Indigenous weather forecasting through animal behaviour in Jodhpur, Rajasthan

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ABSTRACT
In the arid and semi-arid landscapes of Jodhpur, Rajasthan, where conventional meteorological tools have limited reach in rural and marginal areas, indigenous weather forecasting remains a valuable and culturally embedded practice. This study examines how local communities in and around Jodhpur perceive the behavior of animals, particularly birds, reptiles, mammals, and insects, as natural indicators of upcoming weather conditions, especially during the pre-monsoon and monsoon seasons. Through field observations, interviews with traditional knowledge holders, and literature analysis, this research highlights specific behavioral patterns—such as the vocal calls of peacocks, the low flight of swallows, the emergence of ants from burrows, and the unusual movements of snakes—as reliable signs of rainfall, storms, or droughts. The findings suggest that these ethological cues, passed down through generations, offer predictive accuracy that complements scientific forecasts and fosters community preparedness. By documenting and analysing these behaviours, the study underlines the relevance of indigenous ecological knowledge in enhancing climate resilience and sustainability. It also calls for the integration of such traditional insights with modern meteorological systems to build more inclusive and adaptive weather forecasting frameworks, particularly in regions vulnerable to climate variability.
Keywords: Animal behaviour, traditional knowledge, pre-monsoon, Ethological cues, climate resilience, sustainability, environmental indicators

INTRODUCTION
The weather is an essential aspect of the environment and plays a significant role in maintaining ecological balance. Typically, the term "weather" describes the atmospheric conditions of an area, including factors such as temperature, cloudiness, humidity, sunshine, wind, rain, and storms. Different societies around the world have their own unique interpretations and methods for understanding, predicting, and influencing the weather and climate, which contribute to their overall comprehension of climate (Sutton & Anderson, 2010).Indigenous knowledge systems represent a systematic collection of understanding developed by local communities through accumulated experience, informal experimentation, and a deep connection with their environment, which enhances modern weather forecasting (Wary, J. 2020).In the 21st century, farmers benefit from satellite weather forecasting (Kidd *et al.,* 2009). However, decades ago, they relied on natural clues to predict rain with remarkable accuracy (Poudel *et al.,* 2022). These clues, known as indicators, can be either biotic or abiotic. Farmers are keen observers of the weather and can quickly identify conditions that are favorable or unfavorable for their production systems (Usha). Their rain forecasting is often based on the traditional "panchang" (Shankar *et al.,* 2008). Additionally, many indigenous communities worldwide use both traditional weather forecasting and climate indicators to make important decisions that help them adapt to extreme weather variations induced by climate change (Balehegn *et al.,* 2019).
Rajasthan is situated in a region that is highly sensitive to climate change and faces significant vulnerabilities (Kaushik & Sharma, 2015). In this area, members of tribal communities—including the Bhil, Meena, Banjara, and Kathodi—recognize and respond to natural disasters and extreme weather events. They have developed strategies for early detection of impending events and coping mechanisms

for dealing with these occurrences, as well as insights into their short- and long-term impacts on biodiversity (Pareek& Trivedi, 2011). Traditional communities of the Thar Desert are custodians and stewards of their land and environment (Gaur & Gaur, 2004).Research indicates that traditional knowledge systems play a crucial role in environmental conservation and natural disaster management. For instance, the flowering of certain tree species (Ficus spp.), the emergence of termites, ants, butterflies, and frogs are indicators of impending rainfall (Okonya & Kroschel, 2013). In Jodhpur, situated on the edge of the Thar Desert in Rajasthan, the climatic conditions are often harsh and unpredictable. Local communities—particularly those in rural and agrarian areas—have historically relied on animal behavior as a dependable indicator of impending weather changes. Dr. G. R. Parihar (2005) documented traditional practices of weather forecasting based on animal behaviors in the Thar Desert. However, despite Jodhpur's ecological and cultural richness, it remains understudied in this area.This research aims to explore, document, and analyze the indigenous knowledge of weather forecasting through animal behaviour specific to the Jodhpur region. The study seeks to understand local perceptions, recurring behavioral patterns in fauna, and their correlation with climatic changes. By documenting this knowledge, the research contributes to the growing fields of ethnobiology and indigenous climatology, while also emphasizing the importance of preserving traditional ecological wisdom in the face of modern climate uncertainties.

MATERIAL AND METHODS:
Study Area
The present study was conducted in the Jodhpur district, situated in the central region of the Thar Desert in Rajasthan, India. This area is characterized by extremely arid climatic conditions, with significant temperature variations, low annual rainfall, mostly concentrated during the monsoon months, and frequent droughts. Fieldwork primarily took place in rural areas, urban outskirts, agricultural lands, and religious sites, where interactions with local people and wildlife were most prevalent.

