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EVALUATING THE EFFECTIVENESS OF AGRICULTURAL WATER MANAGEMENT POLICIES IN NIGERIA

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Abstract:
Agricultural Water Management (AWM) plays a crucial role in enhancing food security, improving agricultural productivity, and building resilience against climate change in Nigeria. Despite policy frameworks and donor-supported interventions such as the Transforming Irrigation Management in Nigeria (TRIMING) project, only 2% of the country's 3.14 million hectares of irrigable land is currently being utilized. This study evaluates the effectiveness of Nigeria's AWM policies by employing a mixed-methods approach involving surveys, interviews, and document reviews across selected agricultural zones. Findings reveal that institutional inefficiencies, weak policy coordination, and limited infrastructure development are major impediments to achieving water management goals. Smallholder farmers, who make up over 80% of the agricultural workforce, face significant challenges in accessing formal irrigation systems and climate-smart technologies. The study also highlights a lack of participatory planning, poor monitoring systems, and gender disparities in irrigation access. It concludes that for AWM policies to be effective, they must be inclusive, decentralized, and climate-resilient. The study recommends institutional reforms, targeted investments in climate-smart irrigation infrastructure, strengthened stakeholder participation, and robust monitoring frameworks to ensure sustainable water governance in Nigeria's agricultural sector.

Keywords: Agricultural Water Management, Irrigation, Policy Effectiveness, Climate Resilience, Water Governance.

Introduction

Agricultural Water Management (AWM) plays a pivotal role in ensuring food security, improving agricultural productivity, and fostering sustainable rural livelihoods, particularly in countries such as Nigeria, where over 70% of the population relies on agriculture for income and sustenance (National Bureau of Statistics [NBS], 2021). Nigeria's agricultural sector, characterized predominantly by rain-fed farming, is highly vulnerable to climate variability, resulting in inconsistent yields, significant post-harvest losses, and reduced income for smallholder farmers (Akinbile & Adekunle, 2019). Despite the availability of substantial water resources and an estimated 3.14 million hectares of irrigable land, only about 2% of this potential is currently being utilized effectively (Federal Ministry of Agriculture and Rural Development [FMARD], 2022). This underutilization is closely linked to systemic challenges such as dilapidated infrastructure, weak institutional coordination, poor policy implementation, and limited stakeholder participation, all of which continue to hamper progress (Ayanlade et al., 2020; Nnanguma, 2025).

Efforts by the Nigerian government to address these challenges have led to the establishment of key initiatives such as the River Basin Development Authorities (RBDAs), the National Irrigation Policy (NIP), and the World Bank-supported Transforming Irrigation Management in Nigeria (TRIMING) project. These interventions are intended to expand irrigation coverage, promote water conservation, and strengthen

resilience to climate change through infrastructure rehabilitation and institutional reforms (World Bank, 2023; FMARD, 2022).

However, their effectiveness remains limited. For instance, between 2015 and 2023, the TRIMING project targeted the rehabilitation of 42,000 hectares of irrigation infrastructure but only achieved about 60% of its goal due to funding constraints, delayed execution, and governance issues (World Bank, 2023). Likewise, the decentralization of water governance through RBDAs has not yielded the intended outcomes, with these agencies often plagued by underfunding, political interference, and accountability gaps (Olanrewaju & Fagbohun, 2020).

AWM encompasses a range of activities aimed at improving water use efficiency in agriculture, including irrigation development, water harvesting, drainage, and soil moisture conservation (Food and Agriculture Organization [FAO], 2017). These practices are essential for boosting agricultural resilience, particularly in semi-arid and arid regions of Nigeria. However, the implementation of AWM in Nigeria has been hindered by fragmented policy approaches and weak integration across institutions (Biazin et al., 2012; Ayanlade et al., 2020). The country's formal irrigation systems concentrated mainly in the northern regions—are frequently underutilized or non-functional, primarily due to inadequate maintenance, bureaucratic inefficiencies, and low private sector participation (Oyebande, 2018).

In contrast, informal irrigation practices, such as those based on shallow wells and local surface water sources, are more widespread among smallholder farmers but remain largely unsupported by national policy (Akinbile & Adekunle, 2019). These farmers—who constitute over 80% of the agricultural workforce—often lack access to irrigation infrastructure, credit, and climate-smart technologies, making them highly susceptible to rainfall variability, especially in northern Nigeria where water stress is more pronounced (Olayemi et al., 2020). Constraints such as insecure land tenure, limited financial resources, and gender disparities further limit the adoption of AWM innovations (Adeoluwa & Ayanwale, 2022).

