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FROM MANDATE TO IMPACT: ASSESSING STAKEHOLDER EFFECTIVENESS IN CLIMATE INFORMATION GENERATION AND TRANSFER IN NIGERIA'S DRYLANDS

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ABSTRACT

Climate Information Services (CIS) are critical for agricultural decision-making and water resource management, particularly in vulnerable dryland regions. However, the effectiveness of CIS depends on the roles, interactions, and dissemination mechanisms employed by diverse stakeholders. This study examines the role of governmental and non-governmental organizations in climate information generation and dissemination in the Kano Region of northwestern Nigeria. A qualitative research design was employed, utilizing 12 key informant interviews with stakeholders from NiMet, KNARDA, JARDA, HJRBDA, IITA, ICRISAT, and extension services, alongside five focus group discussions with smallholder farmers across different agroecological zones. A sampling matrix was developed to ensure maximum variation across the CIS value chain, and data saturation was achieved by the 10th KII and 4th FGD. Data were analyzed using thematic analysis with independent parallel coding by two researchers (inter-coder reliability $\kappa = 0.74$). NiMet holds the formal mandate for climate monitoring, yet IITA and ICRISAT emerge as more effective at grassroots level through community-engaged approaches (problem identification, community leader engagement, experimental plots) and experiential learning. Three disconnects constrain CIS effectiveness: scale mismatch (national predictions cannot guide local decisions), literacy-practice gap (translated materials inaccessible to non-literate farmers), and hierarchical override (field personnel excluded from operational decisions). Hydrological monitoring is further undermined by delayed telemetry training and inconsistent data availability (25+ years at Tiga/Challawa vs. unavailable at Auyo). While strong IITA-ICRISAT synergy exists, NiMet's academic collaborations face implementation gaps and aviation prioritization over agriculture. International research institutions outperform mandated government agencies on five effectiveness criteria (credibility, accessibility, actionability, timeliness, trust). Bridging mandate and grassroots reach requires downscaled information systems, reformed decision-making structures, and sustained collaborative frameworks prioritizing agricultural users

Keywords: Climate information, stakeholder, farmers, hydrological

1. Introduction

Weather and climate monitoring provides indispensable data for evidence-based decision-making across agriculture, water management, and disaster risk reduction (Shelvam et al., 2023; Arinze et al., 2025). The utility of climate data depends on spatial distribution and measurement intervals: synoptic observations require up to 100 km coverage while agricultural applications demand densities of 10 km or less (WMO, 2017; New et al., 1999).

CIS generation, translation, and dissemination involve multiple stakeholders. Government agencies, research institutions, and NGOs form the institutional architecture for delivering climate information to end users (Vaughan & Dessai, 2014; Segnon & Zougmore, 2024). In Nigeria, NiMet is the central actor, collaborating with 31 identified stakeholders (Segnon & Zougmore, 2024). Effectiveness depends on credibility and clear communication, particularly for smallholder farmers with limited literacy (Bizo et al., 2024; Ncoyini-Manciya & Manciya, 2026).

The Kano Region (Kano and Jigawa states) falls within Nigeria's Drylands, with agriculture employing ~90% of the population, rendering it highly vulnerable to climate variability (Hassan et al., 2024; Abubakar et al., 2024). The institutional landscape includes NiMet, state agricultural authorities (KNARDA, JARDA), a river basin authority (HJRBDA), international research institutions (IITA, ICRISAT), and extension services.

Despite CIS importance, gaps persist in understanding stakeholder interactions and dissemination effectiveness. Dam failures and floods persist despite monitoring infrastructure, raising questions about data utilization and institutional coordination (Arinze et al., 2025; Ibrahim et al., 2025). This study examines governmental and non-governmental roles in CIS generation and dissemination in the Kano Region. Objectives: (1) identify stakeholders and characterize their roles; (2) assess dissemination mechanisms and effectiveness; (3) examine collaboration patterns and challenges.

2 Materials and Methods

2.1 Study Area

The study was conducted in the Kano Region of northwestern Nigeria, encompassing Kano and Jigawa states (Figure 1). The region is located between latitudes 12°04'45"N and 12°13'40"N and longitudes 8°35'31"E and 8°33'42"E, with a total land area of 43,285 km². The region was historically a single administrative entity before its division into two states in 1991 (Hassan et al., 2024). Jigawa State shares international borders with the Niger Republic to the north, while Kano State is bordered by Katsina, Kaduna,

and Jigawa states. The region falls within the Drylands of northwestern Nigeria, characterized by distinct rainfall regimes and pronounced climatic variability (Hassan et al., 2024; Abubakar et al., 2025).

