*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393
**DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

# Public Relations Campaigns for Climate-Smart Agriculture Adoption: A Study of Awareness Creation and Behaviour Change Among Nigerian Farmers

***Ugbome, Maureen**
Department of Mass Communication, University of Delta, Agbor, Delta State
Corresponding author: maureen.ugbome@unidel.edu.ng
ORCID ID: https://orcid.org/0000-0002-2675-0200

**Lasisi, Aminu Jacob**
Department of Agricultural Economics, University of Delta, Agbor, Delta State
jacob.lasisi@unidel.edu.ng
ORCID ID: https://orcid.org/0009-0004-4781-3743

**Umukoro, Ese Steven**
Department of Mass Communication, Delta State University, Abraka, Delta State
umukoroes@delsu.edu.ng
ORCID ID: https://orcid.org/0000-0003-4711-1712

**Abstract**

**Objective:** This study investigates the effectiveness of public relations (PR) campaigns in promoting the adoption of climate-smart agriculture (CSA) among Nigerian farmers. It specifically examines the relationship between strategic communication interventions and critical behavioural metrics, including awareness levels, behavioural intentions, and actual changes in farming practices.

**Method:** The research utilised a quasi-experimental design involving 412 farmers across six agricultural zones over eight months. Data collection was facilitated through validated questionnaires and behavioural observation tools. To determine the efficacy of the interventions, the study employed t-tests to compare exposed and control groups, regression analysis to assess the association between message frequency and behavioural intention, and chi-square tests to assess the association between message frequency and behavioural intention.

**Results:** Farmers exposed to integrated PR campaigns achieved 72.4% CSA awareness, a 37.8 percentage-point increase over the control group. Behavioural indices showed that exposed farmers adopted significantly more practices (4.7 vs. 1.8; $t = 18.34$, $p < 0.001$), with PR exposure explaining 68.7% of the variance in adoption rates ($R^2 = 0.687$). Digital channels outperformed traditional media with an 83.2% message retention rate. Furthermore, message frequency was a major factor: farmers with 5 or more exposures had an 81.5% likelihood of adoption. Trust served as a vital mediator: extension-verified messages led to a 77.9% adoption rate, compared with only 42.1% for unverified content.

**Conclusion:** The study concludes that strategic PR campaigns are highly effective in bridging the gap between awareness and behaviour in agricultural sustainability transitions. The findings emphasise that high message frequency and the use of trusted, verified information sources are essential for driving actual practice changes. These results provide empirical evidence for policymakers and agricultural communicators to design more effective, digital-forward, and trust-based interventions for Nigerian smallholders.

**Keywords:** Climate-smart agriculture, public relations campaigns, behaviour change, agricultural communication, awareness creation

## Introduction

Climate-smart agriculture represents a transformative approach to agricultural development, integrating productivity enhancement, climate adaptation, and mitigation objectives into farming systems. The African Union has adopted a ten-year strategy and action plan to transform Africa's agri-food systems and ensure food security (AU, 2025), recognising CSA as central to achieving sustainable agricultural intensification. However, the gap between the availability of CSA technologies and farmer adoption remains substantial, with adoption rates across sub-Saharan Africa averaging below 30% despite demonstrated benefits (Bashiru et al., 2024). Public relations campaigns are strategic communication interventions designed to raise awareness, shape attitudes, and influence behaviours among target audiences. In agricultural contexts, PR campaigns employ diverse channels—mass media, interpersonal communication, digital platforms, and demonstration events—to disseminate information and motivate practice change (Mulungu et al., 2025; Ivwighren & Umukoro, 2022). The integration of traditional and digital communication approaches has emerged as particularly relevant, with global social media statistics indicating penetration rates exceeding 60% even in rural African communities (Datareportal, 2025).

Nigeria's agricultural sector faces escalating climate-related vulnerabilities, including erratic rainfall patterns, prolonged droughts, flooding, soil degradation, and pest proliferation (National Bureau of Statistics, 2023). These challenges threaten food security for more than 200 million people and constrain rural livelihoods. Climate-smart agriculture practices—including conservation tillage, integrated soil fertility management, drought-resistant varieties, agroforestry, precision irrigation, and integrated pest management—offer proven solutions (Mmbando, 2025). Nevertheless, adoption remains constrained by information deficits, risk perceptions, resource limitations, and institutional barriers (Atta-Aidoo & Antwi-Agyei, 2025).

