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UTILIZATION AND CHALLENGES OF TRADITIONAL WEATHER FORECASTING IN IKARA LOCAL GOVERNMENT AREA, KADUNA STATE, NIGERIA

Suleiman, M.B.[1]; Elisha Ikpe[2*] and Rowland, E.A[3]
[1]Department of Geography and Environmental Management, Ahmadu Bello University, Zaria
[2]Department of Geography, Federal College of Education, Odugbo, Benue State
[3]Department of Geography, Federal University, Lokoja

***Corresponding Author's Email:** elishaikpe@fceodugbo.edu.ng
Phone Number: 08065665954
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ABSTRACT
This study analyzed the challenges of using traditional weather forecasting among farmers in the Ikara Local Government Area, Kaduna State, Nigeria. A total of 384 farmers were purposively sampled to identify respondents knowledgeable about indigenous forecasting practices. Data were collected through questionnaires and interviews and analyzed using descriptive statistics and chi-square tests. The results revealed that the majority of respondents were aged 61–65 years (26%), predominantly male (66%), and married (49%), with farming experience spanning more than 50 years (28%). Findings showed that traditional forecasting is still widely practiced, but major challenges remain: 90% of farmers reported that some traditional indicators are difficult to interpret without elders, and 86% observed that certain indicators (such as bird migration and ant mounds) are no longer easily observable. In comparison, 85% noted that both climate change and modern meteorological forecasts reduce Reliability and reliance on traditional methods. The chi-square test (χ^2 = 38.29, p = 0.001) revealed a significant association between farmers' socioeconomic characteristics and the challenges they face in using indigenous forecasting. The study concludes that although traditional forecasting remains relevant, its sustainability is threatened by climate variability, biodiversity loss, and generational gaps. The study, therefore, recommends strengthening extension services, documenting indigenous knowledge, and integrating traditional and modern forecasting systems to improve farmers' adaptive capacity.

Keywords: Adaptation, Agriculture, Indigenous knowledge, Socioeconomic characteristics

INTRODUCTION

Weather forecasting is the ability to assess and predict weather conditions in advance by analyzing large volumes of meteorological data collected globally in real time and integrating them with numerical weather prediction models on high-performance computing systems (Rautela & Karki, 2015). However, long before the development of modern scientific instruments and analytical techniques, local communities around the world had developed indigenous methods of forecasting weather based on experience, careful observation, and knowledge accumulated over generations (Risiro, Mashoko, Tshuma, & Rurinda, 2012). These traditional forecasting practices are largely rooted in keen observation of faunal and floral behaviour, as well as other environmental changes that precede or accompany significant meteorological events. Such indigenous weather forecasting systems have historically contributed to the success of farming operations, except in situations involving unpredictable or extreme climatic disasters (Acharya, 2011).

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For generations, rural communities have relied on local knowledge systems to predict rainfall patterns, dry spells, and other weather conditions that guide agricultural decisions. These systems, commonly referred to as traditional weather forecasting, involve observing natural indicators such as cloud formation, wind direction, plant flowering, insect activity, and animal behaviour (Sanni, Risiro, Mashoko, Tshuma, & Rurinda, 2012). This knowledge is transmitted orally across generations and is often embedded in cultural beliefs and spiritual practices, making it not only a tool for agricultural planning but also an important component of community identity (Ajibade & Shokemi, 2003). In many African societies, including farming communities in Nigeria, such forecasting practices continue to play a central role because they are cost-free, easily accessible, and trusted by smallholder farmers who depend largely on subsistence agriculture (Nyong, Adesina, & Elasha, 2007). Traditional weather forecasting, therefore, refers to the indigenous knowledge and practices used by rural communities to anticipate weather events through observation and interpretation of natural environmental phenomena (Nyong et al., 2007).

In Nigeria, smallholder farmers constitute the bulk of the farming population and often operate in rural areas with limited access to modern meteorological information. For these farmers, traditional forecasts provide guidance on critical decisions such as the timing of planting, harvesting, and input application. For example, observations of the early arrival of certain bird species or the shedding of leaves by specific trees are interpreted as signals of the rainy season's onset (Ebele, Onoh, & Okoro, 2019). These practices represent adaptive strategies developed to cope with uncertain rainfall patterns in semi-arid and savannah regions, including Kaduna State.