In recent years, climate change has heightened the urgency for effective water management in agriculture. Rising temperatures, erratic rainfall patterns, and increased evapotranspiration have significantly disrupted water availability and crop cycles, particularly in northern Nigeria where rainfall variability has shortened the growing season and undermined agricultural reliability (Intergovernmental Panel on Climate Change [IPCC], 2022; Odekunle et al., 2020). Although adaptive AWM strategies like rainwater harvesting, conservation agriculture, and watershed management have been recommended (Rockström et al., 2010), Nigeria's policy framework remains insufficiently climate-informed. Weak meteorological infrastructure and poor integration of climate adaptation strategies into water planning limit the ability of farmers to make informed decisions and prepare for climate risks.

Despite the policy initiatives and institutional frameworks introduced to improve AWM in Nigeria, significant gaps persist in infrastructure development, governance effectiveness, and stakeholder inclusion. The current approach often focuses on infrastructure rather than addressing the governance and socio-economic dimensions that affect water management efficiency. Bridging these gaps requires a multi-level, multi-actor strategy that includes governance reforms, enhanced private sector involvement, and the scaling up of climate-smart irrigation solutions that align national development goals with the realities of smallholder farmers and global sustainability imperatives.

This study, therefore, seeks to evaluate the effectiveness of Nigeria's agricultural water management policies, focusing on their impacts on irrigation efficiency, water use optimization, and climate resilience,

with a view to identifying policy and institutional reforms necessary for a more sustainable agricultural future.

Agricultural Water Management (AWM) plays a pivotal role in ensuring food security, improving agricultural productivity, and fostering sustainable rural livelihoods, particularly in countries such as Nigeria, where over 70% of the population relies on agriculture for income and sustenance (National Bureau of Statistics [NBS], 2021). Nigeria's agricultural sector, characterized predominantly by rain-fed farming, is highly vulnerable to climate variability, leading to inconsistent yields, post-harvest losses, and reduced income for smallholder farmers (Akinbile & Adekunle, 2019). Despite the country's vast water resources and an estimated 3.14 million hectares of irrigable land, only about 2% of this potential is currently being utilized effectively (Federal Ministry of Agriculture and Rural Development [FMARD], 2022).

Efforts by the Nigerian government to enhance agricultural water management have led to the implementation of several key interventions such as the River Basin Development Authorities (RBDAs), the National Irrigation Policy (NIP), and more recently, the World Bank-supported Transforming Irrigation Management in Nigeria (TRIMING) project. These initiatives were designed to increase irrigation coverage, promote water conservation, and build climate resilience through infrastructure rehabilitation and institutional reform (World Bank, 2023; FMARD, 2022).

However, the effectiveness of these policies remains a matter of concern, as systemic issues such as inadequate infrastructure, weak institutional coordination, poor policy implementation, and limited stakeholder participation continue to hamper progress (Ayanlade et al., 2020; Nnanguma, 2025).

Moreover, the majority of Nigerian farmers smallholders who make up over 80% of the agricultural workforce—have limited or no access to formal irrigation systems. This situation perpetuates low productivity and vulnerability to seasonal rainfall patterns, particularly in the northern regions of the country where rainfall is erratic and water stress is prevalent (Olayemi et al., 2020). Between 2015 and 2023, for example, the TRIMING project aimed to rehabilitate 42,000 hectares of irrigation infrastructure but only achieved 60% of its target due to funding constraints, delays in project execution, and governance challenges (World Bank, 2023).

This study, therefore, seeks to evaluate the effectiveness of Nigeria's agricultural water management policies with a focus on their impact on irrigation efficiency, water use optimization, and resilience to climate change. Through a policy and programmatic lens, the research identifies existing gaps and proposes evidence-based strategies to enhance water governance, strengthen institutional frameworks, and scale up climate-smart irrigation technologies. Such improvements are essential to transform Nigeria's agriculture sector into a sustainable and resilient engine for food security and economic development.

Materials and Methods

Study Design

This study employed a **mixed-methods research design**, combining both **quantitative and qualitative approaches** to comprehensively evaluate the effectiveness of Agricultural Water Management (AWM) policies in Nigeria. The rationale for this design is grounded in the need to triangulate policy documentation with empirical data from government records, as well as stakeholders' perceptions to ensure a more holistic understanding of policy performance (Creswell & Plano Clark, 2018).

