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FARMERS' DISPOSITION TO SCIENTIFIC WEATHER MONITORING AND INDIGENOUS KNOWLEDGE SYSTEMS USED IN RURAL COMMUNITIES OF OGUN STATE, NIGERIA

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ABSTRACT

Climate-based indigenous knowledge provides farmers with the ability to survive and produce under risks due to climate and other environmental constraints. This study assessed farmers' disposition to scientific weather monitoring and indigenous knowledge systems (IKS) used in rural communities of Ogun State. A multistage sampling procedure was adopted in selecting 250 rural farmers drawn from 6 extension blocks across the four Agricultural Development Programme Zones in Ogun State. Data were obtained using an interview schedule, and analyzed with descriptive and inferential statistics. Results revealed that 79.6% of the farmers were male and 91.2% were married. The farmers' mean age, household size, farming experience, and monthly income were 57.24 years, 6 persons, 33.65 years, and ₦32,508.68 respectively. Biological (76.8%), astronomical (54.0%), and atmospheric (58.4%) IKS were utilized as tools for monitoring the weather conditions. Majority (79.6%) had a positive disposition to science-based weather forecast. Chi-square statistic revealed that there were significant associations ($p \leq 0.05$) between farmers' household size ($\chi^2=7.69$), level of education ($\chi^2=9.57$), farming experience ($\chi^2=14.75$) and the use of biological IKS for weather monitoring and forecast of farming season. Also, farmers' age ($\chi^2=15.58$, $p \leq 0.01$), farming experience ($\chi^2=9.99$, $p \leq 0.05$) were significantly associated with atmospheric IKS. Religion ($\chi^2=10.79$, $p \leq 0.01$) and marital status ($\chi^2=6.17$, $p \leq 0.05$) had significant associations with the use of cultural IKS for weather monitoring. The study concluded that local farmers were utilizing biological, atmospheric and astronomical indigenous knowledge systems for weather monitoring and prediction of farming season. The study recommended integrating indigenous knowledge with science-based prediction for the farming season.

Keywords: Astronomical IKS, Atmospheric IKS, Biological IKS, Climate change, Cultural IKS.

INTRODUCTION

Among the issues that the world is attempting to address with its Sustainable Development Agenda are poverty, hunger, and food and nutrition insecurity. Global communities are dealing with climate change, which could have both real and prospective negative effects on agriculture - though these effects would not be felt equally by all farmers (Intergovernmental Panel on Climate Change [IPCC], 2022). Climate variability and change are expected to have the greatest impact on the local farming system in Sub-Saharan Africa (SSA) (IPCC, 2018). Given their impact on the local population's food security, climate change is a significant issue that requires careful observation (Vilakazi, 2017). According to Kom, Nethengwe, Mpandeli and Chikoore (2022), farmers in rural areas are particularly affected by climate change since harsh weather can lead to crop failure and diminish their chances for a living. This is so because the agriculture industry is sensitive to climate change.

Drought, altered rainfall patterns, and the ensuing rise in pest and disease cases as the system as a whole tries to adjust to the changes surrounding it have a negative impact on agriculture (Pereira, 2017). Given Nigeria's growing population, the effects of climate change on agricultural productivity may worsen the nation's food security unless farmers have immediate access to trustworthy climate information services and efficient forecast information dissemination systems (Radeny *et al.*, 2019). Farmers and pastoralists are better able to manage the hazards associated with climate change and deal with climate variability when they have advanced understanding of climate information and agro-advisories. According to the Fifth Assessment Report of the International Panel on Climate Change, there has been a noticeable increase in temperature across Africa in recent years, which is consistent with human-caused climate change. This has a serious negative impact on sectors that are susceptible to climate change, such as the agricultural industry (IPCC, 2014).

According to Olaniyan and Govender (2023), the majority of Nigerian agriculture is still rain-fed,