Despite its cultural and historical importance, the accuracy of traditional forecasting has been increasingly questioned. Climate variability has disrupted many natural indicators, reducing the Reliability of local signs such as wind direction and flowering cycles (Mugabe, Mafongoya, & Mpepereki, 2010). Farmers in northern Nigeria have reported cases in which traditional predictions failed to align with actual weather outcomes, leading to mistimed planting and crop failure (Sanni & Akinyosoye, 2012). This decreasing Reliability has weakened farmers' confidence in indigenous methods while still leaving them without adequate alternatives.

Challenges to the utilization of traditional forecasting extend beyond declining accuracy. One major issue is generational change. Younger farmers often regard traditional knowledge as outdated or unscientific, preferring to rely on personal judgment or sporadic access to radio weather updates (Ifejika, Kiteme, Ambenje, Wiesmann, & Makali, 2010). As a result, much of the indigenous knowledge base is not being transmitted to the next generation, creating a risk of gradual erosion. This loss of knowledge threatens cultural identity and the resilience strategies that communities have relied upon for centuries.

Another challenge is the limited institutional recognition of traditional forecasting. Agricultural extension systems in Nigeria rarely integrate indigenous knowledge into advisory services, focusing instead on disseminating scientific information (Ozor & Cynthia, 2011). This lack of integration sidelines traditional forecasters who have historically played a role in community decision-making. Farmers in Kaduna State, including Ikara Local Government Area (LGA), therefore operate in a dual system in which traditional knowledge is used informally but receives little formal support or validation from extension agents.

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Social and economic factors also influence the challenges of using traditional forecasting. Studies have shown that education, household size, income level, and gender can affect the extent to which farmers adhere to traditional weather indicators (Ofuoku & Obiazi, 2021). For example, households with higher educational attainment may perceive indigenous signs as less reliable, whereas poorer households, lacking access to scientific forecasts, are more dependent on them. Moreover, women, who play critical roles in agriculture, are often excluded from community gatherings where traditional forecast information is shared, further reducing equitable access (Nyong et al., 2007).

In addition, language barriers and differences in local interpretation pose a challenge. Traditional forecasts are communicated through proverbs, folk tales, or coded expressions that are deeply tied to local dialects (Ebele et al., 2019). Younger generations or outsiders may struggle to interpret these messages, leading to miscommunication and limiting broader use. The absence of documentation also makes this knowledge vulnerable to distortion or loss when custodians pass away.

Although several studies in Nigeria and other African countries have documented the value of traditional weather forecasting (e.g., Sanni et al., 2012; Balehegn, Balehey, Fu and Liang, 2019; and Zachary, Adepoju & Ahmed, 2021), only a few have systematically examined the specific challenges associated with its utilization in Kaduna State, particularly in Ikara Local Government Area (LGA). Ikara LGA is recognized as an important agricultural hub within the Northern Guinea Savannah zone, where farming activities are highly dependent on weather conditions. However, empirical evidence on how farmers perceive, utilize, or gradually abandon traditional weather forecasting methods remains limited. This lack of detailed information creates a significant gap in the literature. Consequently, there is a need for a focused investigation to understand the cultural, environmental, and socio-economic factors influencing the use of traditional weather forecasting in the study area. Such an inquiry will provide deeper insights into the relevance, limitations, and sustainability of indigenous forecasting practices among farming communities in Ikara LGA.

RESEARCH HYPOTHESIS

$H0_1$ – There is no significant relationship between farmers' socioeconomic characteristics and challenges faced in utilizing traditional weather forecasting

MATERIALS AND METHODS

Study Area

Ikara Local Government Area (LGA) is located between latitudes 11°09′00″ and 11°30′00″ North of the Equator and longitudes 8°00′00″ and 8°28′30″ East of the Greenwich Meridian (see Figure 1). It is one of the 23 Local Government Areas in Kaduna State, situated in the northwestern region of Nigeria. The LGA shares boundaries with Tudun Wada and Doguwa LGAs of Kano State to the east, Kubau LGA to the west, Soba LGA to the south, and Makarfi LGA to the north (Babajo, Yusuf & Musa, 2018).