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A **descriptive survey design** was adopted to capture relevant data from stakeholders involved in agricultural water management, including policymakers, irrigation engineers, extension officers, and smallholder farmers across selected regions in Nigeria. This design facilitated the analysis of trends, relationships, and institutional outcomes relating to irrigation development, policy implementation, and stakeholder engagement.

Study Area

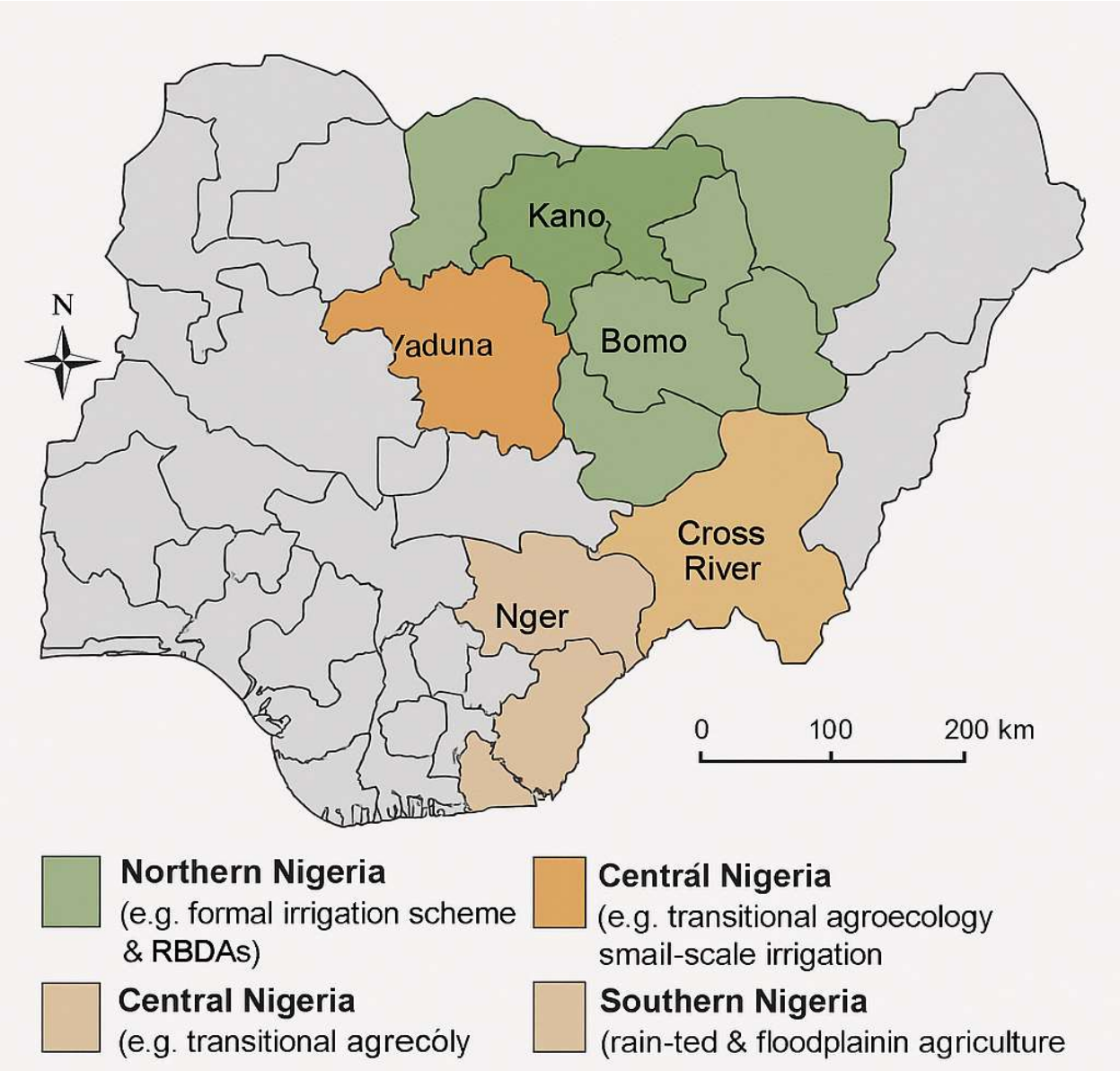

Figure 1: Map of the Study Area
Source: Adapted and generated by the author using geographic data from GADM (2024), NASRDA, and OSGOF (Nigeria).

