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## Indigenous knowledge of weather forecasting with the aid of bioindicators in Tamil Nadu

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### Abstract

A study was conducted to identify the various indigenous weather forecasting methods practiced by the local ethnic people and farmers at Salem and Kanchipuram districts of Tamil Nadu. Biotic indicators are used by the farmers and fishermen for weather prediction in local farming communities. They are holistic, providing farmers with the ability to decide and prepare psychologically for the coming agricultural year. Indigenous knowledge's covering various beliefs and customs, social and religious taboos, communication patterns, music, ecology, vegetation, climate etc. The bioindicator are mainly focused in this study based on the behaviour of animals, birds, insects and flowering and foliage of tree species as indicators of weather forecasting. The farmers were selected using simple random sampling. The data was collected through a pre-tested interview schedule by employing personal interview technique. The percentage analysis was used to analyze the data. The present study revealed that 11 animals, 25 bird species, 17 insect species, and 8 plant species were used as biotic factors in weather prediction. These were time tested to facilitate farmers to make their farming decisions in different seasons and cropping patterns.

**Keywords:** Bioindicator, forecast, rainfall, traditional knowledge

### Introduction

While weather refers to short-term changes in the atmosphere, climate refers to atmospheric changes over longer periods of time, usually 30 years or more. The climate of Tamil Nadu (Southern Most State of India) is strikingly different from the general climate of the country. Due to its topographical features and geographical area the climate of Tamil Nadu is referred to as semiarid and tropical monsoon. The long coastal stretch in the east, hill orography of the western rim, and plain inlands play a significant role and influence the climate of the State. The Climate of the State is tropical with little variation in summer, winter temperatures and features hot temperatures over the year except during the monsoon season. Due to proximity to the sea, the temperatures and humidity remain relatively high all the year round. The summer is hot with the temperature rising to 43 °C and extends from April to June. November to February is the coolest winter period with temperatures around 18 °C [1]. The State receives maximum rainfall during the months of October to December (north-east monsoon), whereas in the rest of the country, the maximum rainfall is received in the months of June to September months (south-west monsoon). The State is frequently subjected to extreme weather conditions such as flooding in the coastal districts and severe droughts in some areas due to monsoon failure, which consequently affect the production and productivity of the food grains [2].