The climate of Ikara LGA is tropical continental, classified as Aw in the Köppen climatic classification system, and is characterized by distinct wet and dry seasons. The rainfall pattern in the area is largely influenced by the seasonal movement of the Tropical Continental (cT) and Tropical Maritime (mT) air masses. The area records a mean annual rainfall of about 1,100 mm, with the rainy season typically beginning in May and ending in October (Ajayi, 2015). Temperatures in the area range from approximately 18°C during the cool season to about 32°C at the peak of the dry season.

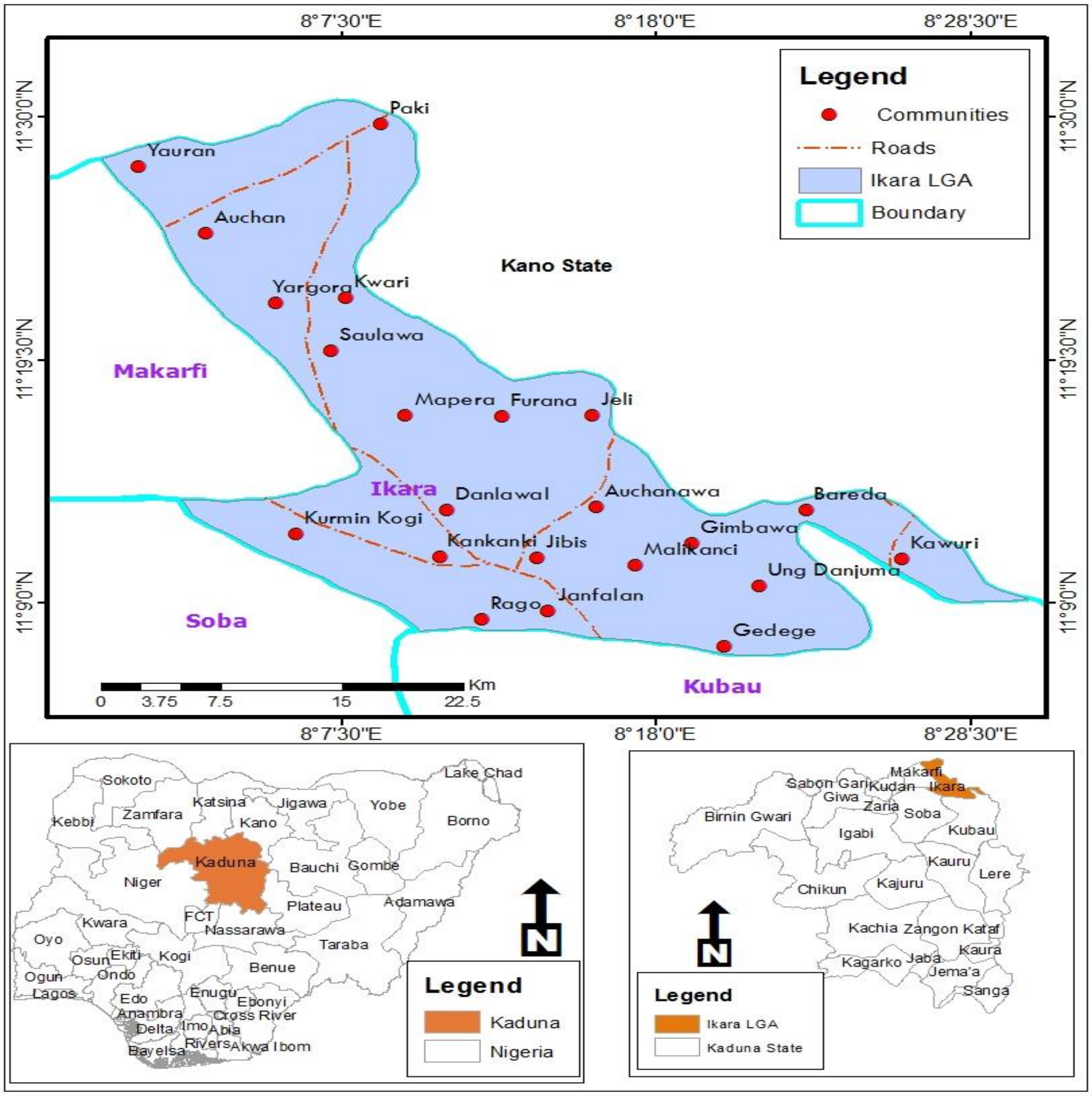

Figure 1: Ikara LGA
Source: Adapted and Modified from Administrative Map of Kaduna State (2025)

The LGA's economy is predominantly agrarian, with most inhabitants engaged in crop farming and livestock rearing. Crops cultivated include maize, millet, guinea corn, and groundnut, while Fulani pastoralists raise cattle for a livelihood. Agricultural activities are highly dependent on seasonal rainfall and local knowledge systems, particularly traditional weather forecasting practices, which remain integral to farming decisions in the area (Abaje, Ati, Iguisi, & Jidauna, 2016).

Sample Size and Sampling Technique

The 1991 National Population Commission figure of 154, 959 was used as the baseline population for Ikara LGA. This figure was projected to 2025 using a growth rate of 2.5% (World Bank, 2024). The projection was made using the standard population growth formula:

$$P_t = P_0(1 + r)^t \quad \text{.. Eq 1}$$

Where: P_t = Projected population after time t
P_0 = Base year population (154,959 in 1991)
r = Annual growth rate (2.5% = 0.025)
t = Number of years between base year and projected year (34 years)

Thus, the projected population of the Ikara Local Government Area (LGA) in 2025 is approximately 358,780. To determine the appropriate sample size for the study, the formula developed by Krejcie and Morgan (1970) for finite populations was adopted. This method is widely used in social science research because it provides a scientifically reliable procedure for determining a representative sample size while maintaining a 95% confidence level and a 5% margin of error. The use of this formula ensures that the selected sample adequately represents the study population and enhances the validity and Reliability of the research findings.