The study covered key agricultural zones in Nigeria with varying degrees of irrigation development and water resource availability. These included:**Northern Nigeria** (e.g., Kano, Kaduna, Borno, and Sokoto States), where most of the formal irrigation schemes and River Basin Development Authorities (RBDAs) are located.**Central Nigeria** (e.g., Benue and Niger States), characterized by transitional agro-ecological features and expanding small-scale irrigation.**Southern Nigeria** (e.g., Ogun and Cross River States), where water management is more aligned with rain-fed and floodplain agriculture.

These regions were selected using **purposive sampling**, based on the presence of key irrigation infrastructure, representation of agro-ecological zones, and diversity in AWM policy implementation outcomes.

Population and Sampling Techniques

The target population included:
Officials from the **Federal Ministry of Agriculture and Rural Development (FMARD).**Project officers of the **Transforming Irrigation Management in Nigeria (TRIMING) project.**Managers of **River Basin Development Authorities (RBDAs).**Agricultural extension agents.Smallholder farmers engaged in both formal and informal irrigation

A **multistage sampling technique** was used. In the first stage, three geopolitical zones were selected (Northwest, Northcentral, and Southwest). In the second stage, two states were selected from each zone. Finally, within each state, local government areas (LGAs) with active irrigation schemes were identified and communities selected randomly. A total sample of **300 respondents** was drawn, consisting of:100 smallholder farmers,50 extension officers,50 irrigation project managers,50 RBDA and TRIMING project officials,50 policymakers and academics.

Data Collection Instruments
Primary Data Collection
Structured Questionnaires: Used to obtain data on irrigation practices, policy awareness, challenges, and satisfaction with water management services. These were administered to farmers and extension workers.***Key Informant Interviews (KIIs)***: Conducted with policymakers, irrigation project managers, and RBDA officials to gain insights into institutional bottlenecks and policy gaps.***Focus Group Discussions (FGDs)***: Conducted in selected communities to capture localized experiences and gender-specific dimensions of water access and usage.

Secondary Data Sources
National Bureau of Statistics (NBS) reports on irrigable land, agricultural productivity, and water use. FMARD ***policy documents***, including the National Irrigation Policy and Strategic Framework. ***TRIMING Project Evaluation Reports.World Bank reports*** on agricultural water investments. ***Peer-reviewed journal articles*** and grey literature on agricultural water governance in Nigeria.

Data Analysis Techniques
Quantitative Analysis
Quantitative data from questionnaires were coded and analyzed using **Statistical Package for the Social Sciences (SPSS) version 26**. Descriptive statistics (frequencies, means, standard deviations) were used to summarize respondents' demographics and policy awareness levels. **Inferential statistics**, particularly **Chi-**

square tests and **multiple regression analysis**, were employed to examine the relationships between policy effectiveness, access to irrigation facilities, and stakeholder satisfaction.

Qualitative Analysis

Qualitative data from interviews and FGDs were analyzed thematically using **NVivo 12 software**. Transcripts were coded to identify recurring patterns, themes, and emerging narratives related to water governance, institutional coordination, climate adaptation, and farmers' experiences.

Thematic categories included: policy implementation effectiveness, institutional challenges, infrastructure gaps, climate-smart water practices, gender dimensions of water access. Findings from qualitative analysis were triangulated with quantitative results to enhance robustness and credibility.

Ethical approval for this research was obtained from the **Modibbo Adama University Research Ethics Committee**. All participants were informed of the study's purpose and gave **informed consent** prior to data collection. Confidentiality and anonymity were maintained throughout the study, and participation was entirely voluntary.

While the mixed-methods approach provided a comprehensive understanding of AWM policy effectiveness, several limitations were encountered. These included: Limited access to some official policy documents due to bureaucratic delays. Variability in respondents' literacy levels, which affected questionnaire administration in rural areas. Regional insecurity in some northern locations, which limited data collection. Despite these limitations, rigorous methodological steps were taken to ensure data validity, reliability, and representational.