meaning that farmers must wait for the rainy season to begin before they can engage in any farming activities, such as pre-planting, planting, and post-planting. The farmers used the indigenous knowledge systems they had established as a result of this to carry out their daily farming operations. Farmers, pastoralists, and other local people use the indigenous knowledge system (IKS) to monitor and predict local weather phenomena, including the onset, cessation, intensity, and distribution of rainfall as well as the occurrence and magnitude of drought and flood events. They also use the IKS to observe the behavior of living organisms, wind direction, and cloud types (Radeny *et al.*, 2019). In spite of climate change and little research funding, indigenous farmers have been able to maintain their production through the use of freely available and reasonably priced indigenous knowledge (Petsakos *et al.*, 2019).
Despite the fact that farmers have mostly relied on the IKS, academics contend that it cannot be trusted since several of its components cannot be verified by science. These academics suggested using current climate data and weather forecasts as a crucial component to help inform agricultural decision-making. The limits of using scientific climate projections at the local farming level in terms of space and time are supported by Nissan *et al.* (2019). In addition, Kom, Nethengwe, Mpandeli and Chikoore (2023) express concern about the fact that indigenous farmers interpret scientific meteorological forecasts incorrectly and do not provide accurate weather information at the local scale. Based on the evaluation of prior submissions' strengths and flaws, this research suggests that combining indigenous and scientific knowledge systems could result in more successful and efficient adaptation plans for farmers in rural areas. This view is supported by research by Jiri, Mafongoya, Mubaya and Mafongoya (2016) and Mugambiwa (2018), which showed that local indigenous knowledge can play complementary roles and that scientific knowledge alone is insufficient to adequately mitigate climatic risks among indigenous farmers.

In Nigeria, there is dearth of empirical data on the integration of scientific and indigenous knowledge systems for weather monitoring, prediction and forecast in local farming practices. Hence, this study assessed farmers' disposition to scientific weather monitoring and indigenous knowledge systems used in rural communities of Ogun State, Nigeria. Specifically, the study described the socio-economic characteristics of rural farmers in Ogun State, assessed the indigenous knowledge systems commonly used by farmers in rural communities of Ogun State, and determined farmers' disposition to science-based weather forecast in comparison to IKS. The study also tested that there is no significant association between selected farmers' socio-economic variables and kind of IKS used by them for weather monitoring.

MATERIALS AND METHODS

Study Area

This study was conducted in Ogun State, Nigeria. Ogun State is one of the six Southwestern States in Nigeria. The agro-climate of the state is characterized by a bimodal rainfall pattern of about 7 months which occur from April to October, with temporary cessation in August and at Peak in July. The dry season of about 4 to 5 months which often sets-in in November and runs through March. Seventy percent of the State's land area is suitable for arable crop production. The major food crops include rice, maize, cassava, yam and banana. The main cash crops include cocoa, kolanut, rubber, palm oil and palm kernels. The farming system is however largely rain-fed agriculture with farmers depending on rainfall for the farming activities. With this, the farming system, the farming activities, of the farmers are greatly influenced or affected by the trending climatic change.

Sampling Techniques and Sample Size

A multistage sampling procedure was adopted in this study. Stage one involved the random selection of one-third of the local government areas in each of the four Extension zones. This resulted in the selection of six (Ilugun, Opeji, Sawonjo, Ala, Ibiade and Obafemi) extension blocks. Stage two involved the random sampling of half of the circles/communities in the selected blocks resulting in the selection of 21 communities through a cluster sampling technique. Stage three involved the convenient sampling of 250 farmers from the selected communities based on availability and readiness to participate in the research.

Measurement of Key Variables

Indigenous knowledge systems for weather monitoring: This was measured at nominal level as biological, atmospheric, astronomic and relief features, and assigned nominal scores of 1, 2, 3 and 4 respectively.

Farmers' disposition to the science-based weather forecast: This was measured at interval level using a developed social behavioural 5-point Likert-type rating scale. The responses were Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree with scores of 5, 4, 3, 2 and 1 respectively for positive statements. The scores were reversed for negative statements.

Methods of Data Analysis

The data collected were cleaned, coded and entered into the Statistical Package for Social Sciences – SPSS version 21.0. This study was subjected to descriptive (frequency counts, percentage, mean and standard deviation) and inferential (Chi-square) statistics.

RESULTS AND DISCUSSION

Socioeconomic characteristics of rural farmers in the study area

Results on the socioeconomic characteristics of the rural farmers are presented in Table 1. It reveals that majority (79.6%) of the farmers were male while the remaining (20.4%) were female. This means that farming was dominated by the male folk in the rural areas and this could be associated with the patriarchal nature of the Nigerian society which regarded women's responsibility as exclusively within the household – child bearing and rearing and domestic chores. Farming is primarily recognized as a masculine task, given the rigour and stress involved in land cultivation and management. This is in line with the findings of Tunde and Ajadi (2018) who inferred that males are into farming with better understanding of indigenous weather variability and forecasting.

