

## FORECASTING AND VALIDATING REAL TIME RAINFALL OBSERVATIONS WITH TRADITIONAL VEDIC TECHNIQUES AT GOVARDHAN ECO VILLAGE

**Malathi Iyer, Ph. D.**

Associate Professor, Vivek College of Commerce, (Affiliated to Mumbai University)

Siddharth Nagar, Goregaon west, Mumbai 400104 Email: mala392000@gmail.com

### Abstract

Ancient Vedas in their Sanskrit texts have given rainfall prediction techniques on specific days yielding useful results. India has predominantly rain nurtured Agriculture and hence is solely dependent on rainfall and rainfall prediction has utmost importance. Amongst various astro-meteorological methods for rainfall forecasting Parasar Muni, Aryabhata, Varaha Mihira found out the science to predict and measure rains. The Krishi Parashara gives simple models for predicting rains. Rainfall prediction is important by modern as well as astro-meteorological methods. Every village had been following the rainfall prediction. Today climatology applies to different areas, but the Vedic method helps to predict rainfall on a daytime to hours of daylight basis whether a specific vicinity would get rains or not. For that, the viewer must be present on the place on specific days. Rainfall over an area is very significant from water management forecasting and regulation aspect. The forecast of rainfall adds and helps in scheduling the activities of farmers, real estates, supply of water, cultivation management, engineering department and others. long term forecasting and planning can be accomplished by two methods, namely Vedic method of forecasting and scientific weather forecasting. Traditional projections are based on systematic annotations and skill using blends of floras, faunas, pests, climatological and astral indicators, and almanacs or Pachanga's over a period of time. The traditional weather estimates can be checked on past records of climate prevailed in the area using mathematical models. During the study, the rainfall calculations by one of the traditional methods of Akshaya Tritiya is studied in wisdom by seeing the actual rainfall over Govardhan Eco village at Wada for 6 years. The basic aspect used by the predictors is the wind direction. This technique has made GEV an award winning eco community and has impacted the lives of over 350 tribal farmers in Wada Taluka. Charts showing the movements of prediction and actual were drawn which indicated the same pattern in both. The ancient approaches of forecasting rainfall cannot be altogether overlooked and there is need to identify and assess the old literature and techniques of spoken civilisations across varied climatic zones.



[Scholarly Research Journal's](http://www.srjis.com) is licensed Based on a work at [www.srjis.com](http://www.srjis.com)

Indian agriculture is solely dependent on rainwater and rainfall prediction has utmost importance where, half of our nation needs irrigation facility. India receives 75% of rains throughout June July August and September of monsoon season. Agriculturists in different areas of the nation from ancient time have developed different traditional means and ways for the predicting precipitation all around the nation. This knowledge of rain forecast is built on several inferred data such as wind direction and climate, formation of clouds, several bio

indicators like blossoming of flowers some particular plants, emblematic behaviour of flora and fauna, position of planets and stars, Indian almanac etc.

This study of Vedic rainfall prediction takes us back into the ancient vedicknowledge of prediction of rains based on works at Govardhan Eco Village. The study divulges that many such native practices prevails in every state of the nation and folks especially, the farmers, depend onthis information to start their cultivation according to predictions of rainfall. Thus, it is felt that if this original information when combined with the latest information expertise, the forecast of the weather conditions and climate related data will be more accurate and resourceful. This will in turn help mitigating various climate calamities such as flood, drought, famine etc. to great extent.