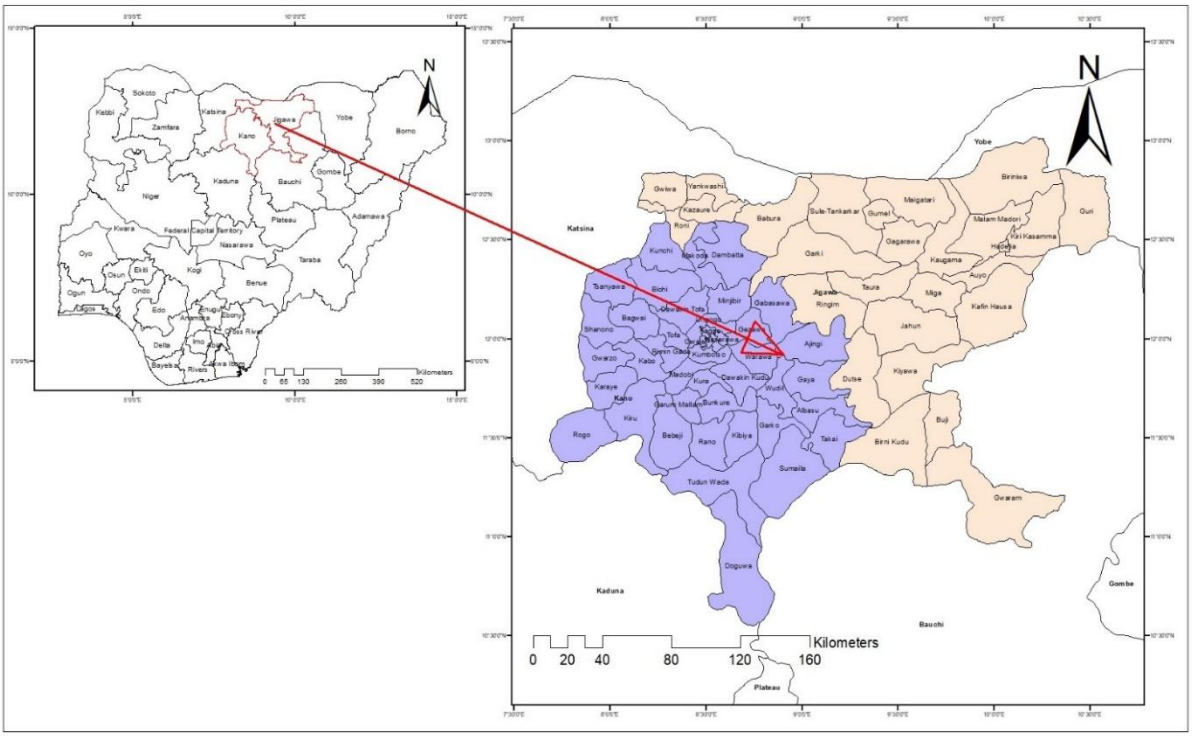


Figure 1: Map of the study area showing Kano and Jigawa states, northwestern Nigeria

The region experiences tropical wet and dry (Aw) climate conditions. Rainfall ranges from 486.1 mm to 1,281.2 mm annually, with a regional mean of approximately 811.9 mm. Temperature maxima occur in April/May (frequently reaching 40.6°C) and minima in December/January (averaging 12.8°C). Agriculture constitutes the primary livelihood for approximately 90% of the population, rendering the region exceptionally vulnerable to climate variability.

2.2 Research Design

This study employed a qualitative research design utilizing key informant interviews (KIIs) and focus group discussions (FGDs). The qualitative approach was selected to capture the depth and nuance of stakeholder experiences, perceptions, and institutional dynamics not accessible through quantitative methods alone (Creswell & Poth, 2018). To ensure rigor, we operationalized credibility (through triangulation of KIIs and FGDs), transferability (through thick description), dependability (through an audit trail), and confirmability (through reflexive memoing and independent parallel coding) (Lincoln & Guba, 1985).

