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Utilisation of Climate Information Services by Arable Crop Farmers in Osun State, Nigeria

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Abstract

The study assessed the utilisation of climate information services (CISs) among arable crop farmers in Osun State, Nigeria. A multistage sampling procedure combining purposive and convenience techniques was used to select 154 respondents. Primary data were collected using a structured interview schedule and analysed using frequency counts, percentages, means, standard deviation, and Pearson's product-moment correlation. Results showed that maize (92.2%) was the predominant arable crop cultivated. Weather forecast services (100%) were the most available, and the most accessible CIS ($\bar{x}$= 4.60). The majority (63.0%) of respondents moderately utilised CISs, with flood and extreme weather alerts ($\bar{x}$= 3.83) the most applied. Lack of extension support services ($\bar{x}$= 2.73) was the most severe constraint to utilisation. Accessibility to CISs had a positive and significant relationship with utilisation (r = 0.394), while annual income had a negative and significant relationship (r = −0.338). The study concluded that arable crop farmers moderately utilised CISs and recommends that the Nigerian Meteorological Agency (NIMET) and extension agencies strengthen dissemination and support services to improve farmers' access to CISs.

Keywords: Climate information services, arable crop farmer, utilization of climate information

Introduction

Agriculture remains central to employment and food security in Nigeria, yet the sector is highly sensitive to climate variability and change, which depress crop yields, farm income, and food availability (Ayinla et al., 2024). Climate change manifests in erratic rainfall and temperatures and in recurrent droughts and floods that weaken the basis for farm decision-making (Agboola et al., 2024). Climate information services (CIS) have emerged as a vital response. CIS involve the systematic generation, packaging, and delivery of customised weather and climate data tailored to the needs of end-users, primarily farmers, covering rainfall onset, duration, and cessation, temperature, and related variables essential for planting and harvesting decisions (Baffour-Ata et al., 2022; Antwi-Agyei et al., 2021).

The adoption of CIS is gaining momentum across sub-Saharan Africa as farmers recognise its value in managing environmental risk (Alhassan et al., 2025). Recent

studies show that the effective utilisation of these services depends heavily on the accessibility of extension support and the technical literacy of farming households (Lawal & Omotesho, 2023; Antwi-Agyei et al., 2021; Baffour-Ata et al., 2022). By enabling a shift from reactive to proactive management, CIS allow farmers to adjust planting dates, select appropriate varieties, and apply precision water management, decisions that are positively associated with crop yield and household food security when information is timely and trusted (Adeloye et al., 2024; Appiah et al., 2025).

Osun State is largely agrarian, with maize, cassava, yams, and vegetables among its common crops. Yet a worrying gap persists in the dissemination of CIS. Many farmers still rely on indigenous weather indicators and informal forecasts rather than scientific climate information, which often fail to address current agronomic challenges (Akano et al., 2023). Although radio, social media, and mobile applications are available, dissemination is constrained by weak infrastructure and socio-economic conditions (Adeloye et al., 2024); many rural farmers cannot afford the smartphones or other devices through which up-to-date weather information is accessed (Coggins et al., 2022), and limited formal and digital literacy further restricts their ability to interpret it (Lawal & Omotesho, 2023). Access is also inequitable across demographic groups: evidence from across sub-Saharan Africa shows that female farmers are more likely to be excluded from climate information (Antwi-Agyei et al., 2021), a concern in Osun State given the substantial share of women in its farming workforce (Agboola et al., 2024).

Where access is inadequate, farmers are left to guess at climatic events, exposing them to lower yields and financial losses. While prior work has examined access to and willingness to pay for CIS in Ghana and northern Nigeria (Antwi-Agyei et al., 2021; Baffour-Ata et al., 2022), comparatively little empirical evidence documents how arable crop farmers in Osun State actually utilise these services, the constraints they face, and the socio-economic factors associated with utilisation. This study was conducted to fill that gap.