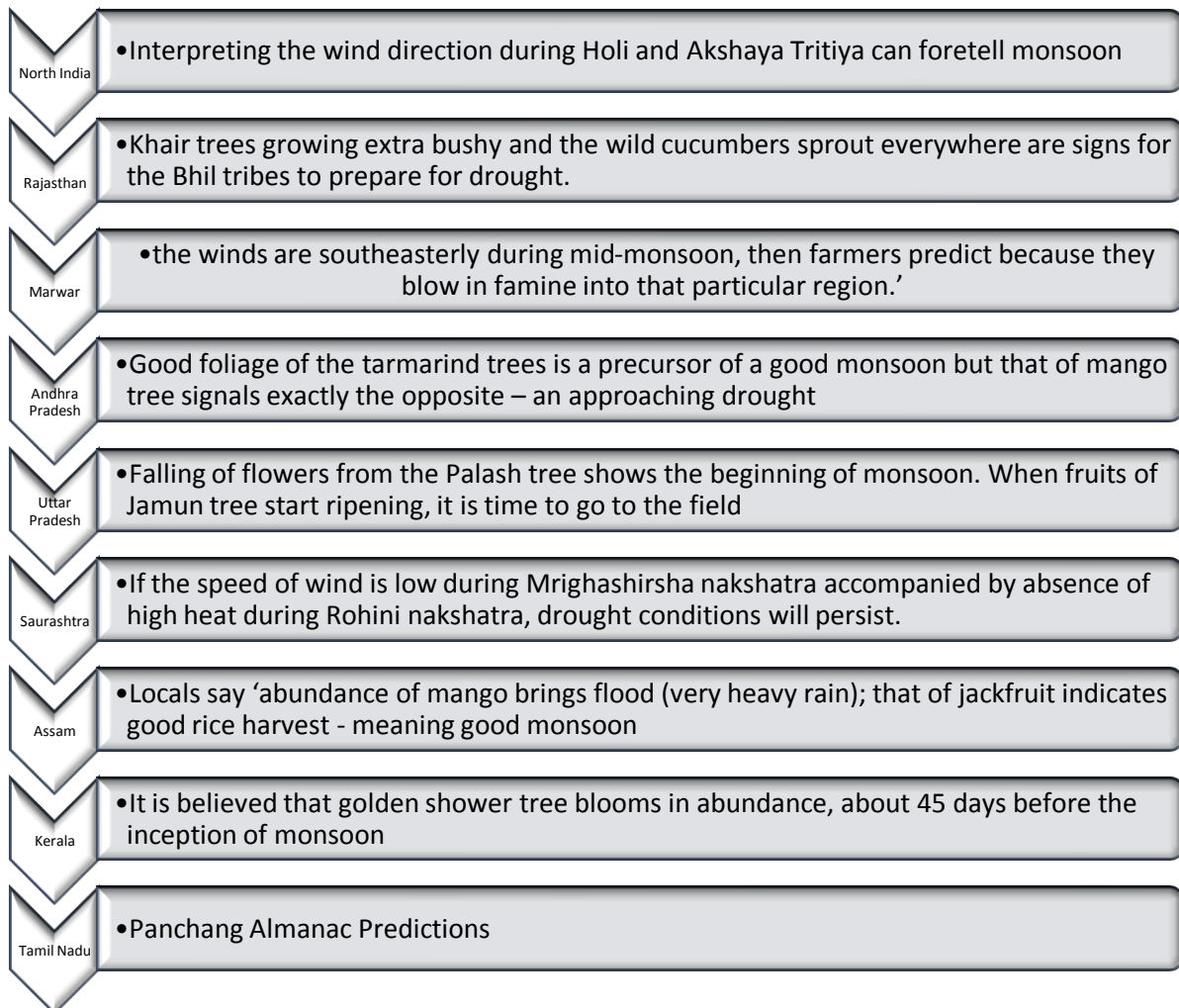
For ages, the earliest ways of predicting rainfall have generated useful results and the Meteorologists use high-tech gadgetry to predict monsoon. Amongst calendar, which includes climate approximations and agriculturalists' planting time are the most popular one. In India, Panchang, the traditional Hindu calendar, gives the forecast accurately for rains and advice agriculturalistsfor cultivation right at the commencement of the Indian calendar year. The Panchangs are being used since 4th century BC in India. In India,traditional forecasts of rains have been made through observation of sudden change in behaviour and presence of various insects, animals and birds. Observation and recording the path of wind during Holi and Akshaya Tritiya can forecast rains. The wind from northern or western direction advises good rainy season while wind from east indicates drought.

### **Review of Literature**

The methods of predictions for rain has been traditional and astrological with changes in temperature. Long before the start of modern technical methods for projections and climate of rainfall every year, agriculture continued successfully with exceptions of regular.

According to Iyengar (2009) year to year variation of Indian Rains is described qualitative in our ancient Sanskrit texts. It has left its imprints in all types of literature starting from theRigveda

### Different areas in India have different traditional practices of rainfall prediction.



Source: Pisharoty, 1993; Kanani and Pastakia, 1999

Vedic traditions have a set of information which 'we can know more than we can tell'. They are often deep-rooted, dispersed, agreed upon and tested among the local specific livelihood and resource dependent communities (Santha et al, 2010). Thus, from ancient time they become a principle with widespread belief that is not projected to be strictly accurate or reliable for every state. It is a simple technique that can be learned for approximate calculations for making forecasts of rainfall of the local people in that particular area.

All across India different methods and theories are followed, and is time tested. This ancient knowledge of forecasting the rainfall is based on sound systematic and mathematical principles and calculations.

These practices mixed observations of wind direction, climate pattern, astrological phenomena, features of rain and celestial bodies and the similar set of information utilized by IMD in their numerical model with various other bio pointers such as blossoming of specific

plants, representative behaviour of insect, animals and birds etc. Based on these explanations, there originates various climate associated sayings among the local folks.

India's Monsoon starts from Kerala, the golden shower tree (KaniKonnu) blossoms in plenty, about 45 days before the beginning of monsoon (Pisharotty, 1993; Kanani and Pastakia, 1999).

