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Short communication

Long-term trends and probability of rainfall for crop planning in Bihar

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Around 60% of the Indian agriculture is rain-dependent. Rainfall is the single most important factor in crop production planning in rainfed ecologies. The information on annual, seasonal and weekly rainfall of a region is useful to design water harvesting structure for agricultural operations, field preparation, sowing, irrigation, fertilizer application and overall in field crop planning (Sharma *et al*, 1979, Singh *et al*., 2008). Historically in Bihar, zone I and zone II are receiving too much rainfall to cause flood in the region whereas zone III B is characterized as rainfed region with low, erratic and uncertain rainfall pattern with frequent dry spells during the monsoon season. Hence monsoon cropping is tricky operation in the region as well as sudden crop failures during the *kharif* season is a common phenomenon due to early withdrawal of monsoon. Rainfall probability pattern has been studied by many scientists in India (Hundal and Kaur, 2002; Suchit and Singh, 2009; Ravindrababu *et al.,* 2010) and conclude that rainfall occurrence is certain at greater than or equal to 80 % probability, while 50% probability is the medium limit of certainty and may involve dry spell risk. Taking into account these climatic and probability factor, the study was conducted for four different locations situated in different agro climatic zones of Bihar for interlinking the rainfall probability with the crop planning pattern in the region.

Weekly rainfall data for the period 1955 to 2012 i.e. 58 years pertaining to Pusa ($25^0 98^{'}$ N, $85^0 13^{'}$ E, 47 m msl), Purnea ($25^0 98^{'}$ N, $87^0 80^{'}$ E, 37 m msl), Sabour ($25^0 23^{'}$ N, $87^0 70^{'}$ E, 37 m msl) and Patna ($25^0 36'$ N,$85^0 9'$ E,58 m msl) representing North west alluvial plains (Zone I), North East alluvial plains (Zone II) and South Bihar alluvial plains (Zone III A and III B) of Bihar respectively as per availability was used for analysis. Weekly, annual and seasonal rainfall distribution patterns were critically examined and analyzed. Trends were examined by Mann-Kendall rank statistics as described by Sneyers (1990). Expected amount of rainfall at a given probability level was computed for 24-39 SMW during monsoon season using Weibull's distribution (Chow 1964).

Trend analysis

The average annual rainfall of Pusa (zone I), Purnea (zone II), Sabour (zone III A) and Patna (zone III B) is 1246.9 mm, 1466.7 mm, 1231.4 mm and 1031.0 mm respectively (Table 1). The long-term annual rainfall of Patna (zone III B) shows significant decreasing trend (Table 1). In Pusa (zone I), it also shows decreasing trend but statistically non significant. But there is increasing trend of annual rainfall in Purnea (zone II) and Sabour (zone III A), though statistically it is not significant.

There is a decreasing trend of winter rainfall in all the zones though it is statistically not significant. There is significant increasing trend of pre monsoon rainfall during long term in Patna (zone III B). In pre monsoon season, there is increasing trend of rainfall for all the zones except zone II, though it is statistically not significant. But there is decreasing trend of monsoon and post monsoon rainfall, in Pusa (zone I) and Patna (zone III B) though it is not statistically significant.

Expected rainfall amount and crop planning

As discussed above, rainfall at 75% and 90% probability is assured rainfall and at 50% probability is the median limit for taking risk. The minimum weekly rainfall amount expected at 50, 75 and 90% probability level is presented for Pusa, Purnea, Sabour and Patna in Fig 1. At Pusa, the probability of more than 30 mm rainfall from SMW 25th is above 50 %, but there is some risk. From 27th SMW, there is probability of more than 75% of getting rainfall of more than 15 mm and farmers can initiate their field preparation operations and from 28th week expected rain becomes more than 20 mm, 27th and 28th week are an ideal time for sowing/transplanting of kharif crop and also for the crop fertilization based upon the rainfall pattern and intensity. In Purnea, the probability of more than 20 mm rainfall from SMW 25th is above 75 % and more than 10 mm rainfall is above 90%. So, from SMW 25th, sowing of kharif crop can be started in the region. In