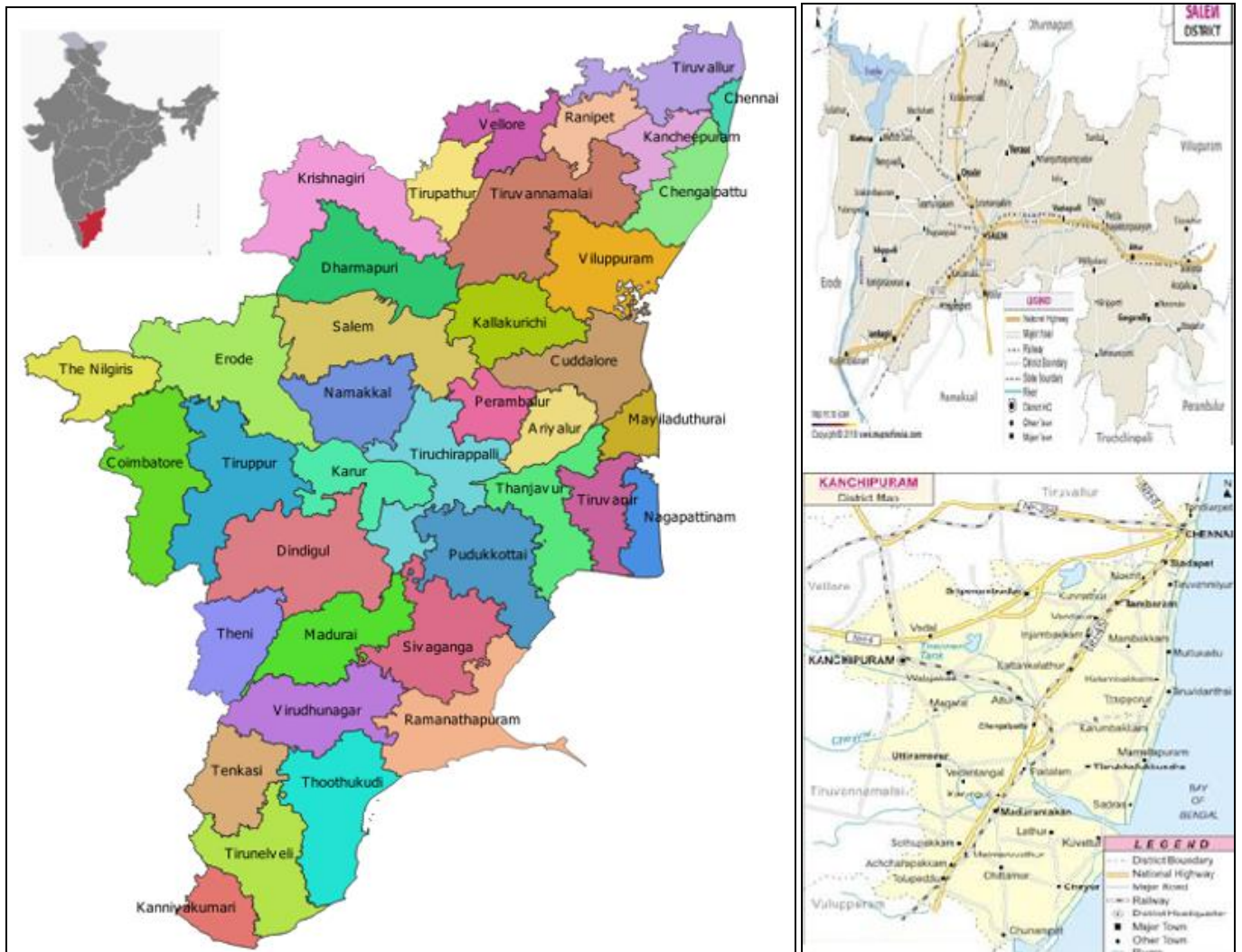
Weather has a significant impact on the prevalence of pests and diseases, the availability of water, the amount of fertilizer needed to grow crops and productivity of farm animals. In 21<sup>st</sup> century having the facility of satellite weather forecasting, decades ago farmers predicted rain very precisely using clues from nature. These clues are referred to as indicators, either biotic or non-biotic. And this dynamic indigenous knowledge was passed on to generations with changing climatic pattern of the planet. Farmers are very astute weather watchers and are quick to recognize weather that is either favourable or unfavourable to their production systems. It is based on many natural, cultural and social phenomena, such as presence of visible spectrum around the sun and the moon, cloud, wind direction and weather prediction through behaviour of birds and other animals [3].

Predicting weather is an important cultural component for farmers, as it is common to discuss indicators on the street, markets and with family members. The production and application of local forecasts are deeply localized, derived from an intimate interaction with a micro environment whose rhythms are intertwined with the cycles of family and community. Local indicators and local knowledge systems cannot be replaced with scientific knowledge.

**Methodology**

The aim of the present study is to document the traditional indigenous knowledge of some biotic factors used to predict weather forecasting and to assess climate change and to help to cultural preservation and renewal in different parts of Tamil Nadu. Besides, indigenous knowledge were collected from four villages of Salem district (western zone) and four villages of Kanchipuram district (coastal area) of Tamil Nadu located in southern India. The study is mainly based on the data collected from the primary sources, interviews and group discussions with local elder people and personal interactions with villagers of particular zone of Tamil Nadu. The farmers were selected by simple random sampling. The data was

collected through group discussions in all selected villages. Farmers who are above 45 years were involved in the group discussions. Information on demographic characteristics and indigenous knowledge of forecasting the onset of the rainy seasons, draught, flood and cyclone were emerged in discussions and documented. Approximately 40 farmers in each village around 320 farmers participated. Questionnaires were prepared to issues on Indigenous Traditional Knowledge (ITK) climate, seasonal rainfall predictions and past climatic events documented through interviews for different group of ethnic people. Information contained in the folklores, sayings, folksongs, folktales and various religio-magical rites and traditional practices of the masses at the same time were analysed for better understanding in effective resource management. Biotic factors for predictions of rainfall were included for the study and were analysed. Various behavior of animals, birds, insects and flowering and foliage of tree species are observed by farmers based on which they make decisions about possibility of rain or draught occurring and in some cases the intensity of rain. The percentage analysis was used to analyze the data for weather predictions.



**Results and Discussion**

In traditional weather forecasting, the onset of the rainy season and upcoming rain is indicated by the unusual behavior of certain birds and animals, insects' aggressive and abnormal activities and flowering and foliage of some plant species. The present study revealed that 11 animal species (Table 1), 25 bird species (Table 2), 17 insect species (Table

3) and 8 plant species (Table 4) were used as biotic factors in weather prediction.

