Relevance of Indigenous Knowledge based Abiotic Indicators in Rainfall Prediction by Farmers of North Karnataka

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ABSTRACT

Farmers are very astute weather watchers and are quick to recognize weather that is either favorable or unfavorable to their production systems. The rural communities are likely to continue relying on their traditional methods of forecasting weather, which they claim to be important and reliable since the localized weather forecasting is normally not made available in the official weather forecasts. The paper presents 39 abiotic indicators used by farmers of north Karnataka based on appearance and movement of clouds, direction of winds, appearance and position of the sun and the moon, occurrence of rainbow, lightening, thunder and eclipse, and appearance of sky for forecasting rainfall. The associated rainfall predictions of these indicators, their awareness and relevance was measured in the selected three districts of north Karnataka as part of research project implemented for developing climate resilient adaptive strategies for empowering farmers. The study observed that majority of farmers in Gadag (89.74%) and Belgaum (89.74%) and Uttara Kannada district (66.66%) were noticed in medium to high category of awareness, and nearly 80.00 per cent of the abiotic indicators were rated in high to very high relevancy indices.

Key words: Awareness, Karnataka, Rainfall prediction, Relevance, Traditional knowledge

INTRODUCTION

Indian economy is mostly agrarian based (around 70.00 per cent of the population earns its livelihood from agriculture) having 67.00 per cent of country's net sown area under rainfed accounts for 44 per cent of the total food production. Similarly, Karnataka state in India is a predominantly agricultural state with 65.00 per cent of cultivated area under rainfed spread over varied topographical character ranging from coastal plains to gentle slopes and the heights of the Western Ghats. Hence, success of rainfed predominant agricultural activities is closely related to occurrence of rainfall which makes rainfall forecasting indispensable to farmers.

Since time immemorial farmers in India have been using astrology, study of clouds (sky features), direction of winds, position of the sun and the moon for forecasting of rain (Galacgac *et al*. 2009: Sivaprakasam *et al*. 2009). Above all, the accuracy of rainfall prediction dependent upon the correct interpretation of indicators developed through experience, skills and insights of people over generations (Anju and Bony, 2019). Despite the methods of modern technology farmers tend to use a combination of meteorological information and indigenous knowledge in their seasonal forecasting, as they primarily rely on indigenous knowledge but are also open to receiving scientific forecasts (Kolawole *et al*. 2014, Mapfumoa *et al*. 2015, Orlove *et al*. 2010, Roudier *et al*. 2014).

In view of this, farmers believe that indigenous knowledge of seasonal rainfall forecasting could be useful in decision making at village level to best exploit the seasonal distribution of rainfall. Thus, record of methods used to forecast rainfall in local communities is important since it addresses the needs for a particular community.

Hence, traditional methods of rainfall forecasting has the potential of being utilized for making modern weather related predictions more robust and effective but if not documented this rich knowledge of the people is likely to be lost forever. Keeping this in view, the study is designed to explore the indigenous knowledge based abiotic factors in rainfall prediction with related rainfall

forecasting.

METHODOLOGY

The study was conducted during 2019-2020 in the selected three districts of Karnataka (India) Gadag (North latitudes of 15° 15' and 15°45' and East longitudes of 75° 20' and75° 47'), Belgaum (North latitudes of 15° 23' and 16° 58' and East longitudes of 74° 05' and 75° 28') and Uttara Kannada (North latitude 13° 52' and 15° 31', East longitude 74° 09' and 75° 10') spread over two agro-climatic situations viz., Northern Dry Zone and Coastal Zone. From these selected districts the study area was demarcated based on the criteria of most vulnerability to climate change by considering more than 19 per cent rainfall deficit for the past 30 years rainfall data. Accordingly, villages Inamhongala, Asundi, Hosalli and Shyagoti in the Northern Dry Zone and in Coastal Zone Halavalli, Dongri and Kalleshwar villages were selected.

By employing exploratory research method the study made an intensive effort to discuss with age old and experienced farmers for detailed analysis of traditional knowledge based abiotic factors of rainfall prediction. Thus, 39 abiotic factors of rainfall prediction were finalized with associated rainfall predictions. Further, by following simple random technique and also considering the extent of involvement of farmers 90 farmers each from Gadag and Belgaum districts of Northern Dry Zone and 60 farmers from Uttara Kannada district of Coastal Zone were selected.