Study Period
The study was conducted over a full seasonal cycle from June 2024 to May 2025, encompassing the pre-monsoon, monsoon, post-monsoon, and winter seasons. Special attention was given to the pre-monsoon months (May to July), as accurate weather predictions during this time are particularly important for the local population.

Data Collection Methods
1. **Ethnobiological Surveys and Interviews**

Structured and semi-structured interviews were conducted with various groups, including elderly farmers, shepherds, tribal communities (such as the Bishnois and Raikas), bird watchers, and local herders.
 A total of 60 respondents from different areas of Jodhpur (Mandore, Balsamand, Soorsagar, Luni, and rural hamlets) were interviewed using a prepared questionnaire in the local dialects of Marwari and Hindi. The questionnaire included the following topics:
- Common animal behaviors observed before rainfall or dust storms
- Seasonal migration or breeding patterns related to changes in weather
- Local proverbs and folklore associated with animal signs

Direct Field Observation
Systematic observation of key animal species believed to exhibit weather-related behaviour, such as:
- Birds: Peacocks, pigeons, crows, lapwings, cuckoo, cattle egret, house sparrow, kite, vulture,
- Mammals: Desert fox, Jackals,
- Reptiles: Uromastix, viper,
- Insects: red mites,grasshoppers, beetles, dragonflies.

  - Observation took place during early mornings and late evenings across 10 selected rural and semi-urban locations in and around Jodhpur.

- o Recorded animal behaviour such as nesting, vocalizing, migration, or unusual movement before rainfall or temperature change.

3. Photographic and Video Documentation
Visual evidence was captured using a DSLR camera and a mobile phone for documentation and verification of behavioural signs. This also served as a reference for further validation with experts.

4. Comparative Literature Review
Past works, including the 2005 study by Dr. G.R. Parihar in the Thar Desert, and other published records on indigenous forecasting and ethno-climatology in Rajasthan and similar arid regions were reviewed to compare and contrast patterns.

OBSERVATION AND RESULT
The residents of the desert are generally aware of their rich biodiversity and its genetic variability, viewing these resources as unique to their survival. Despite the limited scientific literature on local knowledge and biodiversity, there is a considerable understanding of the flora and fauna, primarily conveyed through oral traditions and the desert way of life. Local inhabitants are well-versed in the uses of these bioresources in their daily lives, especially during times of drought and famine. They utilize plants and animals for various needs, including food, fodder, thatching, firewood, fiber, herbal remedies, and industrial materials.

This study documented the weather forecasting methods based on observations of animal and plant behavior, as shared by the people in the study villages.

1) Behaviour of desert animals and weather (rain) forecast:
While interacting with local people, particularly old people, a large amount of information on weather forecasts based on animal behaviour is recorded. Some of the interesting beliefs of local people are

(i) It is said for 'mamalia' a red mite, Oppiaquadricarinata in the local dialect that "निकलेजदमामोनलया, भाईरे हलजोनिया।" means "Plough your fields only when red mites appear".

(ii) If viper, Echiscarnatus crawls on the upper canopy of trees, it is sure to rain within 12 hours in that area.

(iii) If uromastix, Uromastixhardwickiistarts sealing its burrows, the region will receive heavy rains within 24 hours.

(iv) Ifa cuckoo, Cuculusmicropterusflies in the early hours of the day between 5 am to 6 am, from north to south direction, emitting loud vocalization, the region will receive rainon the very third day.

(v) The crow, Corvussplendens, if it starts laying eggs, there will be no rainfor 60-70 days in that area and also in that direction where the eggs have been laid.

(vi) The gliding behaviour in the sky of the Pariah kite, Milvusmigrans, and eagle, Circaetusgallicus, is corroborated with early rains in the area.

(vii) When a house sparrow, Passer domesticus, is seen on dry soil, it indicates that rain will occur in a couple of hours.

(viii) The location of red-wattled lapwing nests (Vanellusindicus) can serve as a good indicator for predicting rainfall. If nests are found on the banks of a water body or in the bed of a tank, it signifies that it will not rain. Conversely, if the nests are situated away from the bank at a higher elevation, it suggests that good rainfall is expected in the near future.

(ix) If the flock of cattle egret, Bubulis ibis,leaves its resting places and flies away, it is going to be a drought year.

(2) Animals as Ecoindicators:
If the population of the mite, Oppiaquadricarinata, which survives only for a short period during the monsoon period is seen in plenty, the year will be considered superb for water, food and fodder a very productive year, locally called as 'Jamana or Sukal'.