FAO and ECOWAS (2018) also reported sex dis-aggregation and insufficient attention to gender as some of the reasons for high male population in agricultural production. It also goes in line with previous submissions (Adenegan, Bamidele and Nwauwa, 2017) that the rigour involved and tedious nature of farming tasks underscores its dominance as occupation by men. This undermines the active roles played by women in agriculture especially in the processing of food. The age distribution of the sampled farmers revealed that 31.6, 31.6 and 24.0 per cents of the farmers were within 41-50, 51-60 and 61-70 years age brackets respectively. The mean age of the sampled farmers was 57.24±11.81 years. Close to two-thirds (65.6%) of the sampled farmers practiced Christianity while 26.4% and 8.0% practiced Islam and traditional religions respectively.

Majority (91.2%) of the farmers were married while 7.6 % were widowed. The marital status is an indication that the farmers are likely to receive assistance from family members especially in form of cheap labour and loans for business purposes. The marital status could also imply that the farmers have dependent family members (children and wives) who they cater for. Married farmers are expected to be more matured and responsible than the unmarried categories. As such, they are likely to have better understanding of environmental factors in their search for improved means of livelihood than unmarried farmers (Tunde & Ajadi, 2018). According to Olaoye *et al.* (2017), being married has implications on both the economic and social responsibilities of farmers for their dependents.

Close to half (49.2%) of the farmers had 6-10 household size while the household size of 45.2 % of the farmers was 1-5 persons. The mean household size of the farmers was 6±3 persons implying that the farmers could have access to cheap labour at little or no cost from family members. In line with Mukaila, Falola and Egwue (2021), a larger household size implies the use of more family labour which will increase the output and income from farming. Some (29.6%) of the sampled farmers had no formal education while the highest proportion (35.2%) had primary education. Also, 15.6 and 19.6 per cents of the farmers had secondary and tertiary educations respectively. This indicates that the farmers had varied level of education with more than half being either uneducated or had low level of education while few had up to tertiary level of education.

Close to two-thirds (66.0%) of the farmers had between 31 and 40 years of farming experience and the mean farming experience of the farmers was computed as 33.65±11.73 years. The position of Shettima, Mohammed, Ghide and Zindam (2014) indicated that farmers' experience had a positively significant relationship with productivity. Adenegan *et al.* (2017) also posited that the longer the farming experience, the more productive the farmers would be due to previous experience that would have been used to tackle challenges such as those posed by seasonality in farming and unpredictable weather conditions. The monthly income of the farmers presented in Table 1 ranged from ₦10000 to ₦80000. About one-third (33.2%) of the sampled farmers earned ≤ ₦20000 while 24.0%, 10.0% and 24.0% earned ₦20001- ₦30000, ₦30001- ₦40000 and ₦40001- ₦50000 respectively on monthly basis. The mean monthly income of the farmers was ₦32508.68±17260.47. This was a little higher than the newly federal government approved minimum wage for Nigerian civil servants that most state governments are still contending with. This could imply that the farmers are already earning more than some civil servants in the country. Hence, farming can be said to be highly rewarding and profitable.

Table 1: Distribution of farmers by socioeconomic characteristics (n = 250)

Socioeconomic variables	Frequency	Percentage	Mean ± Std. deviation
Sex			
Male	199	79.6	
Female	51	20.4	
Age (years)			
≤40	10	4.0	
41-50	79	31.6	57.24±11.81 years
51-60	79	31.6	
61-70	60	24.0	
>70	22	8.8	
Religion			
Islam	66	26.4	
Christianity	164	65.6	
Traditional	20	8.0	
Marital status			
Married	228	91.2	
Single	3	1.2	
Widowed	19	7.6	
Household size (number of persons)			
1-5	113	45.2	6±3 persons
6-10	123	49.2	
>10	14	5.6	
Highest educational qualification			
No formal education	74	29.6	
Primary education	88	35.2	
Secondary education	39	15.6	
Tertiary education	49	19.6	
Farming experience (years)			
≤10	5	2.0	
11-20	26	10.4	33.65±11.73 years
21-30	25	10.0	
31-40	165	66.0	
>40	29	11.6	
Income (Naira)			
≤20000	83	33.2	
20001-30000	60	24.0	₦32508.68±17260.47
30001-40000	25	10.0	
40001-50000	60	24.0	
>50000	22	8.8	

Source: Field survey (2020)

Indigenous knowledge system employed by the rural farmers for monitoring weather situation

The categories of indigenous knowledge system employed by farmers in monitoring the weather condition and predicting farming seasons are presented in Figure 2. It reveals that more than half of the farmers made use of biological (76.8%), astronomical (54.0%), and atmospheric (58.4%) indigenous knowledge systems while 16.0% of the farmers used cultural factors as indigenous knowledge for weather monitoring. This could be attributed to the fact that the biological, astronomical and atmospheric indicators could be easily observed, understood and interpreted by the farmers to effectively guide their farming activities. The use of atmospheric, biological conditions and astronomic characteristics has been previously used to predict the weather over short and long periods (Irumva, Twagirayezu & Nizeyimana, 2021).