Agriculturalists in Kerala believe that heavy rainfall will follow very warm summers. They anticipate heavy rain within few hours if the sky attains a dark colour- 'as dark as the crow's egg' (Kanani and Pastakia, 1999).

It is found that the winter monsoon thunderclouds usually give the impression when 'clouds are over the pounding shed' which are built at northwest corner of the house according to Vaastu and it rains (Nair, 2004).

Similar such observations are also found in different parts of the country. In Saurashtra, farmers forestall drought if 'the velocity of wind is low during Margashirsha constellation, accompanied by absence of high heat during the Rohini' (Kanani et al, 2004).

In Northern India, the understanding of the direction of wind during Holi and Akshaya Tritiya can foretell monsoon- 'wind from north or west suggests good monsoon while wind from east indicates drought' (The Economist, 2001).

Given below are some of the main native techniques and ways of rainfall prediction throughout the country

### Indicators of Rain by Flowers and Fruits

FLOWERS & FRUITS	INDICATOR	EXPECTED OUTCOME
Bahava	In Melghat, a local flower called 'Bahava'	Blooms 40 days before monsoon sets in
Golden Shower Tree	blooms in abundance,	About 45 days before the inception of monsoon
Mango	'abundance of mango brings flood	(very heavy rain)
Jackfruit	indicates good rice harvest -.	Good Monsoon
tamarind trees	Good foliage	Good Monsoon
Palash Tree	Blooms	Good Monsoon
Jamun Tree	Ripens	Time to Rain
wild cucumbers	sprout everywhere	Drought
Khair Trees	Grows bushy	Drought
Mango	Flowering in January	Good Monsoon
Ebony	New Shoots of Ebony	Good Monsoon
Bamboo	Profuse Flowering	Good Monsoon
Night Flowering Jasmine	Large size of Buds	Good Monsoon
Kodoma	Begin to flower	Good Monsoon
Thummi Plant	Flowers	Good Monsoon
Mahuda	Good Foilage	Good Monsoon
Ber	Heavy Flush of Fruit	Good Monsoon
Darbha grass	Good foliage	Good Monsoon

Source: Pisharoty, 1993; Kanani and Pastakia, 1999

Balarama God of agriculture showed ways to cultivate the land and get more production. In Indian Almanac, the beginning of Chaitra (March-April) indicates the commencement of an agrarian year. And Baisakhi (April-May) as the preparatory month of agricultural activities. Sowing of seeds starts on Akshaya Tritiya.

For agriculture Chaturmasya is significant which comprises of four successive months, i.e. Aashaadha, Shravan, Bhadrava and Ashwin. In the process paddy should be imbedded with methodical distance from each other. Then only those vegetation's will be able to get substantial chance for healthy growth and finally it will assist in producing more yields.

### Behaviour of Animals and Birds before the Commencement of Monsoon

Behaviour of Animals and Birds on the commencement of monsoon		
Animals and Birds	Indicator	Expected Outcome
Crow	'crow crying during night	Drought
Owl	crying during the daytime'	Drought
Dragonfly	flying in a group at three to four meters from the ground level	indicates rain in the evening.
Goat	flapping their ears restlessly,	Incessant Rain
sheep	Huddling, Incessant Rain	Incessant Rain
owl	Hooting, Incessant Rain	Incessant Rain
Frog	coming out and croaking due to change in atmospheric pressure and resultant decrease in air underneath the rock, Incessant Rain	Incessant Rain
Peacock	Dancing	Incessant Rain
Caterpillars	Scurrying	Incessant Rain
Thriving Termites	Indicate Good Rain	Incessant Rain
Fox	Howls at Dawn and Dusk	Incessant Rain
Weaver Bird	The height at which the weaver bird builds its nest is another accurate indicator. If the nest is at a good height rains will be copious	Incessant Rain
Weaver Bird	. If the nest is low,.	Scanty rain
Ant colonies	Move enmassing	Incessant Rain
Fish	Small fish in large numbers on the shore	Monsoon Sets In
Chameleon	climbs the tree and assumes black-white-red colours-	Immediate Rain
Titodi or Lapwing bird	lay eggs during the night, especially on river-banks-	Heavy rains
Snake	dimbs up on trees	Drought
Camel	keeps facing north-east direction-	Immediate Rain

Source: Pisharoty, 1993; Kanani and Pastakia, 1999 Santha ,2010

Observation of swift change in behaviour and appearance of various insects, animal and birds also tends to indicate onset of rain or drought. It has been observed that approaching rainfall, there appears many butterfly, ants, termites, snakes etc. When 'sparrow soak in dust' or 'honey bees enter the hive and do not leave', one could expect rain in a couple of days (Santha et al, 2010). In fact, flora and fauna and creatures can sense wind shift, moisture and

gravity change and thus change their behavior. Insects with their antenna can sense increase in humidity. Goat becomes restless due to increase in humidity and resultant discomfort thus flapping their ears to cool down. Frogs come out due to change in the atmospheric pressure and resultant decrease in air underneath the rock, which is a positive sign of onset of rain (decrease in pressure) (Sujata, 2013).