Results and Discussion

This section presents the major findings of the study based on the analysis of primary and secondary data. It discusses the effectiveness of agricultural water management (AWM) policies and programs in Nigeria, with a focus on irrigation coverage, institutional effectiveness, smallholder access, and climate adaptation measures. Quantitative results are complemented with qualitative insights from interviews and focus groups.

Survey results revealed that **only 12.7%** of the farmers in the study areas had access to formal irrigation infrastructure. Out of this group, just **38%** reported regular water supply during dry seasons. The remaining **87.3%** relied on rain-fed agriculture or informal water harvesting techniques (e.g., shallow wells, buckets, or stream diversion), underscoring the gross under-utilization of Nigeria's 3.14 million hectares of irrigable land.

Secondary data from the **National Bureau of Statistics (2021)** corroborated these findings, confirming that **less than 2%** of irrigable land in Nigeria is currently used under formal schemes. This is despite decades of investment by government and donors, including the TRIMING project, which achieved only **60%** of its infrastructure rehabilitation target between 2015 and 2023 (World Bank, 2023).

The results reinforce existing literature that identifies low irrigation coverage as a critical bottleneck in Nigeria's agricultural productivity (Akinbile & Adekunle, 2019; Oyebande, 2018). The findings highlight a mismatch between policy objectives and implementation outcomes. While the National Irrigation Policy (FMARD, 2022) emphasizes expanding irrigated land, on-ground evidence suggests that poor infrastructure, erratic funding, and weak institutional delivery continue to undermine these efforts.

Responses from officials within FMARD and the River Basin Development Authorities (RBDAs) indicated challenges with policy harmonization, overlapping responsibilities, and inadequate capacity for project execution. Only **42%** of policy officials surveyed believed their agencies had adequate technical capacity and autonomy to implement AWM programs effectively.

In interviews, several RBDA staff noted delays in fund disbursement and lack of synergy between federal and state-level actors. Focus group participants also expressed frustration over abandoned or poorly maintained irrigation infrastructure.

These institutional weaknesses align with observations by Agbola et al. (2021) and Olanrewaju & Fagbohun (2020), who argue that Nigeria's water governance suffers from fragmented institutions and unclear mandates. Without reforming these governance frameworks and ensuring better inter-agency coordination, AWM policies will continue to underperform. The study suggests that establishing clearer accountability lines and building local technical capacity are essential for improving institutional performance.

Of the 100 smallholder farmers surveyed, only **5%** had ever benefitted from government-supported irrigation programs. The rest relied on traditional rain-fed systems, which they reported as increasingly unreliable due to rainfall unpredictability. In gender-focused FGDs, **female farmers reported even lower access**, citing land tenure issues, exclusion from irrigation cooperatives, and lack of extension support.

Additionally, **72%** of farmers stated that they had never been consulted during the planning or implementation of irrigation projects in their communities.

These findings highlight the inequitable distribution of water management interventions. Despite forming the backbone of Nigeria's agricultural sector, smallholder farmers remain excluded from formal irrigation schemes (Adeoluwa & Ayanwale, 2022). The gender gap further exacerbates this inequity, as also reported by FAO (2017) and IFAD (2020). Inclusion of marginalized groups, participatory planning, and strengthening of farmer-based organizations could address some of these gaps.

Awareness of climate-smart irrigation techniques such as **drip irrigation**, **solar-powered pumping**, and **rainwater harvesting** was low among respondents. Only **16%** of farmers were aware of any such technologies, and just **4%** had adopted them, mostly through donor-supported pilot projects in Kano and Benue states.

Respondents cited high costs, lack of technical knowledge, and absence of credit support as major barriers. Extension officers also noted that their training curriculum had not been updated to reflect climate adaptation strategies.

This points to a critical knowledge and capacity gap. Climate change is already affecting water availability, especially in northern Nigeria (IPCC, 2022; Odekunle et al., 2020). However, climate-resilient water management is not yet mainstreamed into Nigeria's irrigation strategy. Scaling up access to affordable climate-smart technologies, coupled with policy incentives and training, is vital for building resilience among smallholder farmers.

Across all stakeholder categories, only **29%** rated current agricultural water policies as effective. Common concerns included inconsistent funding, poor monitoring, political interference, and lack of stakeholder

engagement. Respondents from the TRIMING project acknowledged progress in infrastructure rehabilitation but admitted challenges in farmer participation and sustainability.