Radeny *et al.* (2019) also reported that farmer in East Africa used a combination of meteorological, biological, and astrological indicators to forecast local weather conditions. This is in conformity with the opinion of Chikaire, Nnadi, Ajaero and Ogueri (2018) who observed that African farmers do not generally use a single forecasting indicator. Tunde and Ajayi (2018) also reported that local people have their own knowledge of the understanding of the climate change.

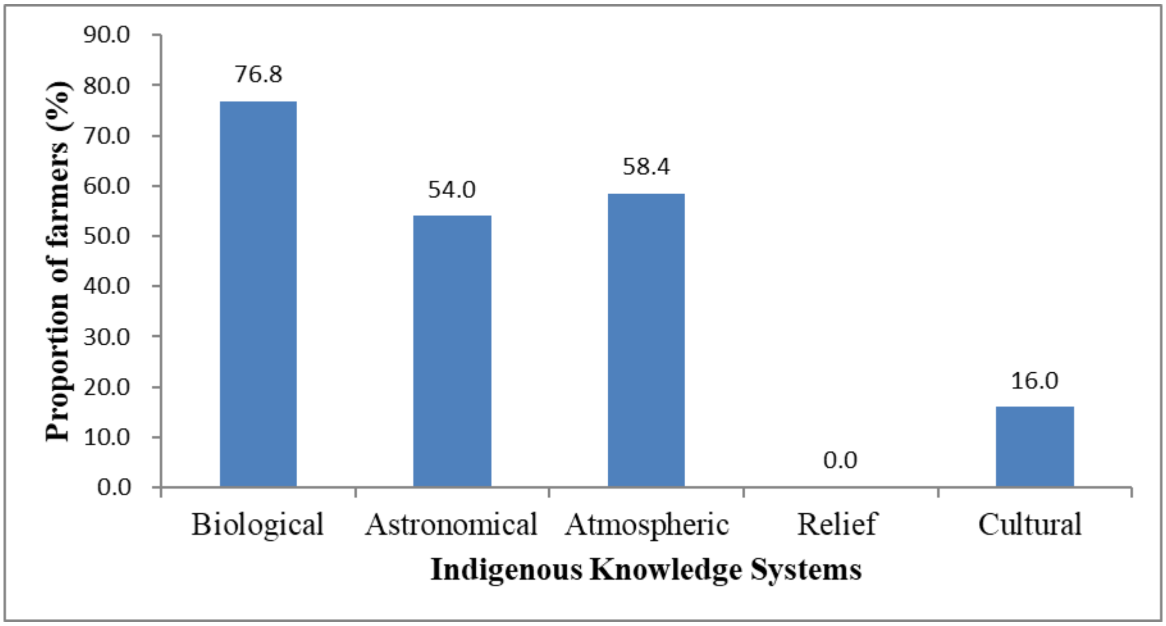

Figure 1: Indigenous Knowledge Systems used by rural farmers for weather monitoring

Farmers' disposition to science-based weather forecast

The farmers' disposition to science-based weather forecast with respect to seven statements is presented in Table 2. It shows that more than half of the farmers were in agreement that science-based climate information is highly valuable (58.4%), accessibility to science-based climate information is crucial to a successful farming (80.0%), and that science-based climate information allows for climate smart agriculture (57.2%). This could imply that rural farmers had some level of awareness on the relevance of climate information on their production activities. International Institute for Applied Systems Analysis (2020) also presented that high level of awareness of climate change was as a result of extensive awareness creation.

Although 76.0 percent of the farmers will be glad to use science-based weather information, more than half (53.6%) were in disagreement on the superiority of science-based climate information over the indigenous knowledge about weather forecast. The mean values (Table 2) ranged from 1.94±1.78 to 4.20±0.55. This disagreement could be attributed to the fact some Nigerians, like other African may consider science-based climate information to their local traditions which are perceived to be rich in value. This is in consonance with the position of Zongo, Dogot and Toé (2022) that the current weather forecasts are still alien to African farmers, most of whom live in rural areas and struggle with illiteracy and poor communications infrastructure. In the same vein, Radeny *et al.* (2019) found that higher proportion of the farmers reported that indigenous knowledge was more reliable than scientific knowledge in the prediction of weather conditions for cropping season.