According to Dr K Ravi Shankar, senior scientist from the Central Institute for Dryland Research in Agriculture, Hyderabad, has researched for three years in the villages of Anantapur, Visakhapatnam and Ranga Reddy areas of Andhra Pradesh and Telangana to collect information on folk insights. He followed the schedule method of data collection with village seniors who shared with him their inherent, almost cagy, traditional practices. In Andhra Pradesh and Telangana together 24 bio indicators and 42 non-bio indicators of rainfall forecast techniques were found.

According to Entomologist Dr D Jagadeeshwar Reddy says, "Insect movement is 100% reliable for rain forecasting." The way mosquitoes bite is different before the onset of rain. Ant clusters move carrying eggs and this is seen as an antecedent to rains. Thriving termites indicate rain too, says senior scientist Ravi Shankar

### **Research Methodology.**

For the present study, mixed methods of research with Akshaya Tritiya Vedic prediction technique at GEV with the predicted and actual quantities of rainfall.

Vedic /Traditional studies to measure rainfall prediction are divided into Analytical studies and observational studies. The analytical factors that are taken into deliberations at the sankhya process with study of sun, place of stars and planets, nakshatra constellation cycle study, Nandi pulse cycle study and the Observational studies are taken into contemplations for change in environment, observation of sky and clouds in sky, physical changes, chemical changes and study of natural indicators.

### **Method used for prediction of rainfall**

The analysis of forecasting rains at GEV is based on Akshaya Tritiya wind forecasting Rains. Durvasa muni has explained the following way to see the direction of winds at the twilight period. One should start to see the winds on Akshaya Tritiya day 96 minutes before sunrise early in the morning.

Mr. Vikram Bhat, an agriculturist from Pune has been promoting awareness of reviving the ancient practice of rainfall predictions. He has studied from 1998-2009 under direct observation found vedic predictions to give accurate results in successfully predicting the

rainfall specific to the regions, and thus helping the farmers. The beauty of this ancient technique is not only its accuracy, but also easy for anyone to predict rainfall in his region by following procedures of prediction.

**Prediction Techniques**

**Time measurement**

<b>Time</b>	<b>0-24 minutes</b>	<b>24 to 48 minutes</b>	<b>48 to 72 minutes</b>	<b>72 to 96 minutes</b>
Month	June/Jyeshtha	July/Ashada	August/Shravan	September/Bhadrapada

The Tools needed for the measurement are Board-2ftX2ft minimum, Chalk, Incense Sticks, Incense Stand, match sticks, Note Book, Pen/Pencil, Compass, Stop Watch, Clock/Wrist watch, Torch.

**Directions of Rainfall for measurement**

<b>East</b>	<b>North east</b>	<b>North</b>	<b>North west</b>	<b>West</b>	<b>South west</b>	<b>South</b>	<b>South East</b>	<b>Top</b>
No Rain	No rain	Low	Medium	High	High	Medium	Low	Very High

The daily rainfall prediction was prepared on Akshaya Tritiya according to Indian Almanac and the actual rainfall has been documented by the agricultural department of GEV (TarunNitai Das).For the present study, Govardhan Eco Village was selected. For undertaking the comparative study, i.e. for comparing the rainfall prediction made GEV with actual rainfall data, mixed research method was used Akshaya Tritiyavedic prediction technique, DRUPAmethod was taken for study and the prediction made by them in the months of June 2012 to September 2016 were compared with actual rainfall data recorded by the agricultural department of GEV Galtare on a day-to-day basis<sup>4</sup>.

Most of the information in this techniqueregarding rainfall forecasting is given in qualitative terms<sup>5</sup>. Methods used for day to day rainfall predictions have been made with five qualitative terminologies, namely very heavyrain, heavy rain, medium rain, low or little rain, and nil or no rainfall.

- a. **Onset of Monsoon:** The commencement of onset of monsoon is predicted according to the date of flowering of Bahua or Amaltus the following table gives the predicted date and actual onset date of rainfall.