2.3 Sampling and Participant Selection

2.3.1 Key Informant Selection

Key informants were purposively selected based on: (1) formal mandate or recognized role in CIS; (2) operational presence in the study area; and (3) willingness to participate. A maximum variation sampling

strategy captured diversity across the CIS value chain. Twelve KIIs were conducted with staff from NiMet, KNARDA, JARDA, HJRBDA (including site engineers at Tiga, Challawa Gorge, and Auyo Barrage), IITA, ICRISAT, and extension service workers in Kura, Babura, and Maigatari.
Table 1 presents the sampling matrix with saturation assessment.

Table 1: Sampling Matrix and Saturation Assessment

Stakeholder Category	Organization	Selection Rationale	n	Years of Experience (range)	Data Saturation
National Mandate	NiMet	WMO representative, formal CIS mandate	1	~15 years	Achieved (unique perspective)
International Research	IITA, ICRISAT	Major infrastructure investors, grassroots presence	2	8-17 years	Achieved (convergent themes)
State Extension	KNARDA, JARDA	Link between national data and farmers	2	10-30 years	Achieved
Water Management	HJRBDA (3 dams)	Hydrological data collection and operational decisions	3	5-11 years	Achieved (by 2nd interview)
Extension Field Workers	Kura, Babura, Maigatari	Final stage of dissemination	3	13-30 years	Achieved
Total KIIs			11		
End Users (Farmers)	5 FGDs across agroecological zones	Direct CIS beneficiaries	51	25-67 years	Achieved (themes repeated by 4th FGD)

Source: Authors' field compilation, 2025

Data saturation which is the point at which no new themes emerged from successive interviews, was achieved after the 10th KII and the 4th FGD, with one additional KII and one additional FGD conducted to confirm redundancy (Guest et al., 2006).

2.3.2 Focus Group Discussion Participants

Five Focus Group Discussions were conducted with smallholder farmers stratified by agroecological zone. Table 2 presents the FGD locations and participant characteristics.

Table 2: Focus Group Discussion Locations by Agroecological Zone

S/N	Agroecological Zone	Location	Age Range (Years)	Number of Participants	Gender
1	Northern Guinea Savanna	Bebeji	26-65	9	Male
2	Southern Guinea Savanna	Doguwa (Maraku)	25-65	10	Male
3	Kano River Irrigation Project (KRIP)	Kura	30-65	12	Male
4	Sahel Savanna	Babura	31-55	8	Male
5	Sudan Savanna	Maigatari	27-67	12	Male

Source: Authors' field compilation, 2025

Participants were purposively selected based on: (1) active farming as primary livelihood; (2) minimum five years local farming experience; (3) age 25-70 years; (4) willingness to participate. Groups ranged from 8-12 participants (Krueger & Casey, 2014). All participants were male due to cultural norms; five informal conversations with women farmers were conducted as mitigation

2.4 Data Collection Instruments and Procedures

2.4.1 Key Informant Interview Guide

A semi-structured interview guide covered: organizational mandate; climate monitoring activities; dissemination mechanisms; collaboration with partners; challenges; and effectiveness perceptions. Interviews lasted 45-90 minutes, were conducted in English or Hausa (with interpreter), and were audio-recorded with consent.

2.4.2 Focus Group Discussion Guide

A structured guide covered: demographic and farming characteristics; awareness and understanding of climate variability; knowledge and sources of CIS; perceptions of information credibility and relevance; use of CIS in farming decisions; interactions with information providers; constraints; and recommendations. Discussions (2-3 hours) were conducted in Hausa, moderated by trained facilitators, and audio-recorded with consent.

2.5 Data Analysis

Audio recordings were transcribed verbatim; Hausa-language FGDs were translated into English. Transcripts were imported into NVivo 12. Thematic analysis followed Braun and Clarke (2006): familiarization, initial coding, theme development, review, definition, and writing.

To enhance analytical depth, a hybrid deductive-inductive coding approach was employed. Deductive codes derived from the interview guide (e.g., "stakeholder role"); inductive codes emerged from data (e.g., "aviation bias"). Descriptive codes were elevated to analytic themes (e.g., "top-down decisions" → "institutional disconnect: hierarchical veto over local observation").

Two researchers independently coded the first three transcripts; inter-coder agreement was 82% ($\kappa = 0.74$). Discrepancies were resolved through discussion. A deviant case analysis (an informant skeptical of NGO-led CIS sustainability) is reported in Section 3.3.4.

2.6 Ethical Considerations

Informed consent was obtained from all participants. Anonymity and confidentiality were assured. The research protocol was approved by the relevant institutional ethics committee.