(i) The presence of the grasshopper, Schistocercamelonopus on aak (Calotropisprocera) indicates a moderate year of production, meaning thereby a normal year.

ii) A good population or appearance of the bhinga metallic woodboring beetle, Chalcophorafortis in a particular area suggests excellent community system of valuable species like 'gugal', Commiphorawighitil; 'kumbhat', Acacia senegal; 'gageti' or 'gergania', Grewiatenax; 'Morali', Lyciuusbarbarum and 'Arni', Clerodendrumpholomidis. These taxa support a variety of animals and keep moisture in the soil, arresting desertification.

(iii) The presence of desert foxes, Vulpesvulpespusillia, keeps rodents under control.

(iv) Presence of jackals, Canisaureusaureus eliminate diseased and weak livestock, preventing the spread of disease in healthy ones.

(v) The presence of vulture Gyps bengalensis and their selection of trees,especially 'khejari', Prosopis cineraria, for nesting and breeding purposes indicates that those trees are ancient and unproductive for biomass.

(vi) People in the study villages are powerful in their belief that 'grey partridge', Francolinuspondicerianus,keeps the population of white out and tiger ants under control. It also helps in saving 'til', Sesamumindicum crop from ants.

(vii) Presence of 'tiger beetles', Cincindelasexuttata, suggests the presence of snacks in that patch.

(viii) Hares, honey bees, and Euphorbia:

In both the study villages, Euphorbia bushes were common. These were found to be very good abodes of honey bees above the ground and hares, Lepusnigricollis, under the ground besides other animals. Hares were observed during May-June cutting and removing the extra roots of Euphorbia bringing these roots on the surface which are used by other animals as food and as nest material. This also helps in aeration to the plant.

(ix) Grey shrike, Laniusexcubitor presence in good numbers suggests that there will be attack of 'katra', Stauropusfagi which is a serious crop pest in the region. However, birds (in good numbers) act as very good biological control by consuming 'katra'.

(x) The fall in the population of Chaleophorafortis is attributed by the…

3) Role of Plants in Forecast System

(i) It is said that if 'aak', Calotropisprocera gives flowers and fruits in good quantity, there will be a very good crop of 'til'.

(ii) In the year when 'peelu', Salvadorapersica fruits are in plenty, that year in general will have very good crop.

(iii) Heavy flowering of 'sewan', Lasiurussindicus is a good indication of good crop of 'gwar', Cyampistetraginoloba.

(iv) If 'khejari', Prosopis cineraria remains green during May-June, it will be a poor rain year. If flowering, fruiting, and drying of fruits on the tree go uninterrupted, the year is considered a good crop year.

(v) If the fresh leaves of P. cineraria dry out during July-August, rains will follow in 2 days.

(vi) If 'neem', Azadirachtaindica fruits ripe in time, than the 'til' crop will be very good. If the fresh leaves turn red, it may rain at any time.

(vii) If the pods of 'desi babul', Acacia nilotica, ripe in time it will rain during winter, leading toa good winter crop and quick ripening of wheat.

(viii) The prolific flowering and fruiting of Salvadorapersica suggest a good crop of 'jawar', Sorghum vulgare.

4) Use of Animals by Local People:

A large number of animals are used by local people for food, fur, game and making medicines. Some of the common animals and their parts used for different purposes, such as the muscles and fat of uromastix as food and in cough and body pain; feathers of peacock as ornamental; flight muscles of grey partridge, sand grouse and spotted doves as food; skin flesh and bones of desert fox as food, caps, etc. and burnt bones used for boils and injuries; skin, flesh and blood of jackal as caps, food and blood for tuberculosis patients; fats of hedgehog and porcupine for rheumatic (joints) pains, etc.

ReReligious taboos for the conservation of biodiversity
    (1) Festival

- **Akshayatritiya**

In many rural regions of India, particularly in Rajasthan, indigenous communities employ a traditional method of rain prediction during the AkhaTeej festival. This ethno-meteorological practice involves the preparation of five unbaked clay vessels, each representing a consecutive month from May to September — the typical pre-monsoon to monsoon period in the region.

Each pot is filled with water and placed in a shaded, outdoor environment under similar physical conditions. Over the following days or weeks, natural environmental factors such as temperature fluctuations, evaporation, humidity, wind dynamics, and soil moisture absorption influence the structural integrity of the pots. The first pot to crack or collapse is interpreted as a climatic indicator that significant rainfall is likely to occur during the corresponding month.