The specific objectives of the study were to: identify the types of CIS available to arable crop farmers; assess the level of accessibility of CIS among the respondents; determine the extent of utilisation of CIS in agricultural practices; investigate the challenges faced in accessing and utilising CIS; and examine the relationship between selected socio-economic characteristics, accessibility, and the extent of utilisation of CIS. The study tested two null hypotheses: $H0_1$, there is no significant relationship between selected socio-economic characteristics of arable crop farmers and their extent of utilisation of CIS; and $H0_2$, there is no significant relationship between accessibility to CIS and the extent of utilisation of CIS.

Methodology

The study was conducted in Osun State, Nigeria, an inland state in the south-west located approximately between latitudes 7°00′ and 8°00′N and longitudes 4°00′ and 5°00′E, with a landmass of about 9,251 km². The state has a tropical climate with distinct wet and dry seasons; rainfall ranges from about 1,125 mm in the derived savanna to about 1,475 mm in the rainforest belt, and mean annual temperature ranges from about 27.2°C to 39.0°C. Its vegetation comprises rainforest, derived savanna, and savanna zones on predominantly sandy, clayey, and lateritic soils. Agriculture is a major economic activity, with major crops including maize, cassava, cocoyam, and beans, alongside cocoa and oil palm.

The study population comprised arable crop farmers in Osun State. A multistage sampling procedure combining purposive and convenience techniques was employed. In the first stage, the three agricultural zones (Ife/Ijesa, Osogbo, and Iwo) were purposively selected because of the prevalence of arable crop farmers in them. In the second stage, two Local Government Areas (LGAs) were selected from each of two zones, Ife North and Atakunmosa West (Ife/Ijesa zone) and Ayedire and Olaoluwa (Iwo zone), and three from the Osogbo zone (Ede South, Boripe, and Ifelodun), giving seven LGAs. In the third stage, two communities were selected from each LGA, giving 14 communities. In the final stage, in the absence of a complete sampling frame, a convenience sample of available and willing arable crop farmers was drawn from each community: ten farmers from each community in the Ife North, Olaoluwa, and Ayedire LGAs, eleven from each community in Atakunmosa West, and twelve from each community in the Ede South, Boripe, and Ifelodun LGAs, yielding 154 respondents.

Primary data were collected in June and July 2025 using a structured interview schedule. Because many respondents had limited literacy, the schedule was written in English and administered orally, with items translated into Yoruba by the interviewer and responses recorded in English. The instrument was subjected to content and face validity by experts in the Department of Agricultural Extension and Rural Development, Obafemi Awolowo University, Ile-Ife, and the reliability of its multi-item scales was confirmed using Cronbach's alpha, which yielded coefficients of 0.84 for the extent-of-utilisation scale and 0.79 for the challenges scale, indicating good internal consistency.

Variables were measured in line with the objectives. Types of CIS available were measured by asking respondents to indicate, for each listed service, whether it was available to them, scored Yes = 1 and No = 0. Accessibility of CIS was measured on a five-point scale on which respondents rated how accessible each service was to them, scored 5 to 1; a mean score of 3.00 (the scale midpoint) and above was taken as accessible. Extent of utilisation was measured by asking how frequently respondents applied each service in their farm practices, using the scale Never = 1, Rarely = 2, Occasionally = 3, and Always = 4; a mean of 2.50 and above was taken as utilised. Composite utilisation scores across the 21 items ranged from 21 to 84 and were categorised as low (48–60), moderate (61–72), and high (73–84). Challenges were measured by asking respondents to rate each constraint as Not at all = 1, Moderately severe = 2, or Very severe = 3; a mean of 2.00 and above indicated a severe challenge. Socio-economic characteristics (age, household size, farm size, annual income, and years of farming experience) were measured as continuous or appropriately coded variables for the relationship analysis.

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 20. Frequency counts, percentages, means, and standard deviation were used to analyse the data, while Pearson's product-moment correlation, were used to test the relationships stated in the hypotheses. A significance level of $p < 0.05$ was adopted.