Results in Figure 2 reveal that majority (79.6%) of the farmers had positive disposition to science-based weather forecast while the remaining (20.4%) were negatively disposed to science-based weather forecast. Having some farmers with negative notions about science-based climate information could be as a result of complete ignorance or lack of access to accurate weather forecast especially as it affects their planting seasons.

Table 2: Farmers' disposition to science-based weather forecast

Statements	Strongly Agreed	Agreed	Disagreed	Strongly Disagreed	Undecided	Mean±Std
Climate-based information from science is highly valuable	83 (33.2)	63 (25.2)	50 (20.0)	34 (13.6)	20 (8.0)	3.62±1.42
Accessibility to science-based climate information is crucial to successful farming	131 (52.4)	69 (27.6)	24 (9.6)	16 (6.4)	10 (4.0)	4.18±0.87
Science-based climate information is superior to indigenous knowledge information	44 (17.6)	36 (14.4)	61 (24.4)	73 (29.2)	36 (14.4)	2.92±1.63
Science-based climate information allows for climate smart agriculture	74 (29.6)	69 (27.6)	53 (21.2)	34 (13.6)	20 (8.0)	3.58±1.01
Local farmers are not sensitized and educated on the value of climate information	131 (52.4)	46 (18.4)	40 (16.0)	23 (9.2)	10 (4.0)	1.94±1.78
There is general lack of access to science-based climate information	63 (25.2)	36 (14.4)	69 (27.6)	75 (30.0)	7 (2.8)	2.71±1.54
Where science-based climate information is accessible, I will gladly make use of it	151 (60.4)	39 (15.6)	30 (12.0)	20 (8.0)	10 (4.0)	4.20±0.55

Figures in parentheses () are expressed as percentages; Std = Standard deviation

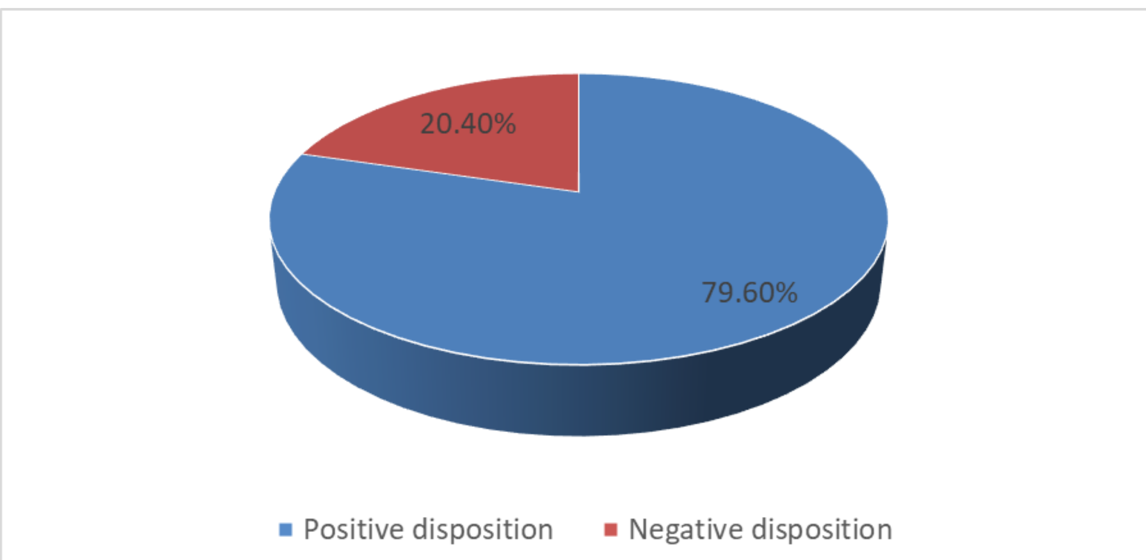

Figure 2: Perception of farmers on science-based weather forecast

Test of Hypothesis

H_{o1}: There is no significant association between selected socioeconomic characteristics of the rural farmers and the category of indigenous knowledge system employed for weather monitoring