Low perceived effectiveness indicates a significant disconnect between policy formulation and field-level impact. This aligns with Nnanguma (2025), who found that policy effectiveness in Nigeria's AWM sector is often undermined by limited political will, weak monitoring frameworks, and inadequate community ownership. For policies to be impactful, they must be co-created with end users and supported by long-term financing and governance reform.

The results collectively indicate that while Nigeria has made commendable efforts in drafting comprehensive AWM policies and launching major interventions like TRIMING, their implementation remains fraught with challenges. These include:Poor institutional coordination and bureaucratic inefficiencies,low coverage of irrigation infrastructure,exclusion of smallholder and female farmers,limited uptake of climate-smart practices,gaps in stakeholder engagement and monitoring mechanisms

Addressing these issues requires a shift toward integrated, inclusive, and climate-sensitive water governance. Public-private partnerships, local community empowerment, and enhanced investment in innovation and infrastructure will be key drivers of success.

Conclusion and Recommendations

This study critically evaluated the effectiveness of Agricultural Water Management (AWM) policies in Nigeria using a mixed-methods approach that encompassed empirical data analysis, institutional reviews, and stakeholder engagement. The findings underscore a multifaceted challenge characterized by underutilized irrigation potential, institutional fragmentation, poor coordination, low adoption of climate-smart water practices, and the marginalization of smallholder farmers—especially women—from formal irrigation schemes. Despite Nigeria's vast irrigable land, only about 2% has been developed and utilized, revealing a significant implementation gap between policy intent and practical outcomes.

Programs such as the Transforming Irrigation Management in Nigeria (TRIMING) and the River Basin Development Authorities (RBDAs) have made moderate progress by rehabilitating key infrastructure and enhancing institutional capacity. However, these gains are undermined by systemic inefficiencies, including inadequate funding, overlapping institutional roles, and limited stakeholder inclusion in decision-making. Most notably, smallholder farmers—who represent more than 80% of Nigeria's agricultural labor force remain largely excluded from accessing formal irrigation systems.

This exclusion is further compounded by low levels of awareness and uptake of climate-smart irrigation technologies, especially in water-scarce regions of northern Nigeria, thereby compromising agricultural productivity and resilience in the face of climate variability.

The study concludes that while Nigeria's AWM policies are conceptually robust, they suffer from weak implementation due to execution failures, limited institutional capacity, and the absence of inclusive and accountable governance frameworks. To address these critical gaps, Nigeria must prioritize strategic reforms that are integrated, inclusive, and climate-resilient. This involves scaling up investments in both formal and informal irrigation infrastructure, especially through community-led and pro-poor irrigation models that foster local ownership and sustainability (Akinbile & Adekunle, 2019). Institutional roles should be streamlined to eliminate duplications through the establishment of a National Agricultural Water

Management Council, which would serve as a central body for harmonizing strategies, monitoring progress, and ensuring high-level policy alignment (Agbola et al., 2021).

To foster equitable access, targeted efforts must be made to integrate smallholder farmers, women, and youth into irrigation development programs by reforming land tenure systems and introducing gender-sensitive quotas (FAO, 2017; IFAD, 2020). Climate-smart irrigation practices such as solar-powered pumps, drip irrigation, and rainwater harvesting should be subsidized, mainstreamed into extension services, and promoted through capacity-building initiatives for both farmers and extension officers (IPCC, 2022). Participatory planning is critical, and this can be achieved by institutionalizing farmer participation at all stages of AWM project cycles and by strengthening Water User Associations (WUAs) to foster collective responsibility and sustainable resource use (Adeoluwa & Ayanwale, 2022).

Furthermore, robust Monitoring, Evaluation, and Learning (MEL) systems must be established, including real-time dashboards and independent annual evaluations to enhance transparency and accountability (World Bank, 2023). Finally, leveraging Public–Private Partnerships (PPPs) is essential for mobilizing finance and innovation, and can be accelerated through incentives such as tax breaks, matching grants, and build-operate-transfer (BOT) models. Collaboration with NGOs, agritech startups, and research institutions will also be pivotal in scaling digital and smart water management solutions (Olanrewaju & Fagbohun, 2020).

Ultimately, the future of Nigeria's agriculture—and its broader socioeconomic stability—depends heavily on how water is managed in the coming years. A re-imagined, inclusive, and well-coordinated Agricultural Water Management system offers a trans-formative pathway to increase food production, reduce rural poverty, and enhance national resilience in the face of escalating climate threats and demographic pressures.

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