Communication plays a pivotal role in agricultural technology diffusion, with information and communication technologies-based extension offering unprecedented opportunities for scale and efficiency (Mulungu et al., 2025; Umukoro et al., 2018). The behavioural drivers that motivate farmers to adopt innovative practices operate through complex psychological pathways that involve awareness, knowledge acquisition, attitude formation, intention formation, and behavioural execution (Ahsan et al., 2025). Public relations campaigns strategically target these pathways, employing persuasive communication techniques grounded in behaviour change theories, including the Theory of Planned Behaviour, Diffusion of Innovations, and Social Cognitive Theory.

Recent technological advances have revolutionised the possibilities for agricultural communication. Voice-first generative AI platforms demonstrate feasibility for delivering contextualised agricultural advice in local languages (Deshpande et al., 2025), while digital agro-advisory tools enable personalised recommendations at scale (Ofosu-Ampong et al., 2025). However, challenges persist in bridging the digital divide, with rural exclusion limiting access for marginalised farming communities (Mwansa et al., 2025). Agricultural education using multilingual YouTube animations has shown promise in reaching language-diverse populations cost-effectively, though feasibility assessments reveal significant resource requirements (Reeves et al., 2024).

Despite CSA's documented benefits, three critical problems impede widespread adoption among Nigerian farmers: substantial disparities exist between farmers' awareness of climate-smart practices and their actual adoption rates. Many farmers possess only superficial knowledge of CSA concepts, without understanding specific implementation techniques, expected benefits, or adaptation requirements for local contexts. This awareness-adoption gap indicates that information dissemination alone is insufficient; strategic communication that addresses motivational barriers and enables factors is essential (Fabregas et al., 2024). Current agricultural extension approaches predominantly rely on outdated communication channels with limited reach, frequency, and engagement capacity (Choruma et al., 2024; Ogwezi & Umukoro, 2020). Traditional extension systems struggle with high farmer-to-extension agent ratios (often exceeding 1:5000), infrequent contact, and one-way information transfer. The optimal communication channel mix for maximising CSA awareness and behavioural change among diverse farmer populations remains empirically unclear.

Rigorous empirical evidence quantifying the impact of public relations campaigns on agricultural behaviour change in African contexts remains scarce. Most studies examine extension effectiveness generally without isolating PR campaign contributions or measuring behavioural outcomes beyond self-reported intentions. This evidence gap constrains strategic investment decisions and the optimisation of campaign design, perpetuating resource inefficiencies in agricultural communication programs.

This research pursues three specific objectives: To assess the effect of public relations campaigns on awareness levels and knowledge acquisition regarding climate-smart agriculture practices among Nigerian farmers; To evaluate the relationship between PR campaign exposure intensity and behavioural intention toward CSA adoption among target farmer populations and To examine the comparative effectiveness of different communication channels (digital platforms, radio, demonstration farms, interpersonal communication) in facilitating actual CSA practice adoption.

**$H_1$:** There is no significant difference in climate-smart agriculture adoption rates between farmers exposed to PR campaigns and those not exposed.

**$H_2$:** Communication channel type has no significant effect on message retention and behavioural change outcomes among campaign-exposed farmers.

This research contributes significantly to agricultural communication scholarship by providing empirical quantification of PR campaign effectiveness in driving CSA adoption, filling critical knowledge gaps that constrain evidence-based program design. For policymakers and development agencies investing in climate adaptation initiatives, the findings offer actionable insights into optimal communication strategies, channel selection, message design, and resource allocation to maximise impact (Ginige, 2025). Agricultural extension services can utilise these results to modernise communication approaches, integrating digital innovations while leveraging the continued relevance of traditional channels.

The study informs communication practitioners designing behaviour change campaigns in agricultural and rural development contexts, providing evidence-based guidance on message frequency requirements, source credibility enhancement, and multi-channel integration strategies (Mpande, 2025). For Nigerian farmers, improved communication approaches emerging from this research promise enhanced access to climate-smart practices, potentially strengthening resilience and improving livelihoods. Internationally, the findings contribute to understanding the dynamics of behaviour change in resource-constrained settings, with applicability across sub-Saharan Africa and other developing regions facing similar agricultural communication challenges.

## Materials and Methods

This study employed a quasi-experimental research design with treatment and control groups, incorporating pre- and post-test measurements to assess the PR campaign's impact on awareness and behaviour. The design enabled causal inference into campaign effectiveness while accommodating practical constraints that preclude random assignment in field settings. The research was conducted across six agricultural zones in Nigeria: Niger Delta (intensive rice production), Middle Belt (mixed cereal-legume systems), Southwest (tree crop zones), Northwest (dryland cereals), Northeast (pastoral-agricultural interface), and Southeast (root crop dominant areas). This geographic diversity captured diverse agroecological conditions, farming systems, cultural contexts, and levels of communication infrastructure. The research spanned eight months (January 2024 to August 2024): two months for baseline assessment, four months for PR campaign implementation, and two months for post-campaign evaluation and behavioural observation. The study population comprised 28,650 registered smallholder farmers in selected Local Government Areas across the six zones. Sample size was determined using Cochran's formula for quasi-experimental designs (Yamane, 1967):

$$n = (Z^2pq) / e^2$$

Where: $n$ = sample size

$Z = 1.96$ (95% confidence level)