The formula for sample size determination, as proposed by Krejcie and Morgan (1970), is presented as follows:

$$s = \frac{\chi^2 N p(1-p)}{d^2(N-1) + \chi^2 p(1-p)} \quad \text{.............................. Eq 2}$$

Where: s = Required sample size
X^2 = Chi-square value for 1 degree of freedom at 95% confidence level (3.841)
N = Population size (358,780)
p = Population proportion assumed to be 0.5 (for maximum variability)
d = Degree of accuracy expressed as a proportion (0.05)

Therefore, the sample size used for the study is 384 respondents. This ensures the study's precision, representativeness and Reliability. For this study, purposive sampling was used at all stages to carefully select farmers knowledgeable about traditional weather forecasting in Ikara LGA. In the first stage, farming wards (see Table 1) were purposively selected based on prior information and evidence indicating that they still rely on indigenous knowledge to predict weather conditions. This ensured that the study focused only on areas where traditional forecasting practices are still relevant and widely used.

At the second stage, individual farmers were purposively selected within the selected wards based on criteria such as years of farming experience and involvement in rain-fed agriculture. They demonstrated familiarity with local weather-prediction indicators, including cloud movement, wind direction, bird migration, insect activity, and plant phenology. This approach was necessary because traditional weather forecasting is not uniformly practiced among all farmers, but is often preserved by older, experienced, and culturally inclined members of the community. By applying purposive sampling throughout, the study generated responses from farmers with the practical knowledge and lived experiences needed to provide meaningful insights into the challenges of using traditional weather forecasting in the study area. However, to reduce bias, copies of the questionnaire were administered in proportion to the total population of each sampled farming ward. The 1991 population census data, which have the advantage of providing figures for localities over those of the 2006 census, were projected to 2025 and used for the proportionate distribution of the research instrument (see Table 1).