In the course of research, the finalized list of abiotic factors was used for measuring the awareness and relevance by the sample farmers. The awareness of the indicators were quantified over completely aware, partially aware and not aware continuum with the assigned weightages of 1, 0.5 and 0, respectively. Similarly, relevance of the indicators were quantified over the response continuum highly relevant, relevant, somewhat relevant, irrelevant and highly irrelevant with weightages of 5, 4, 3, 2, and 1, respectively. Finally elicited response was analyzed using frequency, percentage and mean index scores.

RESULTS AND DISCUSSION

In the study, the finalized 39 abiotic indicators with their associated rainfall forecasting (Table 1) and the summarized grouping of indicators (Fig. 1) brings to focus the highest percent of indictors were observed under type and movement of clouds (35.90%), followed by appearance and position of the sun and the moon (12.82%), occurrence of rainbow (12.82%), type and direction of winds (10.26%), and lightening (7.69%), appearance of sky (7.69%), atmospheric temperature (7.69%) and occurrence of thunder (2.56%) and eclipse (2.56%).

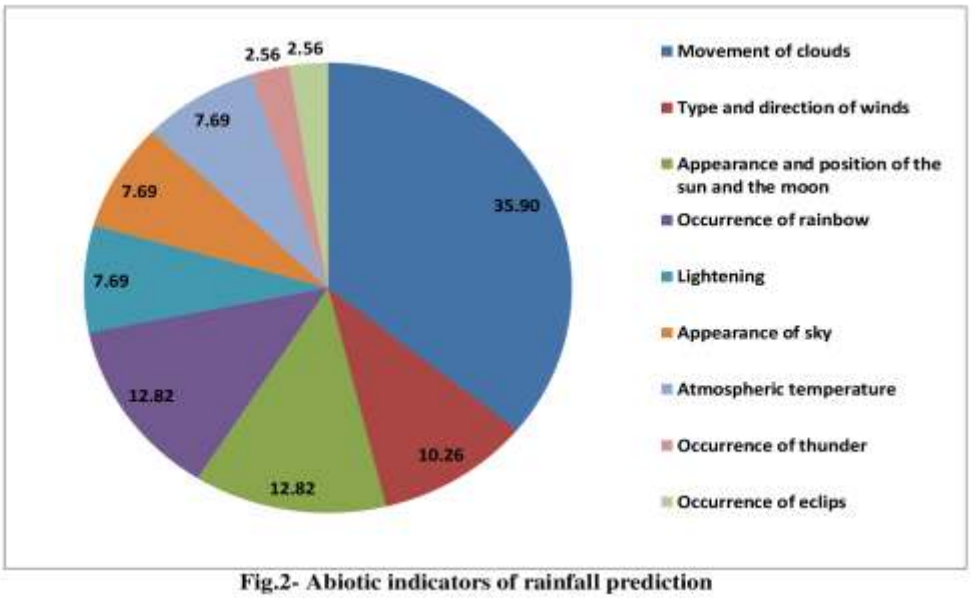

Fig.2- Abiotic indicators of rainfall prediction

The data in Ttable 2 depicts the distribution of farmers of Gadag, Belgaum and Uttara kannada districts in the mean awareness index of abiotic factors of rainfall prediction. The F-test results revealed that farmers in the study area differs with respect to awareness of abiotic factors of rainfall prediction. Further, grouping of indicators in the classified awareness categories (Table 3) highlight that more percent of indicators in high category of awareness has been observed in Gadag (48.72%) and Belgaum (58.97%) as compared to Uttara Kannada district (7.69%) was also found to support the results. This was due to the fact that farmers of Uttara Kannada district were not sure of observing the listed indicators because of their geographical location comes under low laying area and also surrounded by ghat section.

Further, the abiotic indicators were subjected to relevancy test by the farmers. The results presented in Table 4 brings to focus that relevancy of the indicators does not differs amongst the farmers of all the districts. This shows that established trustworthiness of traditional knowledge. The groupings of indicators under relevancy categories (Table 5) substantiates that nearly 80.00 per cent of abiotic indicators were rated in high to very high relevancy indices.

CONCLUSION

The traditional methods of rainfall forecasting may be riddle with inaccuracies but they cannot be ignored altogether as evidenced in the study that majority of farmers were aware of them and have shown their high relevance. Thus the present study was aimed to open an insight into indigenous knowledge based abiotic indicators of rainfall prediction which need to explored for rationalizing and test verifying them to produce more reliable and accurate forecasts for the farming community. The study does not deal with the comparison of scientific weather forecasting with indigenous forecasting or their integration in future to help diverse communities and hence, possible integration could be essential for the further study.

