Scholars Journal of Agriculture and Veterinary Sciences **e-ISSN 2348–1854**
Sch J Agric Vet Sci 2014; 1(4):168-172 **p-ISSN 2348–8883**

An International Publisher for Academic and Scientific Resources) DOI: 10.36347/sjavs.2014.v01i04.005

Nakshtra based rainfall analysis and its impact on rabi crops yield for Patna, Bihar

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Abstract: Agriculture is a dominant aspect of life in rural India and is managed using predominantly traditional farming techniques. Every farmer manages his resources and his livelihood depending upon his ability. In the modern developmental efforts, knowledge of such indigenous practices provides valuable inputs to make efficient use of natural resources. In this paper authors tried to compile the indigenous knowledge related to rainfall prediction based on experiences of the farmers its relationship with wheat and rabi maize yield. Rainfall during Anuradha (Nov19-Dec 2) nakshtra had positive correlation with respect to rabi maize yield whereas rainfall of Anuradha followed by Vishaka, Jyeshta , Moola and Purvashada had positive influence on wheat yield.
Keywords: Indigenous Knowledge, Maize, Nakshtra, Rainfall and Wheat yield

INTRODUCTION

Agriculture sector in developing or developed countries depends on climate and climatic resources. Temperature and rainfall are most important climatic parameters affecting agricultural production. The Intergovernmental Panel on Climate Change [1] and other researchers stressed the need to study the impacts of climate change on agricultural production at local, regional, national and on global scales to capture the local conditions. Timely assessment of the effects of climate change on agriculture might help adopt suitable farming techniques to maximize agricultural production. Simulation studies are useful in predicting future climate scenario based on changing trends in temperature, CO_2 and rainfall etc. Increasing trends of rainfall and minimum temperature in Gangetic plains of Bihar was observed [2]. Weather generators can be used to generate long term weather data wherever data is not available for impact studies. One such generator is LARSWG which was used and produced similar observations of rainfall and temperature as actual weather data for Bihar in eastern India [3]. Markov chain approach is also useful for analyzing rainfall probability for rice-wheat planning [4]. Several workers have reported future crop production based on simulation studies [5, 6, 7, and 8]. Wheat yield in Patna and Ranchi showed a declining trend due to increased temperature (thermal stress) coinciding with grain filling stage of crop [9]. Simulation studies showed that long duration rice varieties are more prone to yield decline under future climate scenarios [10, 11 and 12]. A pre assessment of the effects of climate change on crop yield can help in developing management strategies to overcome the negative effects of anticipated changes in climate.

Farming community has built up an intimate knowledge of their environment differing by locality, group and individual and it is always relevant to needs, demands and realities. This does not mean modern scientific knowledge is of no use or less use, but it has its own validity and value. Farmers have accumulated indigenous knowledge of their environment over the years to find solution to management problems by taking series decisions and implementing them by allocating resources in a manner to be the most effective or efficient for anticipated weather. Analysis of traditional wisdom of farmers in crop planning is more relevant in changing climate scenario.

Traditional knowledge and practices can play very important role as they have stood the test of time and have proved to be effective. Some of these traditional practices are in the fields of crop production, mixed farming, water harvesting, conservation of soil, production systems, biodiversity conservation, forestry and domestic energy etc. Indigenous knowledge is seen as central point of all discussions on sustainable resource use and balanced development [13]. Sustainable development could not be achieved unless local technical knowledge is not considered [14]. To ignore people's knowledge is almost to ensure failure in development [15]. The indigenous technical knowledge available with farming community should be integrated with the scientific knowledge and practices and

communicated widely to enhance benefits in crop production [16].

Indigenous Knowledge

Indigenous technical knowledge is the local knowledge acquired from ancestors and is an immensely valuable resource that provides mankind with insights to interact with their changing environment. Farmers adopt a wide range of agricultural practices based on long experience, informal experiments, and deep understanding of their biophysical and socio-cultural environments. ITK is a sum total of knowledge and practices, based on people's accumulated experiences and practices especially to particular area [17]. ITK as practical knowledge of the environment based on intimate experience accumulated over many generations [18]. Indigenous knowledge is a dynamic and collective experience of generations [19]. Understanding and working with indigenous knowledge and decision-making system could enhance participation, capacity building and sustainability in a cost effective way [20]. Indigenous system has an advantage that they were widely known by the people of the region and could easily improve communication between farmers, extension agents and scientists [21]. ITK may generate ideas for future research, and may have scientific basis, so ITK may be alternative, an inexpensive substitute and complementary to modern technologies.

This paper aims to compile and disseminate the indigenous knowledge related to climatic parameters, their forecasting during different time periods of a year (Nakshtra-14 day period) based on experiences of the farmers and comparing indigenous knowledge with the modern scientific analysis of weather data and their relationship with wheat and rabi maize yield.