$p$ = estimated adoption rate (0.30)

$q = 1-p$ (0.70)

$e$ = margin of error (0.05)

$$n = (1.96^2 \times 0.30 \times 0.70) / 0.05^2$$

$$n = (3.8416 \times 0.21) / 0.0025$$

$$n = 0.8067 / 0.0025$$

$$n = 322.68 \approx 323$$

Adjusting for design effect (1.5 for cluster sampling) and anticipated 20% attrition:

$$\text{Final sample} = 323 \times 1.5 \times 1.2 = 581$$

$\approx$ 412 respondents (206 treatment, 206 control)

*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393 **DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

Due to budgetary constraints and logistical feasibility, the final sample was reduced to 412 respondents through systematic screening. This involved excluding farmers with incomplete records or those unavailable for the baseline assessment, and applying stricter eligibility criteria for land ownership and active farming status during the recruitment phase.

Multi-stage cluster sampling was employed. Stage one: purposive selection of six agricultural zones representing major farming systems. Stage two: random selection of one Local Government Area per zone. Stage three: random selection of communities within LGAs. Stage four: systematic random sampling of farmers from community registers (Yamane, 1967). Treatment and control communities were matched based on socioeconomic characteristics, infrastructure access, and baseline CSA awareness levels.

A structured questionnaire containing 92 items organized into eight sections was developed: (1) demographic characteristics, (2) baseline CSA awareness and knowledge, (3) PR campaign exposure tracking, (4) message recall and comprehension, (5) source credibility perceptions, (6) behavioural intentions, (7) actual practice adoption, and (8) communication channel preferences (Ogwezi & Umukoro, 2020; Umukoro et al., 2018). Additionally, behavioural observation checklists documented the actual implementation of CSA practices on farmers' fields. The instrument underwent expert validation (Content Validity Index = 0.89) and pilot testing with 40 farmers, yielding Cronbach's alpha reliability of 0.882.

The intervention comprised integrated campaigns using five communication channels: (1) radio programs (weekly 30-minute agricultural shows) (Awuah-Frimpong et al., 2024), (2) SMS alerts (twice-weekly CSA tips), (3) WhatsApp groups (daily interactive discussions) (Balaji & Kavaskar, 2024), (4) demonstration farms (monthly field days), and (5) interpersonal communication (extension agent visits) (Mpande, 2025). Campaign messages emphasised the benefits of CSA practice, implementation procedures, risk mitigation, and success stories, and were designed using participatory approaches that incorporated farmers' language and cultural contexts (Aslam et al., 2025).

Data collection involved three phases. Pre-intervention: baseline surveys were administered to both the treatment and control groups to assess initial awareness, knowledge, and practices. During the intervention, exposure-tracking forms documented campaign contact frequency and channels (Mulungu et al., 2025). Post-intervention: follow-up surveys assessed changes in awareness, behavioural intentions, and practice adoption; field observations verified reported practices by directly observing conservation tillage, mulching, intercropping, and water management on farmers' plots (Ali et al., 2025).

Descriptive statistics (frequencies, percentages, means, and standard deviations) characterised sample demographics and variable distributions. Inferential analyses included: independent-samples t-tests comparing the treatment and control groups, paired-samples t-tests assessing pre-post changes within groups, chi-square tests examining categorical associations, Pearson correlations analysing relationships between continuous variables, and multiple regression predicting adoption from campaign variables. Analysis of Covariance (ANCOVA) was used to control for baseline differences. Significance level was set at $p < 0.05$.

*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393
**DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

**Model Specification**

CSA adoption model:

$$Y = \beta_0 + \beta_1 CE + \beta_2 MF + \beta_3 SC + \beta_4 DC + \beta_5 BI + \beta_6 BC + \varepsilon \quad \text{.................... Equ. (i)}$$

Where:

- Y = CSA adoption score (0-10 scale)
- CE = Campaign exposure (binary: 0=no, 1=yes)
- MF = Message frequency (number of exposures)
- SC = Source credibility (1-5 scale)
- DC = Digital channel access (binary)
- BI = Baseline CSA knowledge
- BC = Behavioural change readiness (1-5 scale)
- $\varepsilon$ = Error term

Behavioural Change Readiness (BC) was operationalised as a composite index measuring: (1) intention to adopt CSA practices, (2) perceived self-efficacy, (3) attitude toward climate-smart agriculture, and (4) readiness to modify farming practices. Respondents rated agreement on a 5-point Likert scale (1=strongly disagree, 5=strongly agree); scores were averaged across four items (Cronbach's $\alpha$=0.82).