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Table 1

Identified indigenous knowledge based abiotic factors and their associated rainfall prediction

Codes	Identified Abiotic indicators in the study area	Associated rainfall prediction by the farmers	Reported past research studies
A	Rohini constellation (25th May -7th June)	Onset of S-W monsoon	Kanani and Pastakia 1999, Ravi Shankar *et al.* 2008.
B	Halo around the sun and moon	Rain follows (short range)	Ravi Shankar *et al.* 2008 Chhabra *et al.* 2014 Shoko and Shoko 2017
C	Smaller the halo around the moon	Farther is the rain	Chhabra *et al.* 2014 Shoko and Shoko 2017 Rengalakshmi Raj 2011
D	Moon surrounded by moisture (profuse halo)	Indication of good rain	Netshiukhwi *et al.* 2013
E	Appearance of full and shining moon	No rain	Mbewe *et al.* 2019
F	Ring around the sun and moon caused by light shining through sheet like high level clouds	Rainfall within the next two to three days	Rautela and Karki 2015 Ravi Shankar *et al.* 2008
G	Red / pink clouds in the morning	Possibility of rain	Rautela and Karki 2015 Ravi Shankar *et al.* 2008
H	Red / pink clouds in the evening	No rain	Rautela and Karki 2015 Ravi Shankar *et al.* 2008
I	Black clouds with no stars	Brings good rain	Rengalakshmi Raj 2011
J	Movement of clouds in a group from east to west during cyclone	Rain in next 2 days	Rengalakshmi Raj 2011

Codes	Identified Abiotic indicators in the study area	Associated rainfall prediction by the farmers	Reported past research studies
K	Dark rolling clouds with cool breeze	Heavy rainfall	Ravi Shankar *et al.* 2008, Anju and Bony 2019, Netshiukhwi *et al.* 2013 Rautela and Karki,2015
L	Stationary clouds during transition phase from S-W to N-E monsoon	Localized rains up to few hundred square km.(short range)	Ravi Shankar *et al.* 2008
M	Clouds with vertical development with thunderstorm and lightning	Heavy rainfall	Anju and Bony 2019
N	Overlapping clouds	Gives rain (short range)	Ravi Shankar *et al.* 2008
O	Low clouds moving opposite direction	Gives rain (short range)	Ravi Shankar *et al.* 2008
P	Clouds movement at right angles to each other	Possibility of heavy rain (short range)	Ravi Shankar *et al.* 2008
Q	Small streaks in the clouds	Expect rain in another 2 days	Rengalakshmi Raj 2011
R	Appearance of red colored lower clouds and black clouds at the top during evening	Expect rain in another 2 days	Rengalakshmi Raj 2011
S	Presence of water vapor and warm clouds	Possibility of occurrence of rain	Ravi Shankar *et al.* 2008
T	Day time increase in temperature during rainy season	Triggering of rainfall	Anju and Bony 2019, Mbewe *et al*. 2019, Risiro *et al.* 2012
U	Very hot and humid conditions in summer	Signify good chance of thunderstorms in rainy season	Ravi Shankar *et al.* 2008 Shoko and Shoko 2017
V	Low temperature at night	Late onset of rain	Ravi Shankar *et al.* 2008, Netshiukhwi *et al*. 2013
W	Rainbow in the west during S-W monsoon	Onset of S-W monsoon (short range)	Ravi Shankar *et al.* 2008 Anju and Bony 2019
X	Occurrence of red dominating rainbow	More rain to come (June-July)	Netshiukhwi *et al*. 2013
Y	Rainbow appears in the east in the evening or west in the morning	It will rain on that day	TNAU portal
Z	Rainbow in the sunny weather	No further rainfall	Ravi Shankar *et al.* 2008
AA	Appearance of rainbow during sunsets	Indicates rain is likely to fall in 3-4 days	TNAU portal Santosh and Chhetry 2012
AB	Rainbow in the east direction	Less rainfall/ absence of rainfall	Anju and Bony 2019
AC	Lightening in S-W during N-E monsoon	Indicative of rain (short range)	Ravi Shankar *et al.* 2008
AD	Lightening in the N-E before onset of S-W monsoon	Indication of good rains	Ravi Shankar *et al.* 2008
AE	Lightning in the east	Onset of rains after a gap of 7-8 hours	Rengalakshmi Raj 2011, Ravi Shankar *et al.* 2008
AF	Wind blowing from east	Commencement of monsoon	Ravi Shankar *et al.* 2008
AG	Wind in criss-cross direction after the commencement of rain	Give continuous heavy rain (short rain)	Ravi Shankar *et al.* 2008 Didal *et al*. 2017
AH	Occurrence of cool breeze with moisture	Indicates occurrence of heavy rain (short range)	Anju and Bony 2019
AI	Warm breeze in February-March	Upcoming rain	Anju and Bony 2019
AJ	Less thunder sequence	Gives rain (short range)	Ravi Shankar *et al.* 2008
AK	Reddish yellow sky	Rain will be far away	Rautela and Karki,2015 Chhabra *et al*. 2014
AL	Occurrence of dark sky near the horizon	Instant rain	Ravi Shankar *et al.* 2008
AM	The occurrence of an eclipse	Enhance chances of a good rainfall season	Shoko and Shoko 2017