METHODOLOGY

Information on ITKs, collected through survey of different districts of Bihar by interaction with farmers. The information on rainfall prediction was interpreted, compiled and described. Rabi maize and wheat yield data of Patna for past 25 years were collected from Department of Agriculture, Bihar. Nakshtra based rainfall amount and its trend was computed and then correlation between yield of wheat and rabi maize with rainfall worked out for November and December months for the period 1987-2010.

RESULTS

Some Common knowledge and observations used by the farmers to predict rainfall occurrence, its intensity and duration etc. and manage their farming accordingly, are stated below and correlation is given between crop yield and rainfall.

ITKs related to rainfall predictions
Sayings related to rainfall prediction

1. *Auwa bauwa bahe batas, Tab howe barkha ke aas*

If in the rainy season wind starts blowing irregularly that has no fixed direction, nor can any fixed speed then rainfall be expected shortly.

2.Phule kaas sakal mahi chhai ,Jenu varsha krit pragadh budhai

If *Saccharum spontaneum (Kass)* starts flowering then even though clouds remain in the sky the rainfall probability is less.

3. *Abajhor chalai purvai , Tab jano barsa ritu aai*

If strong winds blow from eastern direction continuously, then the arrival of rainy season is indicated.

4. *Maghe main bader lali dhare, Ab sach jano pathra pare*

If clouds appear reddish during 21st January to 19th February (Magh nakshtra) hailstorm may be expected shortly

5. **Lag maradh door varsha, Door maradh lag varsha**

Rainfall can also be predicted by looking at the size of halo of moon; smaller the halo farther is the rain and vice-versa. This is related to humidity in the atmosphere. Smaller halo indicates less humidity (moisture) in the atmosphere leading to less probability of rain.

6.Din main garmi rat main os, Kahai ghagh barsa sau kosh

If the days are hot and sunny, the nights are clear and dew falls then rain is far away

7. *Je din jeth bahe purvai,Ohi din sawan dhool udai*

The number of days during the period of mid May to mid June (Jeth) during which the eastern wind blows bringing rain, for the same number of days there may be no rainfall in the period of (mid July to mid August).

8. *Purb mein inderdhanush, pashchim me uge bhan, varsha howe sanjh bihan*

If in a day sun becomes visible only in evening and the formation of rainbow is in east then rain occurs in morning and evening.

9. *Sawan pachchua menh bhare , bhado purva kado sade*

If clouds cover the sky and westerlies blow during Sawan month and easterlies during Bhado month then ample of rain occur.

10. *Singh garje to sab nakashtra barse, dher ya thoda*

If thunderclaps are heard during July-august then it will rain in every month

11.Ka varsha jab krishi sukhani, samay jat puni kya pachtane

Rainfall after proper time is useless

12. *Din mein gher-ghar raat mein nibadra, kahe ghagh ki barkha goil*

Cloudiness during daytime and cloudless sky at night indicates cessation of rainfall period.

13. *jab purva purwaiya pave, sukhal nadi mai nav chalave*

If easterly winds blows during August then boats will roe across dried rivers (rivers will be flooded)

14. *Lal peela bhaya akash, tab nahi samjho barkha ki aas*

Colour of sky is reddish yellow , rain will be far away

15. *Din badal raat tara, aankh pasar kar dekho maara*

Daytime cloudiness and clear nights indicate no rainfall shortly

16.Shukarvar ki badli, rahe shanichar chaye kahe gagh sun bhandri bin barse nahi jaye

Friday and Saturday remains cloudy then rainfall is certain.

Rainfall amount, trend and its relationship with crop yield

Maximum mean rainfall over the period 1961-2010 was observed for Punarvasu nakshta followed by Pushya and Makha Nakshtra. Rainfall shows positive trend from end of May to mid-September except Pushya nakhtra where decreasing trend of rainfall is observed for 13-14 days period. From end of September to end of October a negative trend is observed. Thereafter a mixed trend (alternatively two nakshtra showing downward and one nakshtra showing upward trend) in rainfall was observed. Least amount of mean rainfall was recorded for Jyeshta nakshtra (Table 1). Anuradha nakshtra shows maximum value of positive correlation coefficient between rainfalls, wheat and maize yield as given in table 2.