Results and Discussion

Types of Arable Crops Planted

Table 1 shows that respondents cultivated multiple arable crops, with 92.2% mostly cultivating maize, 41.6% cassava, and 37.7% tomatoes. Maize and cassava, the two major staples in Nigeria, dominate, favored by the climatic conditions of the area,

maize and cassava intercropping practices, and high market demand. This pattern is consistent with smallholder cropping decisions in adjoining South-West states, where maize and cassava remain the dominant rain-fed staples (Omodara et al., 2023), and is reinforced by their resilience to the erratic rainfall of the region (Agboola et al., 2024; Akano et al., 2023). The concentration of production in a few rain-sensitive staples has a direct bearing on the value of climate information in the study area, since the timing of land preparation, planting, and harvesting for maize and cassava is tightly bound to the onset and cessation of the rains, information that is tailored to the calendar of these specific crops is therefore likely to be more useful to the respondents than generic forecasts.

Table 1: Types of arable crops planted

Arable crop	Percentage (n = 154)
Maize	92.2
Cassava	41.6
Tomato	37.7
Yam	19.5
Groundnut	11.0
Okra	6.5
Potatoes	4.5
Beans	2.6

*Multiple responses

Source: Field survey, 2025

Types of Climate Information Services Available to Arable Crop Farmers

Table 2 shows the types of CIS available to respondents. All respondents (100%) reported weather forecast and advisory services on the best planting period as available; 99.4% reported pest and disease prediction, 94.8% reported both soil moisture and drought monitoring and flood and extreme weather alerts, and 92.2% reported seasonal climate forecasts. Weather forecasts and planting advisories were thus the most available services, consistent with Adeloye et al. (2024), who noted that radio-disseminated forecasts and planting advisories are the most accessible climate information for farmers in Osun State. The dominance of these two services reflects the delivery channels that prevail in the study area: weather forecasts and planting advisories travel readily over radio and by word of mouth, whereas the slightly lower availability of seasonal forecasts mirrors their dependence on specialized meteorological products that are not always packaged for farmers. The reliance on a mix of institutional alerts and indigenous observation to monitor extreme weather also aligns with Agboola et al. (2024) and with Ayinla et al. (2024), who report that timely meteorological data is the primary tool smallholders use to safeguard farm income against climate variability. It is important to note, however, that the high availability recorded here indicates only whether a service reaches the community at all; as the accessibility results below show, availability and usable access are not the same thing, an observation also made by Appiah et al. (2025), who found that the reach of CIS depends heavily on the social networks through which it is relayed.

Table 2: Types of climate information services available to arable farmers

Climate information service	Percentage (n = 154)
Weather forecast services	100.0
Advisory services on best planting period	100.0
Pest and disease prediction services	99.4
Soil moisture and drought monitoring services	94.8
Flood and extreme weather alerts services	94.8
Seasonal climate forecast services	92.2

*Multiple responses

Source: Field survey, 2025

Accessibility to CISs among Arable Crop Farmers

Table 3 shows that accessibility varied across services. Weather forecast services were the most accessible ($\bar{x}$ = 4.60), while seasonal climate forecasts and flood and extreme weather alerts were the least accessible ($\bar{x}$ = 1.95 each), falling below the 3.00 cut-off. Pest and disease prediction ($\bar{x}$ = 2.24), planting advisories ($\bar{x}$ = 2.03), and soil moisture monitoring ($\bar{x}$ = 2.02) were similarly low. The contrast between the near-universal availability reported in Table 2 and the low accessibility recorded here is one of the central findings of this study: services that exist in principle are not reaching farmers in a form they can readily obtain and act upon. The pattern is intelligible once the mode of delivery is considered. Routine weather updates are broadcast frequently over radio, a medium that is cheap, familiar, and does not require literacy, which explains their high accessibility. Seasonal forecasts, flood alerts, and soil moisture information, by contrast, are predictive and technical; they typically depend on targeted dissemination, interpretation, and in many cases internet-enabled devices that a large share of rural farmers do not own (Coggins et al., 2022). This accessibility gap echoes evidence from northern Ghana, where radio dominates the climate information that actually reaches farmers while more specialised services remain difficult to obtain (Antwi-Agyei et al., 2021; Baffour-Ata et al., 2022), and where access is strongly shaped by household resources and the channels available to each group (Alhassan et al., 2025). The implication is that closing the accessibility gap for predictive services, rather than simply producing more information, is the binding requirement for improving CIS use in Osun State.