The study revealed that indigenous knowledge systems have enabled the various ethnic communities in the area to live in harmony with their environments for generations, and that their traditional knowledge systems are important tools in environmental conservation and natural disaster management.

Based on this traditional knowledge and people's long standing experiences concerning cloud formation, lightning, wind directions, occurrence of rains in a particular period of

the lunar calendar, the indigenous rain forecasters predict the reasonably exact nature of rainfall for the entire season, including good and undesired effects.

**Table 1:** Bioindicator of animals for prediction of weather forecasting in Tamil Nadu

Sl. No	Animals	Scientific name	Animal biological Behaviour	Weather Forecasting
1	Cattle	<i>Bos indicus</i>	Grazing cows returning home early with raising of tails	Indicate rains
			Cattle looks at the sky frequently and jumping.	Rain within short range
2	Goats	<i>Capra hircus</i>	Flapping of ears and goats does not browse in herbs, shrubs and low trees	Immediate Rain
			Flocking of sheep and goats occur and also move in group	Rain short range
3	Dogs	<i>Canis familiaris</i>	Barking continuously and sharply in long time Jumps irregularly	Supportive indicator of rain
4	Pigs	<i>Sus domesticus</i>	Grunting of pigs	Rains are near
5	Donkey	<i>Equus asinus</i>	Sweating in Ears	Indicate rain with short period
6	Frogs	<i>Bufo melanostictus</i>	Frogs croaking in chorus underneath stones	Immediate rain
			Frogs start singing in the initial days of the <i>Jayestha</i> (May)	Early rain
			Frogs in the well makes continues sound.	High rainfall
7	Fox	<i>Vulpes vulpes</i>	Howling in the morning and evening.	Indicator for onset of rains
			Howls irritably at higher place Foxes cry during the day	Severe drought
8	Rats	<i>Rattus rattus</i>	Start to dig the ground	Cyclone, Flood
9	Tortoise	<i>Geochelone elegans</i>	Frequent appearance	Good rain season
10	Crab	<i>Gecarcinus quadratus</i>	If crab makes bigger hole in the channel	High rainfall
11	Snakes	<i>Serpentes</i>	Moving down the mountain	Good rain season

**Table 2:** Bioindicator of birds for prediction of weather forecasting in Tamil Nadu

SL. No	Birds	Scientific name	Birds biological behaviour	Weather predictions
1	Poultry	<i>Gallus gallus</i>	Sit in a place for long time, inserting feathers in the soil and it respond to increased moisture content in the soil and release heat while pushing its wings into the soil	Rain within short range
2	Domestic hen and cocks	<i>Gallusgallus domesticus</i>	Birds lying on ground and spreading its feathers under sun	Rain
			Searching food during rain	Rain would continue
3	Peacock	<i>Pavo cristatus</i>	Take bath in the dust on the full moon day of <i>Jayestha</i> (May)	Plenty of rain
			Making sound early in the morning and late in the evening	Occurrence of rain
4	Sparrows	<i>Passer domesticus</i>	Peacocks cry frequently	Rain within a day or two
			Flying around the sky with scattered clouds	Indicate rain in the afternoon
5	Weaver bird	<i>Ploceus velatus</i>	Loud chirping of birds in group and taking dip in water	Imminent rain
			Sparrow bathing in dust	Good rain
			Positioning of nest is built near the bottom of the well, it acts as an indicator of poor water source in the well	Poor monsoon
6	Swallows	<i>Hirundorustica</i>	If the nest is built at the top of the well, it indicates good monsoon	Long range rainfall
			This bird observe the clouds and weaves nest slightly above the water level in the well	Good rain
7	Maina	<i>Acridotherstristis</i>	Flock of small birds proceeding with black clouds	Rain
8	Crow	<i>Corvus brachyrhynchos</i>	Bathing the water pond	Rainfall within 1 or 2 days
			Crow scratches its nest	Immediate rain
9	Jungle Crow	<i>Corvusmacrorhynchosleivaillantii</i>	Spreading and moving its wings near river or source of water crows cry during the night Flying alone	Indicate dry spell
10	Stock bill	<i>Anastomusocitans</i>	Crows nesting at low height of trees.	Windy year.
11	Partridge (Agili)	<i>Perdixperdix</i>	Parabola shaped flight	Rain
			Sings after sunrise	Imminent rain
12	Cuckoo	<i>Cuculus canorus</i>	Sings while raining	Rain will stop forth at day
13	The Cattle Egret	<i>Bubulcusibis coromandus</i>	Calling of cuckoo and Sings Sowing operations starts	Upcoming rain
14	Parakeets birds	<i>Melopsitta cusundulatus</i>	Appearance of migratory the Cattle Egret	On set of dry season
15	Ground nesting bird	<i>Mniotiltavaria</i>	Migration in N-S direction	Presence of moisture and occurrence of rain
16	Red jungle fowl	<i>Gallus gallus</i>	Making the in nest on higher ground	Heavy rain
17	Owls	<i>Strigiformes</i>	Unusual clucks and sand bathing	Occurrence of flood
18	Doves	<i>Columbia livia domestica</i>	The peculiars squeaking sound of owls	Rain
19	Spotted dove	<i>Spilopelia chinensis</i>	Cries	Heavy rain/flood
20	Eagles	<i>Accipitriformes</i>	Chirping unusually and moving in pairs and taking shelter in shadow of leaves	Adverse weather condition
21	Grey headed Woodpecker	<i>Picuscanus</i>	If more number of eagles and birds flies on the top from west to east	Less good rain season
22	The Blue Throated Barbel	<i>Megalaima asiatica</i>	Unusual activity with rotation around the tree	Upcoming rain
23	The Indian Blue-Eared Barbet	<i>Megalaima australis</i>	Unusual chirping	Upcoming rain
24	Lapwing bird	<i>Vanellus indicus</i>	Unusual chirping and flying low	Upcoming rain
25	Houses swift bird	<i>Apus nipalensis</i>	Lay eggs during the night, especially on river-banks	Heavy rains
			During the rainy season farmers observe the houses wift bird and they predict heavy rain fall if the birds flies high in the sky	Heavy rainy season

