 mm, respectively with CV of 86-92 percent.

The monthly analysis shows that March is the wettest month which receives on an average 122.5 mm snowfall with lowest CV as 55 %. The wettest month next to March is April with average rainfall of 114.64 mm which also exhibits low coefficient of variation of 56.2 %. It indicates consistent precipitation pattern and also ensuring chance of getting snowfall or rains during these months. Hence, March and April are relatively suitable months for water harvesting and recycling for scheduling a protective irrigation under Valley farming condition. The weekly rainfall data at different probabilities are presented in Table 2. The precipitation values which are not significant individually have been clubbed for easy and convenient interpretation. The analysis of weekly data showed that the first weeding and hoeing

Table 2: Expected weekly rainfall (mm) at different probability levels.

Std. Met. Week	Dates	Percentage (%)				
		90	80	70	60	50
1 to 5	1 Jan to 4 Feb	0.0	0.0	2.9	4.8	20.5
6	5 to 11 Feb	0.0	2.4	6.5	8.7	10.8
7	12 to 18	0.5	1.4	7.4	8.0	15.8
8	19 to 25	5.0	8.4	15.0	21.6	24.2
9	26 to 4 Mar	0.0	2.0	4.4	13.5	19.4
10	5 to 11 Mar	0.0	6.3	9.7	12.0	14.8
11	12 to 18	2.0	6.4	7.6	12.0	16.0
12	19 to 25	1.0	7.5	14.0	15.3	20.0
13	26 to 1 Apr	4.0	5.0	10.0	17.8	22.8
14	2 to 8	0.6	4.4	13.3	20.4	24.9
15	9 to 15	0.0	5.3	6.3	23.8	25.2
16	16 to 22	0.0	0.1	3.0	8.0	10.0
17	23 to 29	0.0	3.2	7.6	9.8	29.4
18	30 to 6 May	1.3	7.4	15.2	17.0	22.9
19	7 to 13	0.0	3.1	6.4	6.5	11.4
20 to 27	14 May to 8 July	0.0	3.0	10.0	24.9	62.8
28	9 to 15 July	0.0	3.4	4.7	7.7	9.2
29	16 to 22	3.5	6.3	7.9	8.6	11.8
30	23 to 29	0.0	2.8	10.3	10.6	13.8
31	30 to 5 Aug	0.0	2.2	10.1	19.6	23.9
32	6 to 12	0.0	0.3	1.5	8.6	10.6
33	12 to 18	0.0	1.4	4.0	4.0	5.5
34	19 to 25	0.0	0.0	3.0	10.2	16.0
35 to 52	26 Aug to 31 Dec	0.0	0.0	2.5	14.2	48.7

for Maize, Soybean, Cowpea and Rajmash beans can be done in the 14th SMW as expected rainfall is quite low in this SMW, whereas second weeding and other intercultural operations can be done in the 22nd -23rd SMWs because high rainfall is expected in subsequent weeks. 17th-19th weeks (Apr-May) may be considered as suitable weeks for sowing and transplanting of paddy. However, irrigation for submergence of paddy crop is necessary in month of June, as expected rainfall 20.5 mm is inadequate. Most of the weeks have lesser rainfall in period of June to October which are considered as critical stages for different crops and the protective irrigation

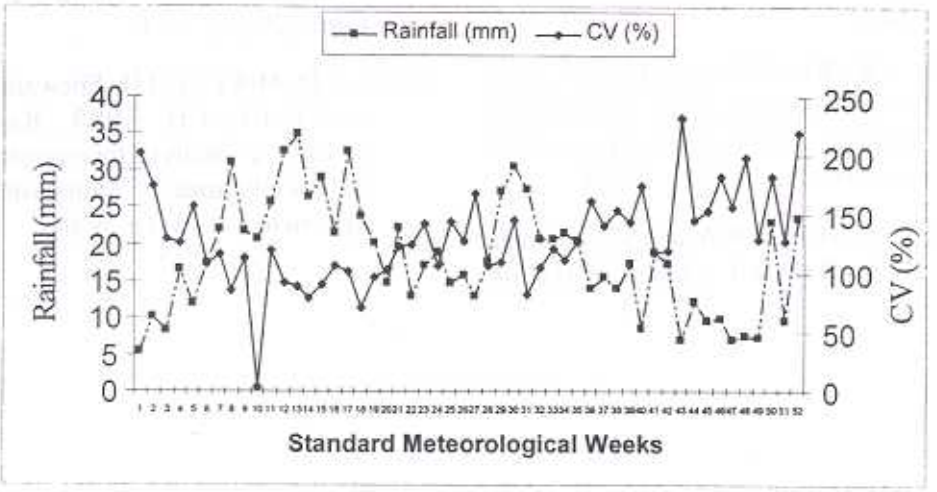

Fig.1: Weekly rainfall variation curve

is required up to August month. For rainfed condition, adoption of short duration varieties with low water requirement crops may be advisable.

The experience of last five years in valley about precipitation showed that its nature of onset, distribution and amount is erratic and uncertain, and about 90 percent area is cultivated under rainfed conditions. Frequent dry spells are commonly experienced in month of July, August and September and hence *Rabi* cropping becomes risky. Failure of rainfed *Rabi* crops like oats, mustard and spring wheat have been experienced due to shortage of irrigation water and unfavorable temperature in severe winter. The entire *Rabi* season indicates less availability of rainfall which emphasized for storage of water to provide supplemental irrigation to *Rabi* crops. For these long duration crops, irrigation in 48th-49th SMWs is recommended as moisture stress severely affects particularly at their crown root initiation (CRI) stage.

In terms of fruit crops, the bearing season is April to October whereas, rest of the year is considered as non- bearing season. The rainfall at 70% probability for the months April-October is 245.2 mm is quite sufficient and does not need any irrigation except in month of June. This is due to fact that it occurs in form of snowfall and deposited layers of snow do not melt easily as rise in temperature during this period is too low. This results in good moisture retention in the soil for longer period.

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