Table 1: Population and Proportionate Sample Size

SN	Ward	1991 Figure	2025 Projected	Sample Size
A	Auchan	14, 871	44,772	64
B	Kurmin Kogi	12, 654	38,089	55
C	Kuya	16, 543	49,784	71
D	Rumi	13, 599	40,933	59
E	Saulawa	12, 124	36,495	52
F	Saya-Saya	11, 187	33,673	48
G	Pala	8, 336	25,092	35
	Total	**89, 314**	**268,838**	**384**

Source: National Population Commission (1991).

Methods of Data Analysis

In analyzing the data for this study, descriptive and inferential statistical methods were employed to provide a clear understanding of the challenges farmers in Ikara LGA face in using traditional weather forecasting. Data collected through questionnaires and interviews were first coded and entered into the Statistical Package for the Social Sciences (SPSS version 30) for systematic analysis. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize farmers' socio-demographic characteristics, the various forms of traditional weather indicators recognized, and the common challenges associated with their utilization. To further explore the relationship between farmers' characteristics (such as age, farming experience, and educational background) and their reliance on traditional forecasting, inferential tools such as the chi-square test were used to assess significant associations. The formula used for the Chi-square test is as follows:

$$\chi^2 = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \quad \text{…………………………………….. Eq 3}$$

Where: $\chi2$ = Chi-square value
O_{ij} = Observed frequency in each cell of the contingency table
E_{ij} = Expected frequency in each cell of the contingency table
$\sum$ = Summation over all cells

RESULTS AND DISCUSSION

Socio-Demographic/Economic Characteristics of the Respondents

The result of the socio-demographic and economic characteristics is presented in Table 2. The age structure of the respondents, as shown in Table 2, shows that a large proportion of the farmers are in the older age categories. Specifically, 26% are 61 – 65 years old, 20% are 51 – 55 years old, and another 20% are 65 years old or older. This implies that a good number of the respondents are elderly, which is important because older farmers are often regarded as custodians of indigenous knowledge, including traditional weather forecasting. Meanwhile, those in the middle age brackets, 56–60 years (18%), 46–50 years (9%), and 40–45 years (7%), were fewer, indicating that traditional knowledge may be concentrated among the elderly population. In terms of gender, 66% of respondents are male, and 34% are female, suggesting that farming in the study area is male-dominated, though women also contribute significantly. Marital status indicates that 49% were married, 30% divorced, 13% widowed, and only 8% single. This distribution shows that most farmers are household heads with responsibilities, which may affect their decisions and reliance on accurate weather forecasting to sustain their livelihoods.

Table 2: Socio-Demographic/Economic Characteristics

SN	Parameters	Options	Frequency	Percentages
A	Age (years)	40 – 45	27	7
		46 – 50	35	9
		51 – 55	76	20
		56 – 60	69	18
		61 – 65	98	26
		65 years and above	74	20
B	Gender	Male	249	66
		Female	130	34
C	Marital Status	Married	187	49
		Single	31	8
		Divorced	112	30
		Widowed	49	13
D	Level of education	Primary	114	30
		SSCE/GII	123	32
		Degree/HND	34	9
		NCE/Diploma	56	15
		No Formal Education	52	14
E	Years of farm experience	30 – 35	54	14
		36 – 40	43	11
		41 – 45	53	13
		46 – 50	121	32
		More than 50 years	108	28
F	Access to extension services	Yes	239	63
		No	140	37
G	Membership of the farmers' association	Yes	241	64
		No	138	36

Source: Field Work 2025

Educational attainment in Table 2 shows that 32% had SSCE/GII, 30% had primary education, 15% had NCE/Diploma, and 9% had Degree/HND. About 14% reported having no formal education. This indicates that while a good proportion of respondents are literate, many may still rely more on oral traditions and indigenous weather-forecasting methods than on scientific systems. With respect to farming experience, 32% reported 46–50 years, 28% had more than 50 years, 14% had 30–35 years, and 13% and 11% had 41–45 years and 36–40 years respectively. This demonstrates that most respondents are highly experienced farmers, an attribute that enhances their knowledge and use of traditional weather forecasting practices. Access to extension services was confirmed by 63% of respondents, while 37% reported no access, highlighting a gap in modern support systems that may reinforce traditional reliance. Furthermore, 64% of the farmers belong to associations, while 36% do not, showing that farmer groups are important platforms for sharing indigenous knowledge, experiences, and challenges related to weather forecasting.