Table 3 reveals that there were significant associations between respondents' household size (χ^2 = 7.69, p<0.05), level of education (χ^2 = 9.57, p<0.05), farming experience (χ^2 = 14.75, p<0.01) and the use of biological indigenous knowledge system for weather monitoring. This implies that the use of indigenous indicators was influenced by farmers' level of education and farming experience. This implies that people are more likely to rely on IKS if they have larger households, less formal education, and a lot of farming experience. Mukaila *et al.* (2021) state there is a greater chance that traditional agricultural and meteorological knowledge and practices will be passed down because larger homes frequently house many generations. Because of their limited access to formal education and reliance on traditional livelihoods, Olumide, Adesina and Olaoye (2014) also found a correlation between lower levels of schooling and a larger reliance on indigenous knowledge. Years of experience may have given knowledgeable farmers the knowledge and abilities to interpret natural indications and weather pattern indicators (Thomas, Riley & Spees, 2020).

With respect to the use of atmospheric knowledge system, farmers' age (χ^2 = 15.58, p<0.01) and farming experience (χ^2 = 9.99, p<0.05) showed significant associations. This implies that age and farming experience are important determinants of the use of atmospheric indicators for weather monitoring. The results imply that modern weather monitoring devices are more likely to be used by younger farmers. This is because younger farmers are frequently more open to new ideas and technologies, such as internet information, smartphone applications, and digital weather forecasting systems (Rizzo, Migliore, Schifani, & Vecchio, 2024).

Respondents' religion (χ^2 = 10.79, p<0.01) and marital status (χ^2 = 6.17, p<0.05) had significant associations with the use of cultural knowledge system for weather monitoring. Farmers' choices for conventional weather forecasting techniques may be influenced by their religious views and practices, as indicated by the significant correlation found between respondents' religious beliefs and the usage of cultural knowledge systems. Religious festivals, ceremonies, and rituals are frequently associated with seasonal variations and agricultural practices in many civilizations. This relationship offers chances to observe natural occurrences and forecast weather patterns. This result is consistent with studies showing that, in many communities, indigenous knowledge systems and cultural traditions are important factors in weather forecasting and agricultural decision-making (IPCC, 2022). The use of cultural knowledge systems and respondents' marital status were shown to be significantly correlated, indicating that married people may be more inclined to rely on conventional weather predicting techniques. Married people might profit from group decision-making in homes and communities where cultural information is passed down through the generations (Louzek, 2022).

Table 3: Results of Chi-Square analysis on the association between respondents' sociodemographic characteristics and usage of different indigenous knowledge systems

Sociodemographic characteristics	Biological knowledge system	Atmospheric knowledge system	Astronomical knowledge system	Cultural knowledge system
Sex (df = 1)	2.546 (0.325)	1.055 (0.411)	3.671 (0.153)	2.317 (0.333)
Age (df = 4)	8.278 (0.096)	15.584 (0.001)**	6.753 (0.143)	7.529 (0.121)
Religion (df = 2)	3.802 (0.349)	5.501 (0.137)	4.500 (0.195)	10.789 (0.001)**
Marital status (df = 2)	4.085 (0.213)	3.469 (0.309)	4.231 (0.218)	6.173 (0.037)*
Household size (df=2)	7.694 (0.026)*	4.852 (0.182)	1.492 (0.435)	3.589 (0.295)
Education (df = 3)	9.567 (0.019)*	7.500 (0.226)	6.017 (0.314)	3.897 (0.491)
Farming experience (df = 4)	14.752 (0.001)**	9.992 (0.039)*	9.210 (0.073)	9.389 (0.062)

df = degree of freedom; *means significant association at p<0.05; **means significant association at p<0.01
Figures in parentheses are p-values

CONCLUSION AND RECOMMENDATIONS

It was deduced from this research that arable crop farmers mostly used the biological, astronomical and atmospheric indigenous knowledge systems for monitoring farming seasons and weather forecast. Though, there were mixed perception, rural farmers generally had positive disposition to science-based weather monitoring; and that the kind of indigenous knowledge systems used by the farmers was influenced by socio-demographic characteristics such as age, religion, marital status, household size, educational attainment and farming experience. The study concludes that rural farmers had established indigenous knowledge in relation to their farming activities based on different indicators, which are in complementality with science-based weather forecasts. The study recommends that rural farmers should integrate indigenous and science-based knowledge systems into weather monitoring and prediction of farming seasons. Extension personnel and other stakeholders should create awareness and train rural dwellers on the complementary nature of indigenous and scientific knowledge in improving agricultural productivity.

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