Assessment Year	Date of flowering in Amaltus/Bahua	Predicted Date of onset of monsoon	Actual Date of onset of Monsoon
2012	26 April	10 June	7 June
2013	19 April	3 June	1 June
2014	29 April	13 June	14 June
2015	17 April	1 June	2 June
2016	16 April	31 may	31 may
2017	19 April	3 June	3 June

Source: GEV

**b. Vedic Techniques:** The accuracy of Vedic rainfall predictions and actual rainfall has been nearly 75% on average and this pattern has been taken on real time data prepared by Mohan Nimai Das for 2012,2013 and 2014 and TarunNitai Das from 2015 onwards. They prepared the data on Indian Almanac for the past two years. They have been validating their predictions every year. The frequency has been every day recordings of actual rainfall.

Concentrated effort was made to decipher these qualitative terms into appropriate quantitative terms with the help of existing works of eminent researchers.

The actual day-to-day rainfall data of rainfall were noted down directly from Govardhan Eco Village To associate the predictions with actual rainfall data, the range of actual rainfall/day were prearranged in similar fashion and is given below

**Data Interpretation of Pattern of Rainfall Prediction month wise for 2016**

The frequency analysis of rainfall intensity and pattern have been recorded in ranges of Very high, high, medium, low and nil and is shown in the table below.

Measurement of Rainfall in mm at GEV				
>than 50	25-50	10-25	1-10	0-0
Very High	High	Medium	Low	Nil
5	4	3	2	1

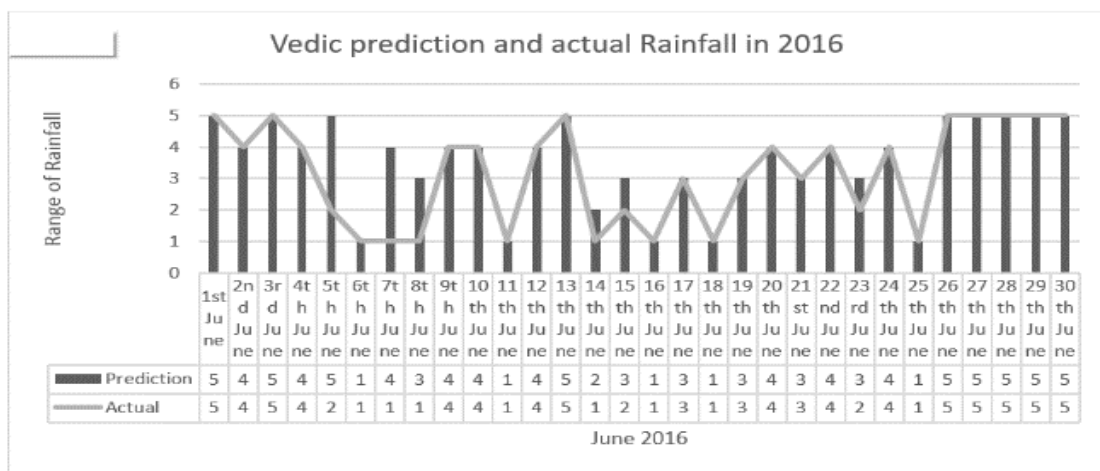
The rainy events have been studied on different ranges and the accuracy has varied between 66% to 90%.



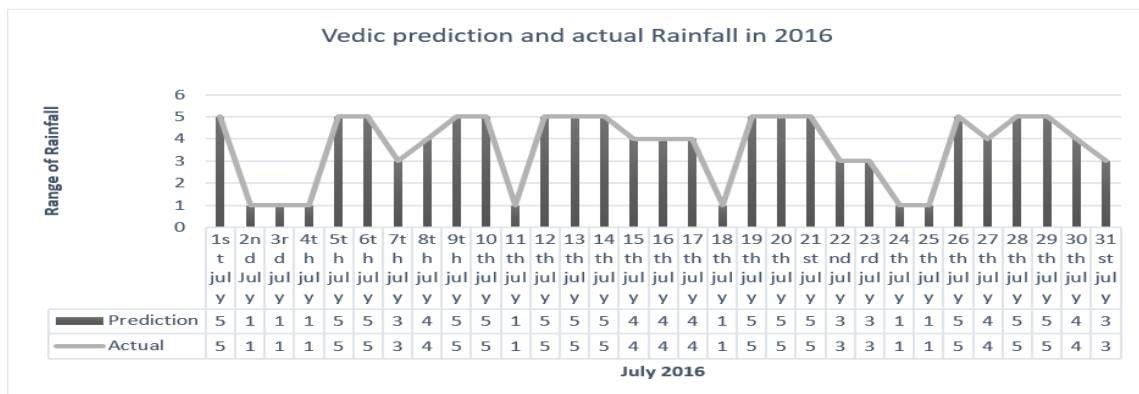
Vedic rainfall Measurement 2016

Measurement in mm		JUNE		JULY		AUGUST		SEPTEMBER	
		P	A	P	A	P	A	P	A
>than 50	Very high	9	8	14	14	8	9	5	5
25 to 50	High	9	8	6	6	6	2	8	6
10 to 25	Medium	6	3	4	4	8	5	5	0
0-10	Low	1	3	0	0	3	4	4	0
0-0	Nil	5	8	7	7	6	11	8	19