Table 3: Accessibility to CISs

Climate information service	Ranked mean	SD
Weather forecast	4.60	0.66
Pest and disease prediction	2.24	0.46
Advisory services on best planting period	2.03	0.21
Soil moisture and drought monitoring	2.02	0.35
Flood and extreme weather alerts	1.95	0.31
Seasonal climate forecast	1.95	0.29

Source: Field survey, 2025

Extent of Utilisation of CISs in Agricultural Practices

Table 4 ranks the extent to which respondents utilised each service. Flood and extreme weather alerts ($\bar{x}$ = 3.83) were the most utilised, followed by advisory services on the best planting period ($\bar{x}$= 3.72), pest and disease prediction ($\bar{x}$= 3.47), soil moisture and drought monitoring ($\bar{x}$ = 3.04), daily weather forecasts ($\bar{x}$= 2.93), and seasonal climate forecasts ($\bar{x}$= 2.51). All service areas exceeded the 2.50 cut-off, indicating broad, if uneven, application of CIS in farm practices. The ranking is instructive. Flood and extreme weather alerts attract the highest utilisation because they prompt immediate and unambiguous protective action, such as protecting standing crops and moving stored produce and assets, where the cost of inaction is severe and visible. Planting advisories and pest and disease information rank highly for the same reason: they translate directly into discrete operational decisions on when to plant, when to apply inputs, and when to intervene against pests. Seasonal forecasts are utilised least, partly because they are the least accessible (Table 3) and partly because probabilistic, season-ahead information is harder to convert into a single concrete action. A particularly telling result is the very low score for using climate information to determine which crop to grow ($\bar{x}$= 1.52): farmers apply CIS to fine-tune the management of crops they have already chosen rather than to revise the choice of crop itself, which remains anchored to the established maize and cassava staples seen in Table 1. In other words, CIS in the study area informs tactical, within-season decisions far more than strategic ones. This selective, decision-specific pattern of use is consistent with Kumar et al. (2023) and Onyeneke et al. (2023), who report that the uptake of climate information is strongest where it maps onto a clear and timely management response, and with Ugwuoti et al. (2026), who note that the translation of agricultural information into changed practice is often only partial.

Table 4: Extent of utilisation of CISs in agricultural practices

Application of service	Mean	SD
Daily weather forecast	**2.93**	**—**
Fertiliser application	3.51	0.58
Crop management	3.51	0.63
Irrigation plan	3.19	0.73
Determine which crop to grow	1.52	0.93
Soil moisture and drought monitoring	**3.04**	**—**
Crop management	3.25	0.75
Timing of planting and irrigation	3.14	0.91
Water conservation technique	3.02	0.83
Drought monitoring	2.76	0.62
Advisory services on best planting period	**3.72**	**—**
Resources management	3.79	0.44
Minimise losses	3.78	0.50
Income generation	3.75	0.49
Maximise crop yield	3.54	0.59
Pests and diseases prediction	**3.47**	**—**
Minimise crop loss	3.71	0.52
Enhance food security	3.39	0.55
Target intervention	3.31	0.68
Seasonal climate forecast	**2.51**	**—**
Irrigation timing	2.59	0.79
Determining planting and harvesting time	2.53	0.70
Fertiliser application timing	2.51	0.71
Weeding and pruning timing	2.40	0.79
Flood and extreme weather alerts	**3.83**	**—**
Crop protection	3.84	0.52
Preserving assets	3.82	0.55