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Common Traditional Indicators used by Farmers in Predicting Weather Conditions

Based on the field studies conducted, it was found that farmers in the study area traditionally used several indicators, such as astronomical, atmospheric, and biological indicators, to forecast weather and climate. This section, therefore, presents the results.

Table 3 shows the astronomical indicators used by farmers in the study area. The results presented in Table 3 reveal that a large majority (85%) of respondents reported that the position of the sun is an important guide in predicting changes in weather, while an even higher proportion (88%) considered the appearance and brightness of the moon as a reliable sign of imminent rainfall. Furthermore, 90% of farmers reported that the appearance of certain stars, particularly Dan Auta, is commonly used to forecast the onset of the rainy season, making it the most widely used astronomical indicator in the area.

Table 3: Astronomical Indicators used by Farmers in Predicting Weather Conditions

SN	Indicator	Agree/Yes F	Agree/Yes %	Disagree/No F	Disagree/No %
A	The position of the sun is used to predict changes in the weather.	321	85	58	15
B	The appearance and brightness of the moon indicate coming rainfall	334	88	45	12
C	The appearance of certain stars (e.g., *Dan Auta*) is used to forecast the rainy season.	341	90	38	10
D	Rainbows are considered signs of upcoming rainfall	338	89	41	11

Source: Field Work, 2025

Similarly, 89% affirmed that rainbows are perceived as a signal of approaching rainfall. However, according to farmers' beliefs, even when rain is approaching, the rainbow may swallow the cloud. These findings suggest that astronomical signs remain deeply ingrained in local knowledge systems and continue to play a significant role in shaping farmers' expectations and decisions on seasonal changes, despite the growing availability of modern meteorological services.

Table 4: Atmospheric Indicators used by Farmers in Predicting Weather Conditions

SN	Indicator	Agree/Yes F	Agree/Yes %	Disagree/No F	Disagree/No %
A	Direction and strength of wind are used to predict rain or drought	276	73	103	27
B	Changes in temperature (heat/cold) are interpreted as weather signals	298	79	81	21
C	The formation and thickness of clouds indicate rainfall patterns	312	82	67	18
D	Thunder and lightning are taken as signs of imminent rainfall	299	79	80	21

Source: Field Survey, 2025

Findings from Table 4 show that atmospheric indicators are widely recognized by farmers in Ikara LGA as reliable tools for predicting weather outcomes. About 73% of respondents rely on wind direction and strength to forecast rainfall or drought, while 79% interpret temperature changes, such as unusual heat or cold, as weather signals. Similarly, 82% affirmed that cloud formation and thickness are important cues for predicting rainfall patterns, making them the most commonly used atmospheric indicators. These findings align with Holschuh (2022), who reported that weather conditions provide insight into the atmospheric state of a particular place, while climatic conditions describe how weather behaves over a specific period and are determined by objective meteorological data. Seasons and natural processes play a crucial role in agriculture, strongly influencing farming activities and productivity.

In addition, 79% of the farmers reported that thunder and lightning are perceived as clear signs of imminent rainfall. These results highlight the continued dependence of rural farming communities on atmospheric observations, which provide practical, real-time insights into short-term weather conditions, thereby guiding agricultural planning and decision-making.

Table 5 reveals that farmers also rely strongly on biological indicators to predict weather conditions and seasonal changes in the study area. About 79% of respondents observed that early flowering of trees such as baobab and mango signals the onset of the rainy season, while 73% associated the abundance of certain fruits with good rainfall. Similarly, 76% noted that ants building high mounds are a sign of heavy rain, and 82% relied on the appearance of butterflies and dragonflies as indicators of the rainy season. However, only 58% believed that the croaking of frogs at night is a sign of imminent rainfall, and an equal proportion linked the flowering of the locust bean tree to the start of the growing season.