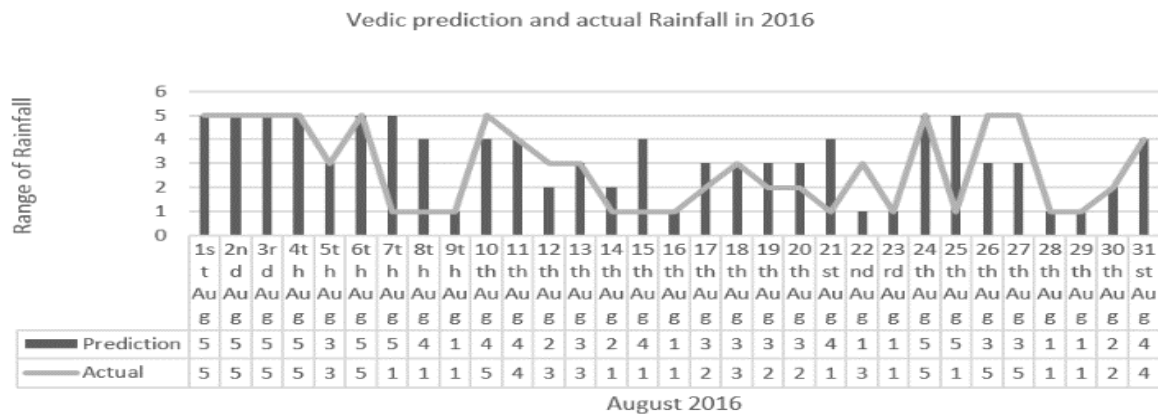
The pattern of prediction of rainfall of days that were shown are for 2016 and the actual data of predicted and actual data of occurrences are given above



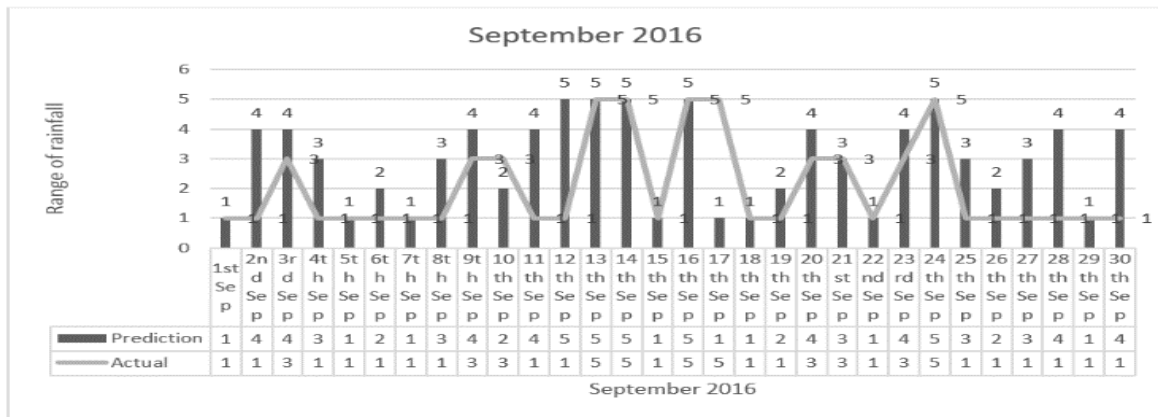
June Occurrences of pattern of rainfall predictions were nearly 70% of days where there was a narrow gap between nil and low matching of pattern from one range to another.



July Occurrences of pattern of rainfall predictions were 100% of days without any over prediction or under prediction.



August Occurrences of pattern of rainfall forecasts were 83.33% matching and (i.e.)25days out of 30 days.



September pattern of rainfall predictions were only 66.6% matching with actual rainfall and there was a dry patch of 19 days

**C.Drupa Technique for comparative analysis:**

The ancient texts show the indigenous knowledge which had techniques that are scientific where our country is known as a source of knowledge in weather forecasting. The data of GEV has been used for comparative study for localised rainfall prediction. The overall analysis has been done with Tibetan theory Drupa were taken for study and the predictions and actual data were compared for the years 2012 to 2016 and has been made in qualitative terms.