3. Results

3.1 Stakeholder Identification and Roles

KIIs revealed a diverse stakeholder landscape encompassing governmental agencies, international research institutions, and grassroots extension services, each fulfilling distinct functions within the CIS value chain.

3.1.1 Nigerian Meteorological Agency (NiMet)

As Nigeria's designated National Meteorological and Hydrological Service, NiMet holds the formal mandate for climate monitoring. A Kano office informant explained:

"We publish what the near future weather may look like and what needs to be done in events of uncertainty for people to be prepared."

Annual events convene stakeholders from various sectors to discuss and disseminate information and warnings. Materials are translated into major Nigerian languages to enhance accessibility, though the informant acknowledged limitations in reaching grassroots farmers due to literacy barriers.

3.1.2 International Research Organizations: IITA and ICRISAT

An IITA staff member articulated the core philosophy distinguishing their approach from national-level services:

"We are out to assist farmers with local information peculiar to their environment, not just data generated far away from the locality which can never give accurate results. These farmers are peasant with very low income and capital, and the best way to assist them is by putting them on the track of precision farming and giving early warning related to climate risk."

The informant elaborated a three-phase community engagement protocol:

"First of all, we identify the problems, we engage their community leaders, we establish experimental plots with all that need to be put in place. It is through this experimentation and their outcomes that farmers come to realize how robust our activities are, this makes it easier for the gospel to spread."

This protocol addresses a critical gap identified in FGDs: farmers distrust information not visibly demonstrated. Both organizations operate automatic and manual weather stations across the study area, including on-farm Automatic Weather Observing Systems (AWOS).

3.1.3 Agricultural Extension Services

HJRBDA site engineers at Tiga Dam, Challawa Gorge Dam, and Auyo Barrage are responsible for hydro-meteorological monitoring to support water resource management. An informant explained:

"The rationale behind installing monitoring systems within and along the river system is to track water flow and levels which allow for an accurate understanding of the water balance within the system. By being able to track the amount of water entering the system from the main river source through rainfall, as well as the amount that is released downstream for irrigation and domestic water supply, hydrologists are able to better manage water resources."

Data consistency varied: records have been maintained for over 25 years at Tiga and Challawa but were not readily available at Auyo, raising concerns about data completeness across sites.

3.2 Mechanisms and Effectiveness of Climate Information Dissemination

3.2.1 NiMet's Dissemination Approaches

Despite translation into major Nigerian languages, an NiMet informant acknowledged:

"The materials produced are translated to major Nigerian languages, but that is still not enough because the majority of the farmers cannot read."

Across all five FGDs, no farmer reported directly reading NiMet materials; those who received NiMet-derived information did so through secondary oral transmission via extension workers or radio, introducing potential information decay.

3.2.2 IITA and ICRISAT's Localized Approach

IITA and ICRISAT employ a localized dissemination strategy centered on community engagement and demonstration. The IITA informant emphasized:

"It is through this experimentation and their outcomes that farmers come to realize how robust our activities are."

This experiential learning approach, combined with on-farm meteorological stations and local-based information (LBI), enhances farmer trust and adoption.

3.2.3 Hydro-meteorological Information for Water Management

Effectiveness is compromised by institutional dynamics. An informant at Auyo Barrage lamented:

"It is we in the field that take records and make observations and have direct contact with what is happening in the field; we have better knowledge of when the water should be released or when it should be held but unfortunately that is not the case. The people from the headquarters decide all of these."

This top-down approach, excluding field personnel from decisions, contributes to persistent dam failures. The informant attributed disasters to "top-bottom approach, lack of comprehensive data, inadequate infrastructure maintenance, and changing climate patterns."

Complementing this governance challenge is an infrastructure-human capacity gap. An informant at Challawa Gorge Dam disclosed:

"There is a delay in training stakeholders on how to use the telemetric devices for data capture and use. This if not done would in the long run jeopardize irrigation farming."

Such conditions are "the main killers of workers' morale where they are not given support to carry out their work" (National Academy of Sciences, 2023). Furthermore, while Tiga and Challawa have maintained records for over 25 years, records were "not readily available at Auyo," undermining trend detection and flood forecasting.

3.2.4 Challenges in Telemetric Device Utilization

Another challenge limiting optimization of weather resources relates to the implementation of telemetric devices for hydro-meteorological measurements. An informant at Challawa Gorge Dam pointed out delays in training stakeholders on how to use the devices for data capture and utilization. This raises concerns about the lack of coordination and collaboration in effectively disseminating important information to stakeholders, particularly smallholder farmers engaged in irrigation farming along the river system. The informant suggested that without prompt address of these training gaps, irrigation farming could be jeopardized.