Table 2
Awareness of abiotic factor indicators in rainfall prediction among the farmers

Abiotic indicators codes	Mean awareness index			
	Gadag district (n=90)	Belgaum district (n=90)	Uttara Kannada district (n=60)	Overall (n=240)
A	55.56	57.78	45.56	59.58
B	44.44	46.67	41.11	49.58
C	34.44	34.44	37.78	40.00
D	38.89	35.56	23.33	36.67
E	64.44	66.67	47.78	67.08
F	40.00	40.00	22.22	38.33
G	43.33	45.56	16.67	39.58
H	36.67	42.22	22.22	37.92
I	63.33	64.44	42.22	63.75
J	28.89	28.89	17.78	28.33
K	48.89	55.56	50.00	57.92
L	66.67	66.67	46.67	67.50
M	44.44	54.44	30.00	48.33
N	55.56	55.56	42.22	57.50
O	61.11	55.56	42.22	59.58
P	53.33	53.33	40.00	55.00
Q	33.33	33.33	21.11	32.92
R	27.78	27.78	16.67	27.08
S	23.33	23.33	22.22	25.83
T	22.22	22.22	11.11	20.83
U	72.22	72.22	52.22	73.75
V	72.22	72.22	52.22	73.75
W	23.33	23.33	11.11	21.67
X	54.44	55.56	38.89	55.83
Y	33.33	33.33	22.22	33.33
Z	36.67	36.67	25.56	37.08
AA	63.33	63.33	35.56	60.83
AB	28.89	28.89	17.78	28.33
AC	21.11	21.11	11.11	20.00
AD	66.67	66.67	44.44	66.67
AE	66.67	61.11	44.44	64.58
AF	63.33	63.33	45.56	64.58
AG	55.56	55.56	41.11	57.08
AH	71.11	73.33	48.89	72.50
AI	64.44	64.44	44.44	65.00
AJ	44.44	50.00	33.33	47.92
AK	55.56	55.56	33.33	54.17
AL	48.89	51.11	35.56	50.83
AM	51.11	51.11	32.22	50.42

F-test results for the awareness of abiotic factor indicators in rainfall prediction

GROUPS	Sum of squares	df	Mean square	F value	P value	F critical value
Between the group	11434.4	2	5717.199	33.63522	3.3E-12	3.075853
Within the group	19377.33	114	169.9766			
Total	30811.73	116				

Table 3
Overall distribution of Abiotic Indicators of Rainfall Prediction in the different categories of Awareness index among the farmers

Awareness categories	Gadag district (n=90)	Belgaum district (n=90)	Uttara Kannada district (n=60)	Overall (n=240)
Very High (> 75% index)	-	-	-	-
High (50-75% index)	A,E,I,L,N,O,P,U,V, X, AA,AD,AE, AF, AG,AH, AI, AK,AM (48.72%)	A,E,I,K,L,M,N, O,P, U,V, X,AA, AD,AE, AF,AG, AH,AI, AJ, AK,AL,AM (58.97%)	K,U,V (7.69%)	A,E,I,K,L,N, O,P,U,V, X, AA, AD,AE,AF,AG, AH,AI,AK,AL, AM (53.85%)
Medium (25-50% index)	B,C,D,F,G,H,J,K,M , Q,R,Y,Z, AB, AJ,AL (41.02%)	B,C,D, F,G,H, J,Q,R,Y, Z, AB (30.77%)	A,B,C, E,I, L, M, N, O,P,X,Z, AA, AD,AE, AF,AG, AH, AI,AJ, AK, AL,AM (58.97%)	B,C,D,F,G,H, J, M,Q,R,S,Y,Z, AB,AJ (38.46%)
Low (<25% index)	S,T,W,AC (10.26%)	S,T,W,AC (10.26%)	D,F,G,H,J,Q,R,S,T, W,Y,AB,AC (33.33%)	T,W,AC (7.69%)