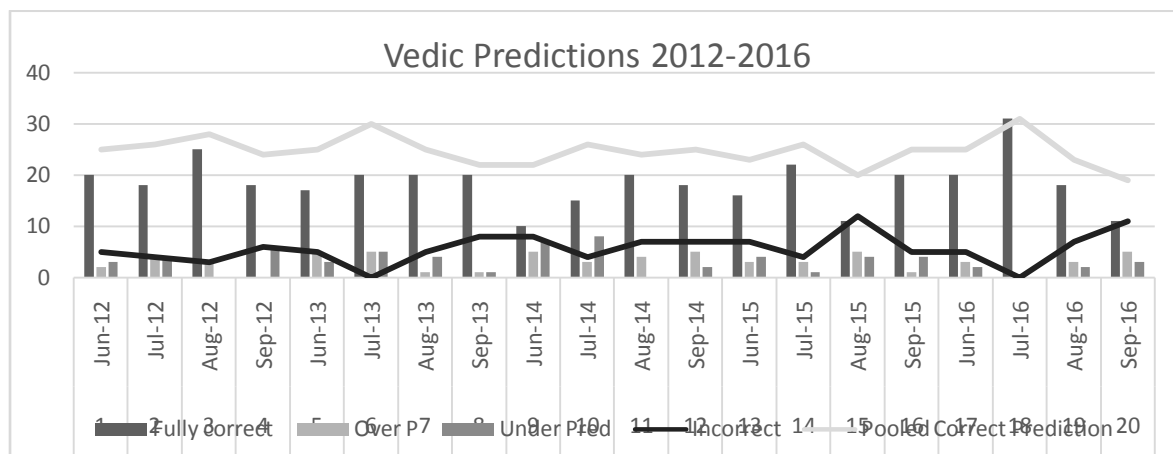
The raw data was calculated for counting frequencies of fully correct, over prediction, under prediction and incorrect prediction every day for June July August and September from 2012 to 2016. Rainfall month wise is important from agricultural point of view and efforts have been made to analyse predictions.

**Pattern of rainfall predictions and validation at GEV 2012-2016**

No of Months	Months	Fully correct	Over Prediction	Under Prediction	Incorrect	Pooled Correct Prediction
1	Jun-12	20	2	3	5	25
2	Jul-12	18	4	4	4	26
3	Aug-12	25	3	0L	3	28
4	Sep-12	18	0	6	6	24
5	Jun-13	17	5 H	3	5	25
6	Jul-13	20	5	5	0	30
7	Aug-13	20	1	4	5	25
8	Sep-13	20	1	1	8	22
9	Jun-14	10 L	5	7	8	22
10	Jul-14	15	3	8 H	4	26
11	Aug-14	20	4	0	7	24
12	Sep-14	18	5	2	7	25
13	Jun-15	16	3	4	7	23
14	Jul-15	22	3	1	4	26
15	Aug-15	11	5	4	12H	20
16	Sep-15	20	1	4	5	25
17	Jun-16	20	3	2	5	25
18	Jul-16	31H	0 L	0	0L	31H
19	Aug-16	18	3	2	7	23
20	Sep-16	11	5	3	11	19L

**Highest-H,Lowest-L**

The above table shows month wise range of comparative data the highest fully correct prediction recorded was 31in July 16 and lowest was 10L, the pooled correct prediction shows 31H in July 16 and 19L in September 16.



The forecast in the above chart shows a custom combo chart to show the predictions and actual rainfall year wise. The above diagram shows monthly range of correct, incorrect and pooled correct predictions.

## **Findings.**

On an average, the vedic predictions at GEV have shown 75% accuracy. The localised simple traditional vedic method is being taught to farmers and it is cost effective. There are no effective models based for predicting rains. It seems that technology do not have the necessary information to understand rain patterns. The null hypothesis has been rejected and alternate hypothesis of Rainfall predictions made on Akshaya Tritiya are on an average go hand in hand and in some cases at par with the actual data made at GEV agricultural department through vedic techniques and procedures, was accepted.

According to Meteorological Scientist Y S Ramakrishna traditional systems combined with scientific methods can give better forecasts of weather rather than depending on one method. The awareness and knowledge has to be supported with the objective of attaining precision in weather forecasts for improving agro-development." He also says that these methods are based on astrological parameters that are generated by watchful and methodical explanations and experience. "These are in no manner inferior to the research models used by modern scientists."

Director B Raji Reddy, from Agrometeorology Research Centre agrees, "Traditional methods have been in practice for a long time. But you have to associate bio-indicators with methodical data for dynamic weather readings."

Recently there have been failures in forecasting rains. Monsoon rains have become unpredictable. Sometimes it arrives early, followed by a dry spell. Then you have heavy rains at the end of the season, leading to floods and damage to standing crops. These vagaries have confused even birds and animals and they are trying to adapt themselves to the changing weather.

According to Pendse(2012) The monsoon predictions by the IMD, supported by technology and satellites, have gone haywire over a period and have affected the agricultural sector of our country. Failure to predict monsoon have far-reaching effects on a nation like ours, where its population is still dependent on rain. In future other parameters like yield forecasting and crop prospect of nearby villages can be studied and test their practical utility.