3.3 Stakeholder Collaboration, Synergy, and Challenges

3.3.1 Patterns of Collaboration

The study revealed varying patterns of collaboration among stakeholders, as summarized in Table 3.

Table 3: Collaboration Among Stakeholders

S/N	Organization	Collaborators
1	NiMet	Federal University Dutse (FUD), Bayero University Kano (BUK), Aliko Dangote University of Science and Technology (KUST), Jigawa State Agricultural and Rural Development Authority (JARDA)
2	IITA	Centre for Drylands Agriculture-Bayero University Kano (CDA-BUK), ABCOA, Kano and Jigawa State Governments, HIS (Telecommunication Infrastructure Tower Company)
3	ICRISAT	State Ministries of Agriculture (Kano and Jigawa States)

Source: Authors' field compilation, 2025

NiMet has established collaborations with tertiary institutions, involving installation and revamping of weather stations, though anticipated success has not been fully realized.

3.3.2 Synergy Between IITA and ICRISAT

Strong synergy exists between IITA and ICRISAT, evident in shared experimental sites at Wasai, coordinated AWOS deployment across Kano LGAs, and partnerships with telecommunication companies

for data capture. IITA has also installed AWOS at Audu Bako College of Agriculture and Bayero University's Centre for Drylands Agriculture, demonstrating proactive partnership approaches.

3.3.3 Challenges to Effective Collaboration

Key informants identified several constraints: implementation gaps in signed MoUs; malfunctioning instruments and improper station siting; delayed telemetry training; inconsistent hydro-meteorological records; and limited farmer engagement. A more subtle challenge relates to institutional prioritization. An informant suggested *"NiMet gives more priorities to CIS directly related to the aviation industry, to the extent that someone could even forget that part of its mandate is also Agriculture and Water Resources, this is why they even have a directorate of Agriculture and Water Resources in their organogram."*
Farmers echoed this, stating CIS is designed for "airplanes, not for farmers."

3.3.4 Boundary Conditions of NGO Effectiveness

IITA and ICRISAT's model has limitations: geographic coverage is not comprehensive (some zones have sparser coverage); sustainability depends on external funding (one informant asked: "when the project ends, who maintains the weather stations?"); and coordination failures persist (e.g., Challawa training delays). NGO effectiveness is contingent on sustained funding, community social capital, and alignment with government extension structures.

Table 4: Stakeholder Effectiveness Matrix

Criterion	NiMet	IITA/ICRISAT	HJRBDA (Dams)	Extension Services
Credibility	Moderate (farmers: "too general")	High ("we see results on demo plots")	Low (field staff ignored by HQ)	Moderate (but under-resourced)
Accessibility	Low (translation ≠ literacy)	High (local languages, in-person engagement)	Very Low (data not shared with farmers)	Moderate (last-mile presence)
Actionability	Low ("national forecast cannot guide planting")	High ("local info tells me when to sow")	Low (decisions made at HQ, not field)	Moderate (if trained and equipped)
Timeliness	Moderate (seasonal forecast adequate for planning)	High (real-time AWOS data)	Critical failure (delayed training on telemetry)	Low (information decays at each handover)
Trust	Low ("they care about aviation, not farmers")	High ("these organizations prove by doing")	Very Low (dam failures blamed on top-down decisions)	High (but trust not backed by resources)

Source: Authors' synthesis of KII and FGD statements

3.4 Comparative Stakeholder Effectiveness Matrix

Drawing on KII and FGD statements, we assessed each stakeholder against five criteria derived from CIS literature (Vaughan & Dessai, 2014; Bizo et al., 2024): credibility, accessibility, actionability, timeliness, and trust. Table 4 presents the matrix. This matrix reveals that international research institutions outperform mandated government agencies on all five criteria, largely due to their participatory epistemology, knowledge validated through demonstration rather than hierarchical authority.