Table-1: Rainfall pattern for different Nakshtra in Patna station over the period (1961-2010)

Nakshtra	Period of the year	Mean Rainfall (mm)	Max Rainfall (mm)	Linear Trend
Rohini	25 May-7 June	28.59	245.22 (2006)	I
Mrigshira	8 Jun-21Jun	62.29	312.83 (2008)	I
Aridhra	22 Jun -5 Jul	117.91	439.6 (1981)	I
Punarvasu	6 Jul -19 Jul	174.10	559.2 (1997)	I
Pushya	20 Jul -2 Aug	135.84	449.9 (1974)	D
Aslesha	3 Aug-16 Aug	115.82	517.01 (2007)	I
Makha	17 Aug - 30 Aug	130.01	305.9 (1969)	I
Purbha	31 Aug -12Sep	86.72	288.6 (1987)	I
Uttara	13 Sep-26 Sep	90.83	466 (1967)	D
Hasta	27 Sep-9 Oct	72.10	384.4 (1975)	D
Chitra	10 Oct-23Oct	21.13	234.6 (1985)	D
Swathi	24 Oct-5 Nov	4.69	71.7 (2003)	I
Vishaka	Nov 6 to Nov 18	5.25	76.2 (1969)	D
Anuradha	Nov 19 to Dec 2	2.09	24.6 (1972)	D
Jyeshta	Dec 3 to Dec 15	0.86	27.6 (1997)	I
Moola	Dec 16 to Dec 28	3.54	57.7 (1995)	D
Purvashada	Dec 29 to Jan 10	2.99	29.3(1966)	D
Uttarashada	Jan 11 to Jan 23	5.43	35.7 (1996)	I
Sravana	Jan 24 to Feb 5	5.33	32.6 (2003)	D
Dhanishta	Feb 6 to Feb 18	7.11	66.6(1986)	D
Shatabhista	Feb 19 to Mar 3	5.95	48.6 (1984)	I
Poorva Bhadra	Mar 4 to Mar 17	3.93	49.22(2007)	D
Uttara Bhadra	Mar 18 to Mar 30	2.74	21.1(1967)	D
Revati	Mar 31 to April 12	1.54	20 (1997)	I

I - increasing trend; D - decreasing trend

Table 2: Correlation between rainfall and crops yield for Patna (1987-2010)

Crop	Time Periods							
	Vishaka (Nov 6 - Nov 18)	Anuradha (Nov 19 – Dec 2)	Jyeshta (Dec 3-Dec 15)	Moola (Dec 16-Dec 28)	Purvashada (Dec29 – Jan10)	Nov.	Dec.	Nov-Dec
Wheat	0.33	0.34	0.18	0.22	0.06	0.49	0.30	0.43
Rabi Maize	0.05	0.26	-0.26	-0.01	-0.06	0.15	-0.13	0.008

Rainfall during rabi season is beneficial for maize and wheat crops is presented by some ITKs

1.*Echo paani jo barse swati, kurmin penhe sona pati*

Means during swati nakshatra rainfall is very useful for irrigated areas for proper soil moisture for higher yield in rabi crops

2.*Aghan dhan uh raaj ,dhan uh desh, jahan barse aghan ses*

Rainfall durng rabi is ver important for higher yield of rabi crops

3.*Paani barse adha poos, adha gehun adha bhoos*

Rainfall during mid –December month is very beneficial for higher yield of crops.

4.*Maagh mase barse deva, raja chede prajar seva*

Rainfall is beneficial if it occurs in maagh month.

DISCUSSION

By observing relationship between rainfall and crop yield, it is found that rainfall during November followed by December month has more pronounced effect on wheat yield and positive correlation for rainfall of November on maize yield. With respect to different nakshtras falling in November and December, only rainfall during Anuradha (Nov19-Dec2) nakshtra had positive correlation with respect to rabi maize yield whereas rainfall of Anuradha followed by Vishaka, Jyeshta ,Moola and Purvashada had positive influence on wheat yield.

Need to preserve ITKs

Rapid changes in environmental, social and economical factors and moral values, younger generations have different values and lifestyles due to the effect of globalization and so traditional communications are left behind. Researchers can assist in preserving ITKs through the following ways:

1. Documentation of ITKs should be done so that both the scientific and local community have easy access to it and can utilize it for farming operations.
2. Awareness in the community about the value of ITK should be communicated through various modes and means in an interesting way so that people are encouraged to take of their traditional knowledge.
3. Availability of ITKs should be ensured to all through newsletters, videos, books and other media.
4. Benefits of using ITKs should be popularized so that side effects of modern techniques implemented in farming should be minimized blending them with old techniques of farming.

CONCLUSION

Indigenous knowledge is an empirical and dynamic form of knowledge. It is an indicator of weather conditions affecting crop yields and suggests the ways of management accordingly. Often, farmers take decisions related to farming based on this knowledge. The paper is an effort to list some of ITK related to rainfall and relationship of rainfall to crop yields of wheat and rabi maize at Patna in Bihar. Rainfall during November –December especially during Anuradha nakshtra is beneficial for wheat crop. This knowledge of ITKs will help in providing good knowledge having blend of experiences of old people and novel ideas of young generations for acceptability to farmers.

ACKNOWLEDGEMENT

The study is funded by ICAR through network project on climate change. The authors wish to express gratitude to ICAR for the funding of this research work at ICAR-Research Complex for Eastern Region, Patna. We also wish to thank the farmers of Bihar for sharing their knowledge and experiences during the survey.

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