Also, bird migration, particularly swallows and storks, as shown in Table 5, was acknowledged by 85% of respondents as a reliable seasonal change signal. Other observed signs include human body perspiration (73%), the appearance of army worms (72%) as indicators of dry spells, chameleons signaling the start of dry spells (77%), guinea fowls laying eggs as an indication of the rainy season (73%), and crickets digging holes (78%) to show that the growing season is established. These findings aligned with those of Sanni and Akinyosoye (2012), who reported that farmers in some northern states used several indicators to predict the onset of the rainy season and planting season. These findings demonstrate that farmers in the study area rely on a wide range of plant and animal behaviors to complement other forecasting methods, highlighting the depth of indigenous ecological knowledge in weather prediction.

Table 5: Biological Indicators used by Farmers in Predicting Weather Conditions

SN	Indicator	Agree/Yes		Agree/Yes	
		F	%	F	%
A	Early flowering of trees (e.g., baobab, mango) is used to predict the rainy season	298	79	81	21
B	An abundance of certain fruits indicates good rainfall	277	73	102	27
C	Ants building high mounds is seen as a sign of heavy rainfall	287	76	92	24
D	The appearance of butterflies and dragonflies signals the start of the rainy season	311	82	68	18
E	Croaking of frogs at night indicates rainfall is near	221	58	158	42
F	Migration of birds (e.g., swallows) signals seasonal change	321	85	58	15
G	The perspiration of the human body indicates rain soon	276	73	103	27
H	The appearance of the army worm indicates a dry spell	271	72	108	28
I	The appearance of a chameleon indicates the start of a dry spell	290	77	89	23
J	Flowering of the locust bean tree indicates the start of the growing season	219	58	160	42
K	Guinea fowl laying eggs is an indication of the start of the rainy season	278	73	101	27
L	Cricket digging holes means the growing season has established itself	294	78	85	22

Source: Field Survey, 2025

Challenges Experienced by Farmers in Utilizing Traditional Weather Forecasting

Table 6 presents the challenges farmers encounter in utilizing traditional weather forecasting methods. These challenges highlight the limitations of relying solely on indigenous knowledge systems for agricultural decision-making. Understanding these constraints is essential for improving farmers' resilience and integrating traditional forecasts with modern scientific approaches.

The findings presented in Table 6 highlight several challenges farmers face in utilizing traditional weather forecasting methods in the study area. A major concern is that climate change has made these methods less reliable, with 85% of respondents agreeing that shifts in rainfall and temperature patterns have distorted the accuracy of indigenous indicators. Closely linked to this is the problem of biodiversity loss, as 82% reported that the disappearance of certain plants, animals, and insects has affected the availability of natural signs used in forecasting. Furthermore, 90% indicated that some indicators are difficult to interpret without guidance from elders, highlighting how generational gaps contribute to the weakening of indigenous knowledge systems.

Table 6: Challenges of Using Traditional Weather Forecast in the Study Area

SN	Challenges	Agree/Yes		Disagree/ No	
		F	%	F	%
A	Traditional weather forecasting methods are becoming less reliable due to climate change	322	85	57	15
B	Younger farmers show less interest in learning and applying traditional forecasting methods	211	56	168	44
C	Some traditional indicators are difficult to interpret without the guidance of elders	341	90	38	10
D	Loss of biodiversity (e.g., plants, insects, and animals) affects the availability of natural indicators	311	82	68	18
E	Modern meteorological forecasts reduce farmers' reliance on traditional weather forecasting	324	85	55	85
F	Seasonal variations sometimes make traditional indicators misleading	298	79	81	21
G	Urbanization and deforestation disrupt the natural signs used in traditional forecasting	218	58	161	42
H	Some traditional indicators (e.g., bird migration, ant mounds) are no longer easily observable	326	86	53	14
I	There is limited documentation of traditional knowledge, making it difficult for younger generations to learn	312	82	67	18
J	Dependence on oral transmission increases the risk of losing traditional forecasting knowledge	290	77	89	23

Source: Field Survey, 2025

Seasonal variations were also noted by 79% of respondents as a factor that sometimes makes traditional signs misleading, highlighting the growing uncertainties in weather patterns. Additionally, 86% observed that some natural indicators, such as bird migration and ant mound formation, are no longer easily observable, which further erodes the Reliability of traditional methods. That farmers in northern Nigeria are faced with the challenges of limited traditional knowledge, making it difficult for younger generations to learn, this result agrees with the findings of Rautela and Karki (2015), which stated that there are challenges among the people of the Himalayas in forecasting weather using traditional knowledge.