Table 1: Mean and long term trends of seasonal and annual rainfall in four districts representing different zones of Bihar

Season	Pusa(zone I)		Purnea(zone II)		Sabour(zone III A)		Patna(zone III B)	
	Rainfall (mm)	Trend (mm/year)	Rainfall (mm)	Trend (mm/year)	Rainfall (mm)	Trend (mm/year)	Rainfall (mm)	Trend (mm/year)
Annual	1246.9	-1.57	1466.7	0.81	1231.4	2.08	1031.0	-7.04*
Winter	30.3	-0.48	20.6	-0.10	34.8	-0.39	34.0	-0.51
Pre-monsoon	98.6	1.10	175.5	-0.14	127.8	0.54	46.4	0.43*
Monsoon	1044.7	-1.20	1175.3	2.26	969.7	2.39	886.1	-5.74
Post- monsoon	73.3	-0.99	95.4	-1.20	99.1	-0.46	64.5	-1.23

* Significant at 5%

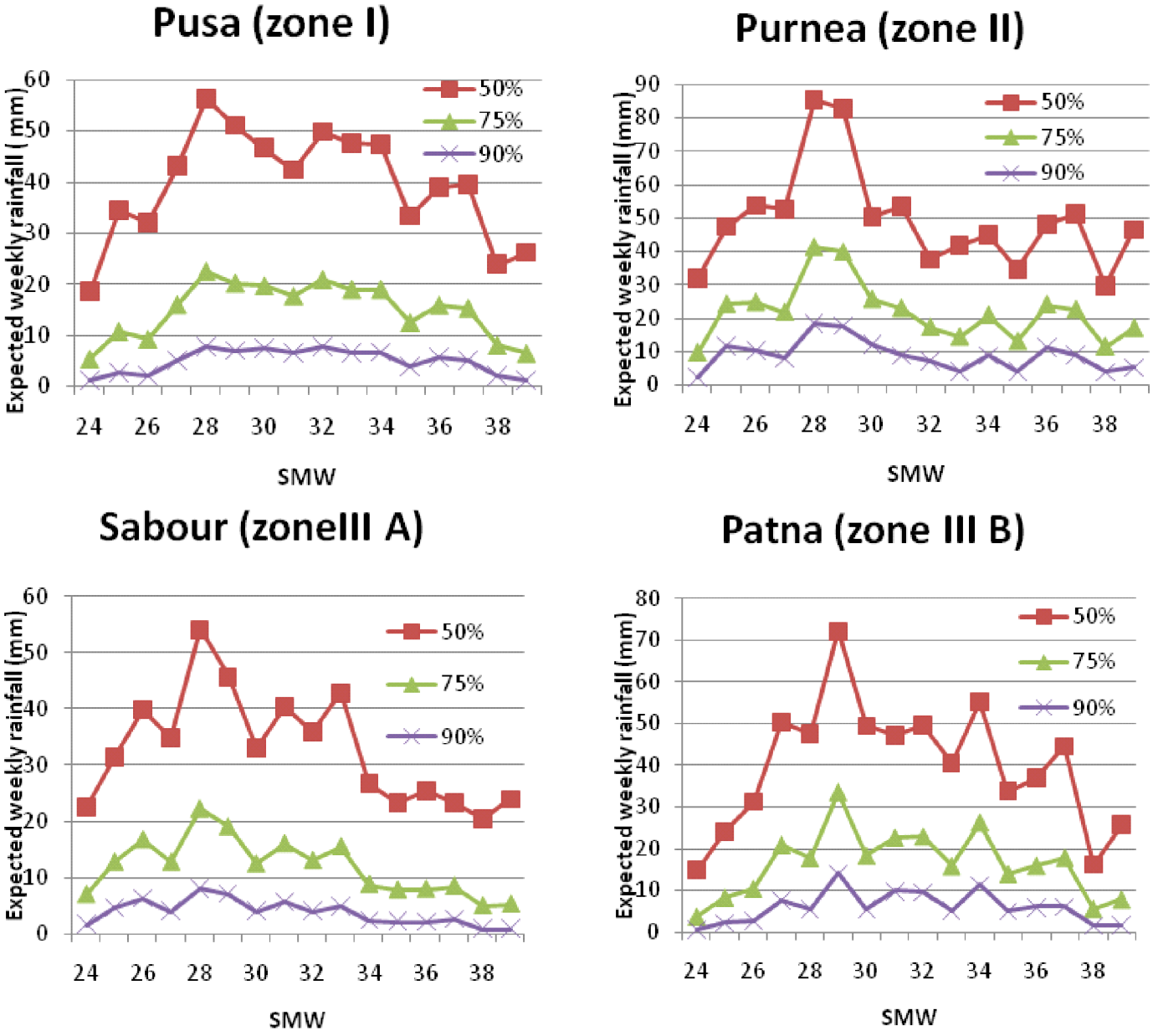

Fig 1: Expected weekly rainfall amount (mm) at different probability level (%) in four districts representing different zones of Bihar

28th and 29thweek probability of receiving more than 30 mm rainfall is more than 75% which is sufficient amount of rainfall for transplanting of rice in the region. In Sabour and Patna region, the probability of more than 10 mm rainfall is above 75 % from 25th and 26th SMW respectively. The probability of receiving more than 20 mm rainfall in the regions are from 28th and 29th week respectively in which transplanting of rice can be completed.

Major crop of the region is rice, which is highly dependent on monsoon rainfall for nursery bed preparation, transplanting and maintenance of water in the field. Analysis indicates the need for selection of crops according to the probability of getting wet weeks preceded by wet weeks with the onset of southwest monsoon in the region. Timely monsoon will favour selection of long duration and high water requiring crops like rice. Late monsoon will lead to selection of crops with medium duration and moisture stress tolerant crops like