While not grounded in modern meteorological science, this observational method reflects a form of indigenous knowledge system (IKS) rooted in long-term environmental monitoring and intergenerational learning. It represents an empirical, though non-instrumental, method of seasonal weather forecasting that aligns with climate-sensitive agricultural planning in arid and semi-arid zones.

Recent studies in climate adaptation science emphasize the value of such traditional forecasting methods, particularly in contexts where modern meteorological infrastructure may be limited. Further comparative analysis with regional rainfall data could help evaluate the statistical reliability of this practice.

- **MakarSankranti**

It marks the sun's transition into Capricorn (Makara), indicating the end of winter solstice and beginning of longer days and warmer weather.

Farmers start predicting crop health and rainfall based on sky patterns (clouds, mist, sunlight) during this time.

In Rajasthan, people observe animal behavior and wind direction to predict the upcoming harvest and monsoon timing.

(2) Traditional songs

रोनहणीि पे,
मृगबाजे,
आदर- खादर,
अणिनिनियाहीगाजे

पनिमी राजस्थाि में इि नदिोीं आँनियोीं का जोर िरम सीमा पर है। लेनकि पुराि समय से िली आ रही कहाविोीं किअुसार आँि कपीछे बाररश भी अिी है। उसी किि हि क्षेत्र कनकसाि भी अपि अपि अिुमाि लगाि शुरू कर नदए हैं। नकसाि का मि है नक माि सूि की अच्छी बाररश से पहले ..

रोनहणी िपे मृगबाजे आदर खादर अणिनिनिया गाजे
अर्

पन्द्रह नदि लगाि र आँनियोीं नजसका प्रीक मृग (मृगबाजे) िलिा है... वैसे भी नहरण की िाल िज होि है... इि
िलोीं या हवाओँ क बाजि को स्थाि य बोलीवाईयोीं कहि है.... जो बाजे ही भले... इि पन्द्रह नदिोीं को भी अलग अलग भागोीं में बाँटा गया है।.. दो मुशा (मुषक), दो काि रा, दो ि E ी, दो ि व, दो बाजे जलहरो, दो नवश दो भाव बाजे, ि हो जाए लीला लहर

नकसाि का अिुमाि है नक अच्छे जमाि क शगुि इि आँनियोीं क िलि और वाईयोीं क अिार पर निवारे जा सकि हैं। यनद मृग कपन्द्रह नदि लगाि र आँनियाँ िलेगी ि ि नबमारी फैलेगी ि फसलोीं में कोई कीट पोींगोीं से
ि कसाि िहीीं होगा... अच्छी पैदावार रहेगी।

___!! वाया ज्िुजरोशिलोनडाया।

ओं⬡ी के हाला⬡ मि पुछो भाई वैसे अकाल जमा⬡ आदी की बा⬡ भी खूब ⬡ल रही है यनद रोनहणी ⬡क्षत्र में गमी अनिक हो ⬡र्⬡ा मृग ⬡क्षत्र में ओं⬡ी जोरदार ⬡ले, ⬡ो आर्द⬡ा ⬡क्षत्र के लगि ही बादलों की गरज के सार् वषाा हो⬡ की सोंभावि बि सकिी है।

एक दोहे में अकाल के लक्षणों का नित्रण इस प्रकार नकया गया है :-

नमरगा बावि बानजयौ, रोहण ⬡पी⬡ जेठ।कू⬡ोंः बों⬡ौ रे झोंपडौ, बैठोबडलेहेठ।।

आर्द⬡ा ⬡क्षत्र के प्रारों भ में यनद बाररश के छीटें हो जाएँ, ⬡ो शुभ मा⬡ जा⬡ हैं और जल्दी ही बरसा⬡ हो⬡ की आशा बों⬡⬡ी है।

पहलों आदर टपूकडौ मासों पखों मेह।

यनद आर्द⬡ा ⬡क्षत्र में आँ⬡ी ⬡लि शुरु हो जाये, ⬡ो अकाल का जोखखम ⬡

अि⬡े लगा है। आदर पनडया बाव, झूपड झौलाखाय।

यनद ⬡ौदह ⬡क्षत्रों में दो-दो नदि के नहसाब से हवा ⬡हीं ⬡ले, ⬡ो क⬡ा- क⬡ा होगा, इस नवषय में निम्नलखखि छोंद कहा गया है :-

दो एमूसा, दो एका⬡रा, दो एनि⬡ी, दो ⬡िाव। दो यांराबादी जळ हरै, दो एनबसर, दो एबाव।। रोनिही बरसै मृग ⬡पै, कुछ कुछ अर्द⬡ाजाय। कहै घाघ सु⬡े घानघी, खा⬡ भा⬡ ⬡हीं खाय।।