Source: Field survey, 2025

Level of Utilisation of Climate Information Services

Table 5 shows that 20.1% of respondents had a low level of utilisation, 63.0% moderate, and 16.9% high, indicating that most respondents moderately utilised CIS. A moderate modal category is itself informative: it suggests that climate information has been partially, but not fully, integrated into routine farm decision-making, with most farmers drawing on some services some of the time rather than relying on the full suite consistently. This is consistent with Onyeneke et al. (2023), who found that while awareness of climate services is high among Nigerian food crop farmers, consistent

utilisation often remains mid-range owing to gaps in localised data. Adeloye et al. (2024) similarly link moderate utilisation in Osun State to the reliance of farmers on a blend of scientific forecasts and indigenous knowledge rather than a full shift to digital services, a pattern also documented among Osun cocoa farmers (Famakinwa et al., 2023). Read alongside the accessibility results, the moderate level of utilisation appears to be capped less by unwillingness than by the limited accessibility of the more advanced services; moving farmers from moderate to high utilisation will therefore depend on widening reliable access and strengthening trust in the information provided.

Table 5: Level of utilisation of climate information services

Level of utilisation (score range)	Percentage (n = 154)
Low (48–60)	20.1
Moderate (61–72)	63.0
High (73–84)	16.9

Source: Field survey, 2025

Challenges Faced in Accessing and Utilising CISs

Table 6 ranks the challenges to accessing and utilising CIS. Lack of extension support services ($\bar{x}$ = 2.73) was the only constraint above the 2.00 cut-off, marking it as the most severe, followed by poor dissemination ($\bar{x}$ = 1.89), unreliable information ($\bar{x}$ = 1.73), high cost of access ($\bar{x}$ = 1.69), lack of access ($\bar{x}$ = 1.68), and limited technical knowledge ($\bar{x}$ = 1.34). Respondents particularly lamented the absence of training and workshops by extension agents. Taken together, the ranking points to a system-level rather than a farmer-level diagnosis: the most severe constraints concern how information is delivered and supported, namely weak extension contact and poor dissemination, while limited technical knowledge, a deficit located in the farmers themselves, was ranked lowest. This ordering suggests that farmers in the study area do not regard their own capacity as the principal obstacle; rather, they identify the delivery and support system as the weak link, which is consistent with the accessibility and utilisation patterns reported above, where the advanced services that most need explanation and follow-up were the least accessed and least applied. The finding corroborates Adeloye et al. (2024), who found that the absence of structured feedback and physical extension workshops in Osun State impedes the transition from weather awareness to farm-level application, and Ojo et al. (2025), who reported largely unfavourable attitudes towards climate-smart practices among extension agents in North-Central Nigeria. Onyeneke et al. (2023) and Senyolo et al. (2025) likewise identify weak extension and farmer linkages and the absence of tailored dissemination channels as binding constraints on CIS utilisation, while Lawal and Omotesho (2023) show that limited digital literacy compounds the problem where information is delivered through digital channels.

Table 6: Challenges faced in accessing and utilising CISs

Challenge	Mean	SD
Lack of extension support services	2.73	0.57
Poor dissemination of CISs	1.89	0.64
Unreliable information from CISs	1.73	0.49
High cost of accessing CISs	1.69	0.54
Lack of access to CISs	1.68	0.55
Limited technical knowledge of CISs	1.34	0.56

Cut-off point = 2.00 (scale midpoint); n = 154

Scale: Not at all (1), Moderately severe (2), Very severe (3)

Source: Field survey, 2025

Relationship between Socio-economic Characteristics and Extent of Utilisation of CIS