ragi, finger millet and sorghum, in the moderate rainfall districts, where erratic monsoon behavior is observed. Pulses like green gram and black gram, need to be selected often as intercropping based on varied rainfall situation. Direct seeded rice can be adopted in that situation. Analysis reveals that past rainfall record may be handy tool for future rainfall probability projections.

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REFERENCES

Chow, V.T. (1964). Statistical and Probability Analysis of Hydrological Data. Hand book of applied Hydrology. V. T. chow editor, Mc Graw Hill, New York pp 81-89.

Hundal, S.S. and Kaur Prabhjyot (2002).Annual and seasonal climatic variability at different location of Punjab state.*J. Agrometeorol*., 4(2): 113-125.

Ravindrababu, B.T., Rajegowda, M.B., Janardhanagowda, N.A., and Girish, J. (2010). Weekly, monthly and seasonal rainfall at Bengaluru in Karnataka, *J. Agrometeorol*., 12(2): 263-265.

Serrano.,Mateos, V. L. and Garcia, J.A. (1999). Trend analysis of monthly precipitation over Iberian Peninsula for the period 1921-1995.*Phys. Chem. Earth,* 24: 85-90.

Sharma, H.C., Chauhan, H.S. and Sewa Ram (1979). Probability analysisof rainfall for crop planning. *J. Agri. Eng.,* 16: 887:34.

Singh, K. A., Sikka, A. K. and Rai, S. 2008. Rainfall distribution pattern and crop planning at Pusa in Bihar. *J. Agrometeorol.,* 10 (2): 198-203.

Sneyers, R. (1990). On the statistical Analysis of series of observation.*WMO Tech. Note No.143, Geneva.*

Suchit, K., Behari, P., Satyapriya, Rai, A. K. and Agrawal, R. K. (2012). Long term trends in rainfall and its probability for crop planning in two districts of Bundelkhand region. *J. Agrometeorol*., 14 (1): 74-78.

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