## **References**

- Ashok K., Guan Z. and Yamagata T., 2001, *Impact of the Indian Ocean Dipole on the between the Indian Monsoon Rainfall and ENSO Relationship*, *Geophysical Research Letters*, Vol. 28, No. 23, December 1, p 4501
- Angchok D, and Dubey V.K.(2005), *Traditional method of rainfall prediction through Almanacs in Ladakh*, *Indian Journal of Traditional Knowledge*, Vol 5 No 1, January 2006 pp.145-150
- Attri S.D. and Tyagi A., 2010, *Climate Profile of India*, *Met Monograph No. Environment Meteorology-01/2010*, p.2

- Cherchi, A. and Navarra, A., 2013, *Influence of ENSO and of the Indian Ocean Dipole on the Indian summer monsoon variability*, *Climate Dynamics* 41, p. 81–103
- Das Madan Mohan, Department of Agriculture, Govardhan Eco Village, Galtare(MH) India, Personal Communication 2017
- Das Tarun, Department of Agriculture, Govardhan Eco Village, Galtare(MH) India, Personal Communication 2017
- Goswami, B.N., 1998, *Inter annual variations of Indian summer monsoon in a GCM: external conditions versus internal feedbacks*. *Journal of Climatology*, 11, p. 501–521
- Goswami, B.N., 2012, *Long Range Forecasting of Monsoon Rainfall*, *Yojana*, Vol. 56, p. 33
- IMD, <http://www.imd.gov.in/doc/history/history.htm>
- IMD, 2014, *PRESS RELEASE*, 15th May, New Delhi
- Kanani, P. R., and Pastakia, A. 1999, *Everything is Written in the Sky!: Participatory Meteorological Assessment and Prediction Based on Traditional Beliefs and Indicators in Saurashtra*. *FiubiosJournal Asia and International Bioethics*, 9, p. 170-6.
- Kanani, P. R., Malavia, D.D. and Savaliya, V.J., 2004, *Validation of Traditional Meteorological Principles in Saurashtra, India*, *Conference Proceedings' Bridging Scales and epistemologies: Linking Local Knowledge and Global Science in Multi-Scale Assessments'* Alexandria, Egypt, March 17-20
- Lenka Balaram (2016) *Impact of Baladev Cult on the Socio-Economic and Religious Life of the People of Odisha* *Odisha Review Vol-LXXII No 12*, July 2016, ISSN-0970-8669 I
- Nair, K. S. 2004. *Role of water in the development of civilization in India: a review of ancient literature, traditional practices and belief*, *The Basic*, A IS Publication 256, December, p. 160-164.
- Pareek, A. and Trivedi, P.C., 2011, *Cultural values and indigenous knowledge of climate change and disaster prediction in rajasthan, India*, *Indian Journal of traditional Knowledge*, Vol. 10, No. 1, January, p. 184
- Pisharoty, P.R. 1993. *Plant that Predicts Monsoon*. *Honey Bee*, 4 (4): 12
- Ramnath, M., 1992, *Predicting the monsoon: Modern science vs. traditional wisdom*, *Third World Resurgence*, No. 18/19, Feb-Mar, p. 64
- Reuters, 2014, *Monsoon may arrive at Kerala coast in 24 hours; El Nino still a threat for 2nd half*, *Financial Express Jun 05*
- Santha, S.D., Fraunholz, B. and Unnithan, C., 2010, *A societal knowledge management system : harnessing indigenous wisdom to build sustainable predictors for adaptation to climate change*, *The international journal of climate change : impacts and responses*, vol. 2, no. 1, p. 51.
- Sarvesh, K. and Singh, A.K., 2013, *Traditional Agricultural Knowledge Followed by Tribal Farmers of Uttar Pradesh, India*, *Search and Research*, Vol-IV, No. 3, p.45
- Sujata C., 2013, *Predicting rain, Indian style*, *Al Jazeera*, December 20, p.4
- The Economist*, 2001, *Folk wisdom: Traditional weather-forecasting on trial*, November 22nd ISSN 0970-8669 <http://www.thehindubusinessline.com/news/variety/predicting-the-indigenous-way/article7099096>
- Pendse S (2012)  
[https://www.academia.edu/22128527/Traditional\\_Methods\\_of\\_Monsoon\\_Predictions\\_of\\_India](https://www.academia.edu/22128527/Traditional_Methods_of_Monsoon_Predictions_of_India).  
retrieved on 20.06.2017
- 25.Singh S. S. Vaidya and Rajagopal E.N. *Regional Model for Monsoon Prediction*, *Mausam* 41(2) 1990 265-268