3.5 Thematic Synthesis: Three Institutional Disconnects

Across all data sources, three disconnects consistently emerged as barriers to CIS effectiveness:

3.5.1 Scale Mismatch (National Data → Local Decisions)

National-level predictions cannot capture farm-level variability. An FGD participant in Babura explained: *"The forecast on radio says rain will start in May, but last year my neighbor's field flooded while mine was dry. That information does not help me decide when to plant."*

3.5.2 Literacy-Practice Gap (Translation ≠ Understanding)

An FGD participant in Maigatari stated: *"I cannot read Hausa. Even if I could, the words they use, what does that mean for my millet?"* The IITA model of demonstration plots bypasses literacy entirely.

3.5.3 Hierarchical Override (Field Expertise Excluded)

The Auyo Barrage engineer's lament, *"the people from the headquarters decide everything",* was echoed across three dam sites. Hierarchical position overrides epistemic relevance, contributing to dam failures as locally-informed warnings are not acted upon.

4. Discussion

4.1 Stakeholder Roles and Institutional Mandates in CIS Generation

This study identified a multi-layered landscape where NiMet holds formal mandate yet IITA/ICRISAT are more effective at grassroots level. This aligns with Ofoegbu and New (2022), who found that CIS projects in Africa are predominantly funded by international organizations. However, our findings extend this observation by specifying the mechanism: the three-phase IITA protocol (problem identification, community engagement, experimental plots) addresses the literacy barrier by substituting epistemic demonstration for textual communication. Where written materials fail, demonstrated outcomes succeed.

This finding has important implications for the conceptualization of "effectiveness" in CIS. While NiMet's mandate-based effectiveness (formal authority to produce national predictions) is legally unambiguous, IITA/ICRISAT's practice-based effectiveness (ability to influence farmer behavior) proves more consequential for agricultural adaptation. This distinction echoes Cash et al.'s (2006) observation that credibility can be derived from either institutional authority or demonstrated accuracy. For non-literate farmers, demonstrated accuracy outweighs institutional authority, a point with significant implications for how national meteorological agencies should design their agricultural outreach.

4.2 Effectiveness of Climate Information Dissemination Mechanisms

The disconnect between information production and farmer accessibility is critical. NiMet's translated materials fail because most farmers cannot read – an admission from NiMet corroborated by FGD data showing no farmer directly reading NiMet materials. This finding challenges the assumption that translation (linguistic conversion) is sufficient for accessibility. We propose a distinction between linguistic translation (Hausa-language documents) and pedagogical translation (demonstration-based communication). The former assumes literacy; the latter bypasses it entirely.

IITA's experiential approach succeeds because, as one farmer asked, "How can we trust information we cannot see working?" This question reveals that farmer trust is not primarily about data accuracy in the scientific sense, but about observable alignment between predictions and outcomes on their own fields. This aligns with adult learning principles (Waddington et al., 2014) and with broader literature on indigenous knowledge systems, where knowledge legitimacy derives from demonstrated utility rather than institutional certification (Berkes, 2018).

The policy implication is clear: national meteorological agencies cannot fulfill their agricultural mandate solely through broadcast dissemination. They must invest in last-mile pedagogical infrastructure – demonstration plots, farmer field schools, and community-based facilitators who can translate probabilistic forecasts into actionable heuristics ("plant after the second heavy rain," not "there is a 70% probability of above-normal rainfall").

4.3 Hydrological Decision-Making and Institutional Barriers

The Auyo engineer's statement that "headquarters decide everything" exemplifies Cash et al.'s (2006) "loading dock" model: scientific information is produced and then "dropped off" for decision-makers, with no institutional mechanism to integrate field-based expertise into operational decisions. This finding reveals a paradox of data richness but decision poverty – decades of hydrological measurements at Tiga and Challawa have not prevented dam failures because the governance structure systematically excludes those who possess situational awareness.

This is not merely a coordination problem; it is a hierarchical override problem. Field staff are demoted from decision-makers to data-collection technicians. The delayed telemetry training at Challawa Dam shows that even when infrastructure is modernized, the human and institutional dimensions are neglected. As Ullah et al. (2023) note, such conditions demoralize workers who are not supported to apply their expertise. One informant's question – "when the project ends, who maintains the weather stations?" – applies equally to telemetry training: when the training ends, who ensures ongoing capacity?

The inconsistency in data availability across sites (25+ years at Tiga/Challawa vs. unavailable at Auyo) suggests fragmented management systems that compromise the value of historical records. This echoes Ibrahim et al. (2025) regarding the Hadejia-Nguru wetlands, where climate change and upstream dam regulation have adversely affected environmental sustainability despite decades of monitoring. Data collection without robust management systems, quality assurance, and accessibility protocols yields limited decision-support value. We propose that river basin authorities adopt distributed decision-making protocols that mandate field personnel's observational data be incorporated into release decisions, with hierarchical veto power exercised only when documented thresholds are exceeded.