Table 7 presents the relationship between selected socio-economic characteristics and the extent of CIS utilisation. Annual income had a negative and significant relationship with utilisation ($r = -0.338$; $p < 0.05$): as income rises, utilisation declines. This inverse relationship, although counterintuitive at first sight, is plausible on closer reading. Higher-income farmers are better able to absorb the consequences of adverse weather through savings, diversified income, and other private buffers, and so depend less on free public advisories, whereas lower-income farmers, who are more exposed to weather-related losses and have fewer fallback options, have a stronger incentive to seek out and apply climate information. The pattern is supported by Alhassan et al. (2025), who found that higher-income households often rely on financial buffers rather than institutional advisories, and by Bakare et al. (2023), who found microcredit access, typically associated with lower-income farmers, to be a stronger driver of adaptation uptake than income alone. Age, household size, farm size, and years of farming experience showed no significant relationship with utilization. The absence of significant demographic effects suggests that CIS use in the study area is becoming broad-based rather than confined to particular age or experience groups, which is consistent with the wide reach of radio-based delivery and with Agboola et al. (2024) and Amankwah (2023), who report that conventional demographic markers are weak predictors of climate information and technology use. $H0_1$ is therefore rejected for annual income but retained for the other characteristics. From an equity standpoint, the income result is encouraging, since it indicates that the farmers who most need climate information are already among the most inclined to use it, provided it can be made accessible to them.

Table 7: Relationship between socio-economic characteristics of arable crop farmers and their extent of utilisation of CIS

Variable	r-value
Age	−0.118
Household size	−0.070
Farm size	−0.068
Annual income	−0.338**
Years of farming experience	0.140

**P≤ 0.05

Source: Field survey, 2025

Relationship between Accessibility of CISs and Extent of Utilisation of CIS

Table 8 shows that respondents' accessibility to CIS had a positive and significant relationship with utilisation (r = 0.394): greater access is associated with greater use. This result ties the study together. The earlier tables establish that CIS is widely available (Table 2) yet only moderately utilised (Table 5), and that the shortfall is largest precisely for the services that are hardest to access (Tables 3 and 4); the significant positive association in Table 8 confirms that accessibility, rather than mere availability or awareness, is the operative lever for raising utilisation. This is corroborated by Adeloye et al. (2024), who showed that the frequency of climate-smart agronomic adjustments in Osun State depends on the reliability and accessibility of delivery channels, and by Appiah et al. (2025) and Senyolo et al. (2025), who found that improving the channels through which CIS reaches farmers, including their social networks, is what translates information into use. $H0_2$ is therefore rejected, and the alternative hypothesis, that accessibility is significantly related to utilisation, is accepted. The contribution of this finding for policy is direct: in the study area, interventions that widen reliable access to the under-utilised predictive services are likely to yield greater gains in utilisation than further awareness campaigns alone.

Table 8: Relationship between accessibility of CISs and extent of utilisation of CIS

Variable	r-value	Sig.
Respondents' accessibility to CISs	0.394**	0.000

**P≤ 0.05

Source: Field survey, 2025

Conclusion and Recommendations

The study assessed the utilisation of CIS among arable crop farmers in Osun State. Weather forecasts and planting advisories were the most available and accessible services, while seasonal forecasts and flood alerts were largely inaccessible. Most respondents moderately utilised CIS, with flood and extreme weather alerts the most applied. Lack of extension support was the most severe constraint, accessibility was positively and significantly related to utilisation, and annual income was negatively and significantly related to it.

Based on these findings, the study recommends that NIMET and relevant agricultural agencies strengthen extension support services, including regular training and workshops, since their absence was the most severe constraint to utilisation. Dissemination of the least accessible services, particularly seasonal forecasts and flood and extreme weather alerts, should be improved through channels suited to farmers with limited literacy and digital access. Given the negative income–utilisation relationship and the documented access barriers facing female and lower-income farmers, interventions should be designed to keep CIS relevant and accessible across income groups and to extend coverage to women in the farming workforce.

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