**Table 3:** Bio indicator of insects for prediction of weather forecasting in Tamil Nadu

SL. No	Insects	Scientific name	Insects biological behaviour	Weather predictions
1.	Red hairy caterpillar	<i>Amsacta albistriga</i>	Quick movement and restless	Indicator of rain
2.	Honeybee	<i>Apis cerana</i>	Wasps hiding their honey comb	Upcoming rain
	Honeybee	<i>Apis mellifera</i>	Appearance and movement of the insect.	Onset of dry season
3.	Spider	<i>Argiope catenulata</i>	Spiders pinning shorter and making thick web	Adverse weather condition (flood).
			Spiders leaving their webs	Occurance of Rain
4.	Crickets	<i>Gryllus campestris</i>	Calling or chirping throughout the night	Indicate change in weather
5.	Houseflies	<i>Musca domestica</i>	Become active when atmospheric humidity reaches saturation	Rain within short range
			Increased number of mosquito bites	Low rain Supportive indicator
6.	Butterfly	<i>Papilio machaon</i>	Appearance of many butterflies	Early and good rainy season
			Flight of butterflies from north-south direction	Arrival of rainfall
7.	Dragonflies	<i>Anax parthenope</i>	When humidity reaches saturation, a couple of hours before, dragon flies move in swarms 3-3 m height from the ground level	High rainfall within a day or two
8.	Blackants	<i>Formicasp</i>	Movement of black ants in a row and hair of ants length due to increase in the humidity triggering the process of carrying the eggs to a safer place	Occurrence of flood
9.	Snail	<i>Helixpomatia</i>	Climbs certain trees	No rain
	Leeches	<i>Hirudinea</i>	If the leeches are moving rapidly in the upward and downward direction in water	Rainfall predicted
10.	Grasshopper	<i>Omocestus viridulus</i>	Moving in group of 10-12	Rainwilloccurinnext2
11.	Moth	<i>Tineolabis selliella</i>	Appearance in large numbers	Predict drought
12.	Mosquito	<i>Culex pipiens</i>	Increased mosquito bite	Rain
13.	Winged termites	<i>Coptotermes formosanus</i>	Appearance	Indicate rains
14.	Tiauhmi bug	<i>Anaxparthenope</i>	Found in the forest during summer	Rainfall and flooding
15.	Termites	<i>Isoptera</i>	Flying in the evening hours. Appearance of winged termites after a dry spell of some days	Indicates occurrence of rain
16.	Fireflies	<i>Lampyridae</i>	Large number of fire flies seen at night on the forest trees is	A sign that the monsoon will start early
17.	Centipedes	<i>Chilopoda</i>	Emerge from their holes carrying their egg sins warms in order to shift them to safer places	Farmers predicts early rainfall