Beyond environmental challenges, socio-cultural and institutional factors also play a significant role. More than half of the respondents (56%) acknowledged that younger farmers show less interest in learning and applying these methods, largely due to the availability of modern meteorological forecasts, which 85% said reduce reliance on traditional systems. Urbanization and deforestation, highlighted by 58% of respondents, further disrupt the natural environment, diminishing the visibility and accuracy of traditional signs. The lack of proper documentation also poses a major threat, with 82% noting that reliance on oral transmission limits intergenerational knowledge transfer. This is compounded by the fact that 77% emphasized the risk of total loss of traditional forecasting knowledge if it continues to be passed down informally. Together, these findings suggest that both environmental transformations and socio-cultural shifts are undermining the continuity and reliability of traditional weather forecasting practices in the study area.

Test of Hypothesis

Table 7 presents the Chi-Square Test of association between farmers' socioeconomic characteristics and the challenges of using traditional weather forecasting in the study area.

Table 7: Hypothesis Test

Variables	X^2 Value	df	P-Value
Socioeconomic Characteristics Challenges faced by Farmers	38.29	12	0.001

Source: Field Survey, 2025

The chi-square test result ($\chi^2 = 38.29$, df = 12, p = 0.001) indicates a statistically significant difference between farmers' socioeconomic characteristics and the challenges they face in utilizing traditional weather forecasting in the study area. Since the p-value is less than the 0.05 significance level, the null hypothesis was rejected, confirming that variables such as age, marital status, education, years of farming experience, and membership in farmers' associations significantly influence how farmers perceive and experience challenges in using indigenous forecasting methods. This suggests that farmers' social and economic background shapes their ability to understand, interpret, and adapt traditional weather indicators.

The findings further reveal that older farmers with longer years of experience are more inclined to rely on traditional methods, but their ability to interpret some indicators may be constrained by biodiversity loss, urbanization, and reduced oral transmission to younger generations. Conversely, younger and more educated farmers are increasingly exposed to modern meteorological forecasts, which reduce their reliance on indigenous practices and, in some cases, lead to a lack of interest in learning traditional methods. Moreover, marital status and membership in farmers' associations play critical roles, as farmers who are married or who belong to associations tend to access information and knowledge-sharing platforms that reinforce their perceptions of the relevance or limitations of traditional weather forecasting.

CONCLUSION

Based on the findings, the study concludes that traditional weather forecasting remains relevant among farmers in the study area but is increasingly constrained by environmental, social, and institutional factors. The results further indicate that farmers' socioeconomic characteristics, particularly age, education, farming experience, and social networks, significantly influence their perceptions and use of indigenous forecasting methods. Although traditional knowledge retains strong cultural value, its sustainability is threatened by climate change, biodiversity loss, and weakening intergenerational knowledge transfer. Consequently, systematic documentation of indigenous knowledge, strengthened intergenerational knowledge exchange, and the integration of traditional and modern meteorological forecasting systems are essential to enhance farmers' adaptive capacity and improve climate-related decision-making.

RECOMMENDATIONS

The study recommends that agricultural extension services be strengthened to promote the transfer of indigenous weather forecasting knowledge from elderly custodians to younger farmers**,** thereby reducing interpretation challenges and bridging generational gaps. It is also recommended that indigenous climate forecasting knowledge and indicators be systematically documented and preserved by relevant institutions to safeguard them against loss arising from ageing knowledge holders, biodiversity decline, and climate variability. The study further recommends the integration of indigenous forecasting methods with modern meteorological **s**ystems in order to enhance the reliability of climate information and improve farmers' adaptive capacity to climate change.

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