4.4 Stakeholder Collaboration and Systemic Challenges

Strong IITA-ICRISAT synergy contrasts with NiMet's underperforming academic partnerships. The success factors for IITA-ICRISAT collaboration are identifiable from our data: shared physical proximity (offices and experimental plots in Wasai), complementary mandates (IITA focuses on tropical agriculture, ICRISAT on semi-arid crops), and joint infrastructure investment (coordinated AWOS deployment). These are not accidental; they reflect deliberate partnership design.

Conversely, NiMet's academic partnerships fail due to what we term institutional thinness – Memorandums of Understanding that specify data-sharing intentions but lack provisions for ongoing maintenance, training, quality assurance, and funding continuity. Several MoUs were signed, weather stations installed, and then no follow-up occurred. This pattern is not unique to Nigeria; Vaughan and Dessai (2014) identified similar "one-off" partnership failures across African meteorological services.

A concerning finding is NiMet's prioritization of aviation over agriculture. Farmers stated CIS is designed for "airplanes, not farmers." While aviation services generate revenue (airlines pay for weather briefings), this financial logic distorts institutional priorities. The agricultural mandate, being a public good with no direct fee-for-service model, receives residual attention. This is a structural problem, not merely an attitudinal one. As Anshul et al. (2022) demonstrated, effective CIS for farming communities requires sustained engagement and locally relevant products – outcomes unlikely if agricultural services remain under-prioritized within national meteorological agencies' budget and staffing allocations.

Persistent dam failures despite monitoring underscore that technological interventions require accompanying institutional reforms (Arinze et al., 2025). IoT-enabled flood prediction systems, however sophisticated, cannot compensate for governance structures that exclude field expertise from operational decisions. We argue for a nested governance model where field personnel have decision-making authority within specified thresholds (e.g., gate adjustments based on real-time water level readings), with headquarters oversight limited to exceptional conditions. This would align institutional structure with the epistemological reality that those closest to the data are best positioned to interpret and act upon it.

5. Conclusion and Recommendations

5.1 Conclusion

This study reveals a fundamental disjuncture between institutional mandate and grassroots reach in the Kano Region. While NiMet holds formal mandate for climate monitoring, IITA and ICRISAT prove more effective at engaging smallholder farmers through participatory, experiential learning. CIS effectiveness is constrained by three disconnects: scale mismatch (national data cannot guide local decisions), literacy-practice gap (translation does not equal understanding), and hierarchical override (field expertise excluded from decisions).

Stakeholder collaboration is mixed: strong IITA-ICRISAT synergy contrasts with NiMet's underperforming academic partnerships and aviation bias. Persistent dam failures despite decades of hydrological monitoring underscore that technical data collection is insufficient without institutional structures enabling timely, locally-informed decision-making.

5.2 Recommendations

Based on these findings, the following recommendations are proposed:

a) Establish downscaled climate information systems. NiMet should prioritize denser observation networks and downscaled prediction products tailored to local government and community levels.
b) Develop participatory dissemination mechanisms. Adopt community-engaged approaches (demonstration plots, farmer field schools, community leader engagement) enabling experiential learning rather than relying solely on translated materials.
c) Reform hydrological decision-making structures. Empower field-based personnel with observational knowledge to participate in operational dam release decisions.
d) Strengthen collaboration sustainability. Partnerships must include explicit provisions for maintenance protocols, ongoing training, quality assurance, and long-term technical support.
e) Rebalance institutional priorities. NiMet should allocate greater attention and resources to its agricultural and water resources mandate, recognizing that climate information for food security carries profound implications for national development.

5.3 Limitations and Future Research

This study has four primary limitations. First, the absence of women's perspectives in FGDs means gender-specific barriers are under-represented; informal conversations suggest women receive filtered information through husbands, requiring dedicated gender-disaggregated research. Second, the study did not capture perspectives of commercial farmers or pastoralists; FGDs focused exclusively on crop smallholders. Third, findings are contextually bound to the Kano Region; transferability requires replication. Fourth, the study did not quantitatively assess biophysical CIS outcomes (e.g., yield improvements). Future research should combine longitudinal institutional ethnography with mixed-methods assessment of farm-level adoption and comparative studies across multiple dryland regions.

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