**Table 4:** Flowering & foliage of tree species as indicators of weather forecasting in Tamil Nadu

SL. No	Plants	Scientific name	Flowering/Foliage	Weather predictions
1.	Neem tree	<i>Azadirachta indica</i>	Full bloom of neem tree in summer and Neem flower blooms 40 days before monsoon sets in.	Onset of monsoon triggering heavy rains
			As soon as the neem kernels ripen and start falling	Rain will be after 10-15 days.
			Heavy Flush	Drought
			Dried appearance of Neem tree in summer	Heavy drought
2.	Mushroom	<i>Agaricus bisporus</i>	Flourishing both edible and wild mushrooms	High humidity, Indicates good rainfall distribution for the year
3.	Babul tree	<i>Acacia nilotica</i>	After 10 to 15 days off flowering in babul tree	Rain
4.	Castor	<i>Ricinus communis</i>	When buds starts sprouting, it is predicted	Rain will appear within 10-15 days.
5.	Banyan tree	<i>Ficus bengalensis</i>	When the adventitious root so fast start sprouting tillering)	Rain will appear within 2-4 days
6.	Pipal	<i>Ficus religiosa</i>	Good foliage	Adequate rain
	Ber	<i>Zyzyphus mauritiana</i>	Heavy Flush of Fruit	Average Monsoon
7.	Bamboo	<i>Bambusa vulgaris</i>	Good Foliage	Drought
8.	Mahuda,	<i>Madhuca latifolia</i>	Good foliage	Good Monsoon

Traditional indigenous knowledge deals with the activity of various species at those moments when animals prepare to take necessary precautions against upcoming natural dangers. Farmers used insects, birds and animals as indicators to predict rainfall [4] in Karnataka. In South Africa and Western Kenya, inhabitants use birds, toads, and white ants to predict the summer season and onset of rains [5]. Bio indicators used by people for weather forecasting in Uttarakhand Himalaya area were observed to be based on their long-standing familiarity with seasonal patterns of precipitation, temperature, behaviour of animals and birds, insect, appearance of reptiles and floral indicators [6].

Cattle sense cool breezes few hours early before rain. When low clouds are formed and energy is released from water

vapour and formation of excess heat, it cannot be tolerated by sheep and goats. Hence, flocking of sheep and goats occur and move into groups [7]. The use of bioindicators is an innovative approach for assessing various types of environmental mismanagement, including pollution, high input farming, inappropriate disposal of wastes, contamination, etc. Local community members, cultural leaders and local elders have observed recent abnormalities in the weather, with unusual rains and abrupt changes in temperature. Due to this phenomenon, some plant species are changing their growth patterns [8].

Indigenous knowledge of seasonal weather forecasting could be useful in decision making at village level to best exploit the seasonal distribution of rainfall in order to increase or

stabilize crop yields. Together with the meteorological forecasts, traditional indicators could be very useful in rain forecasting and improving the timing of agricultural activities [9]. Key informants and literature indicate that the main driver of biotic indicators during the onset and cessation of rains is availability of food resources and this applies mostly to birds, insects and fish. The onset and cessation of rain forecasts influence pastoralists' and farmers' decision-making in selection of crop enterprises and livestock management practices for the first and second rainy seasons [10].

Not all respondents are familiar of using traditional signs to predict seasons. It was also noted that recent changes in climate are affecting the use of traditional signs for forecasting the start of the rainy season. Hence, farmers would profit from weather forecasts provided by governmental institutions. This will enable farmers to make sound decisions on how to fully exploit the seasonal distribution of rainfall to improve and stabilize crop yields [11]. Countries like India, which are totally dependent on the seasonal rainfall for sustainable agricultural and allied activities. It will suffer greatly in near future from deficiencies in short, medium and long range rain forecasting [12]. These are some grass root innovations for predicting rainfall to support the extra demands for local weather prediction at specific times and in particular regions at this era of rapid climate change.

### Conclusion

The traditional knowledge may be explored with scientific knowledge to come out with an error free system of forecasting, which is very crucial for a predominantly agricultural country like India that depends so much on the rains. The study found that biotic factor animals, birds, insects and plants to predict weather forecasting can be utilized for the purpose of short-term and long-term seasonal rainfall predictions by local communities. These are time tested and facilitated by farmers to make their farming decisions and cropping patterns according to different seasons.

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### Conflict of Interest

All authors declare that they have no conflicts of interest.

### Authors' Contributions

The authors have contributed equally in collecting information and preparing the manuscript.

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