यनद रोनहणी बरसे, मृगनशरा ⬡पै और आर्द⬡ा में सा⬡ारण वषाा हो जाए ⬡ो ⬡ा⬡ की पैदावार इि⬡ी अच्छी होगी नक कुत्ते भी भा⬡ खा⬡ से ऊब जाएँगे और ⬡हीं खाएँगे।

Table: Animal Behaviour as Weather Indicators in Jodhpur

S.No.	Animal/Bird/Insect	Observed Behaviour	Traditional weather interpretation
1.	peacock	Dancing and loud calling before rains	Imminent rainfall or storm
2.	House sparrow	Dust bathing in large numbers	Rain will occur ina couple of hours
3.	Crow	Starts laying eggs	There will be no rain for 60 to 70 days in that area
4.	Cuckoo	Fly in the early hour of the day between 5 am to 6am from north to south direction emitting loud vocalization.	Theregion receive rains the very 3rd day.
5.	Kite	Gliding behaviour	Corroborated with early rains
6.	Red wattled lapwing	Nest is a good measure to forecast the extent of rain. If nest are found on the banks of a water body. If it is away from the bank at the higher elevation	It will not rain The rain will be good.
7.	Cattle egrets	Leave their resting place and fly away.	It is going to be poor rain year.

8.	Kalchiri	If nest are located on the higher canopy. If nest is on the lower branches.	Rain heavily/ Rain will be poor
9.	Ant	Start lifting & shifting their eggs	It may rain at any time.
10.	Grasshopper	If presence of it on aak	Normal year
11.	Viper	If crawls on the upper canopy of trees.	Rain within 12 hours in that area.
12.	Uromastix	When start sealing its burrows	The region will receive heavy rains with 24 hours.
13.	camel	Urinating frequently, avoiding dusty aras	Sandstorm or thunderstorm prediction
14.	dog	Hiding under structures, whining before storms	Lightning or thunder approaching

DISCUSSION:

The findings of this study highlight the enduring significance of indigenous ecological knowledge in predicting weather patterns through animal behaviour in the Jodhpur region. Despite the growing reliance on modern meteorological tools, many rural communities continue to depend on time-tested, observational techniques based on the instincts of fauna. This study not only reaffirms the accuracy of such indigenous methods but also brings attention to the cultural and ecological embeddedness of local weather knowledge.Field data and interviews revealed that residents in rural and semi-urban areas of Jodhpur associate specific animal behaviours with impending weather events. For instance, the increased calling of peacocks (Pavocristatus) was widely mentioned as an indicator of imminent rainfall. Similar patterns were observed with ants relocating to higher ground, frogs becoming vocally active before storms, and sudden appearances of certain bird species such as the common myna (Acridotherestristis) or drongo (Dicrurusmacrocercus), all of which locals interpret as signs of changing weather.Interestingly, many participants emphasized how their reliance on animal behaviour for weather forecasting is strongest during pre-monsoon months, when formal meteorological predictions are often inconsistent or unavailable at the micro-regional level. In such contexts, indigenous forecasting serves as a vital tool for planning agricultural activities, safeguarding livestock, and conserving water resources, especially important in drought-prone regions like western Rajasthan.

However, the discussion also revealed a generational decline in the practice and transmission of this knowledge. Younger members of the community showed limited awareness of animal-based weather signs, indicating a possible erosion of this ecological wisdom due to urbanization, modernization, and changing lifestyles. This finding aligns with global concerns about the loss of traditional knowledge systems due to the spread of scientific homogenization and disconnection from nature.Another crucial observation is the ethical and respectful relationship that traditional communities maintain with animals and their environment. Many elders spoke not only of observing animals but also of treating them as "messengers" or "helpers," indicating a deeper cultural philosophy of coexistence. This ethical dimension, often missing in modern scientific approaches, offers a valuable perspective in discussions about sustainable and inclusive climate resilience strategies.

Furthermore, while indigenous methods are highly contextual and often lacking in standardized metrics, they remain remarkably effective within their ecological context. The challenge, therefore, lies in integrating this knowledge with modern forecasting tools without undermining its cultural roots.

In summary, the study underscores the value of indigenous weather forecasting through animal behaviour in Jodhpur as a living knowledge system that is ecologically sound, culturally rich, and practically useful. As climate variability increases in the 21st century, acknowledging and preserving such local wisdom is not only a matter of heritage conservation but also an urgent necessity for community-based climate adaptation in arid landscapes.

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