Table 4
Relevancy of abiotic factor indicators in rainfall prediction among farmers of North Karnataka

Abiotic indicators codes	Mean relevancy index			
	Gadag district (n=90)	Belgaum district (n=90)	Uttara Kannada district (n=60)	Overall (n=240)
A	96.67	94.44	91.33	94.50
B	87.78	92.00	60.00	82.42
C	58.00	59.33	57.33	58.33
D	40.44	41.78	41.67	41.25
E	84.89	63.33	77.33	74.92
F	40.89	40.22	43.67	41.33
G	59.33	60.44	36.67	54.08
H	73.11	73.78	39.67	65.00
I	94.67	87.11	83.00	88.92
J	40.67	79.11	81.00	65.17
K	77.78	72.22	71.33	74.08
L	93.33	82.89	71.67	84.00
M	56.00	75.11	37.33	58.50
N	48.44	78.89	58.00	62.25
O	84.67	60.00	57.00	68.50
P	66.00	75.56	58.00	67.58
Q	38.44	40.44	39.33	39.42
R	60.67	39.56	81.00	57.83
S	40.89	40.67	52.33	43.67
T	70.00	76.44	68.33	72.00
U	83.11	85.11	90.00	85.58
V	78.22	70.22	63.33	71.50
W	82.67	84.00	64.67	78.67

X	56.67	88.22	82.00	74.83
Y	60.89	84.44	62.00	70.00
Z	46.89	40.89	66.00	49.42
AA	83.78	78.00	78.33	80.25
AB	36.44	40.00	58.00	43.17
AC	53.11	59.78	40.67	52.50
AD	87.33	87.33	58.33	80.08
AE	93.56	60.22	67.33	74.50
AF	45.78	40.44	65.67	48.75
AG	79.11	93.33	79.00	84.42
AH	87.33	88.22	74.00	84.33
AI	85.33	72.89	56.33	73.42
AJ	62.22	64.44	59.00	62.25
AK	85.56	88.89	65.67	81.83
AL	80.89	68.89	69.67	73.58
AM	88.67	83.56	75.00	83.33

F-test results for relevancy of abiotic factor indicators of rainfall prediction

GROUPS	Sum of squares	df	Mean square	F value	P value	F critical value
Between the group	835.1885	2	417.5943	1.39541	0.25193	3.075853
Within the group	34115.97	114	299.2629			
Total	34951.15	116				

Table 5
Overall distribution of abiotic indicators of rainfall prediction in the different categories of relevancy rated by the farmers

Relevancy categories	Gadag district	Belgaum district	Uttara kannada district	Overall
Very High (> 75% index)	A,B,E,I,K,L,O,U,V,W, AA,AD,AE,AG,AH, AI,AK,AL,AM (48.72 %)	A,B,I,J,L,M,N, P,T,U,W,X,Y, AA, AD,AG,AH, AK,AM (48.72 %)	A,E,I,J,R,U,X, AA,AG (23.08 %)	A,B,I,L,U,W,AA, AD, AG, AH, AK,AM (30.77 %)
High (50-75% index)	C,G,H,M,P,R,T,X,Y, AC, AJ (28.20 %)	C,E,G,H,K,O,V, AC, AE,AI,AJ,AL (30.77 %)	B,C,K,L,N,O,P,S, T,V,W,Y, AB, AD, AE,AF, AH,AI,AJ, AK,AL,AM (58.97 %)	C,E,G,H,J,K,M,N ,O,P,R,T,V,X,Y, AC, AE,AI, AJ,AL (51.28 %)
Medium (25-50% index)	D,F,J,N,Q,S,Z, AB, AF (23.08 %)	D,F,Q,R,S,Z,AB, AF (20.51%)	D,F,G,H,M,Q, AC (17.95 %)	D,F,Q,S,Z,AB, AF (17.95 %)
Low (<25% index)	-	-	-	-

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