Behavioural change model employing logistic regression:

$$\text{Log}(p/1-p) = \alpha_0 + \alpha_1 CT + \alpha_2 MR + \alpha_3 SI + \alpha_4 RE + \mu \quad \text{..................... Equ. (11)}$$

Where:

- p = probability of CSA adoption
- CT = Communication channel type (categorical)
- MR = Message retention score
- SI = Social influence index
- RE = Resource endowment
- $\mu$ = Error term

Resource Endowment (RE) comprised: (1) land size (hectares), (2) ownership of farm equipment (count), (3) access to credit (binary), (4) annual farm income (Nigerian Naira), and (5) household labour availability (adult equivalents). Components were standardised (z-scores)

*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393
**DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

and summed to create a continuous index, with higher scores indicating greater resource capacity for CSA adoption (Atta-Aidoo & Antwi-Agyei, 2025).

Statistical analyses were conducted using SPSS version 27 and the R programming language. Specific procedures included multivariate analysis of variance (MANOVA) for multiple dependent variables, structural equation modelling (SEM) to examine mediation pathways, and propensity score matching to enhance the validity of causal inference (Fabregas et al., 2024). Model diagnostics assessed assumptions, including normality (Shapiro-Wilk test), homogeneity of variance (Levene's test), and multicollinearity (Variance Inflation Factors).

MANOVA assessed simultaneous effects on multiple CSA adoption outcomes. SEM examined mediation pathways between communication exposure, knowledge change, and adoption behaviour (Ahsan et al., 2025). PSM controlled selection bias by matching treatment and control groups on baseline characteristics, enhancing causal inference validity. Model diagnostics (Shapiro-Wilk, Levene's test, VIF) were used to verify statistical assumptions before primary analyses.

Cost per adopter was calculated by summing all direct and indirect expenses associated with each communication channel during the intervention period, then dividing by the number of farmers who successfully adopted at least one CSA practice (Reeves et al., 2024). Cost components included: (1) personnel costs—extension agent salaries, facilitator fees, and technical staff time allocated proportionally based on activity hours; (2) media expenses—radio airtime purchases, SMS bulk messaging fees, WhatsApp data costs, and digital platform subscription charges (Balaji & Kavaskar, 2024); (3) material costs—demonstration farm inputs, educational materials, training handouts, and visual aids; (4) infrastructure costs—equipment depreciation, venue rentals for group sessions, and transportation expenses; and (5) administrative overheads—program coordination, monitoring visits, and documentation activities. All costs were converted to US dollars using prevailing exchange rates and standardised per the 12-month intervention period to ensure comparability across channels (Choruma et al., 2024).

The Intention-Action Gap percentage was computed as: [(Number of farmers expressing intention to adopt − Number of farmers who actually adopted) ÷ Number of farmers expressing intention to adopt] × 100. Adoption intention was measured using pre-intervention surveys in which farmers indicated their willingness to implement specific CSA practices within six months (Ofosu-Ampong et al., 2025). Actual adoption was verified through post-intervention field observations and farmer self-reports at the six-month follow-up, and cross-validated against physical evidence of practice implementation. This metric quantifies the differential between behavioural intention and realised action, providing insight into communication effectiveness beyond mere awareness generation (Fabregas et al., 2024).

## Results

### Demographic Characteristics

The sample comprised 412 farmers: 206 in the treatment group and 206 in the control group. The gender distribution was 54.1% male and 45.9% female. Age averaged 42.3 years (SD = 11.7). Education levels: 22.3% no formal education, 31.8% primary, 35.9% secondary, 10.0% tertiary. Mean farming experience: 16.4 years (SD = 9.2). Average farm size: 2.8 hectares (SD = 1.9). Baseline equivalence tests indicated no significant differences between the treatment and control groups in demographic variables ($p > 0.05$).

*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393
**DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

**Table 1: Effect of PR Campaigns on CSA Awareness and Knowledge Levels**

| Awareness Indicators | Treatment Group (n=206) | Control Group (n=206) | Difference | t-value | p-value |
|---|---|---|---|---|---|
| Pre-Campaign Awareness (%) | 36.2 | 34.6 | 1.6 | 0.42 | 0.674 |
| Post-Campaign Awareness (%) | 72.4 | 35.8 | 36.6 | 12.87 | <0.001*** |
| Awareness Gain (% points) | 36.2 | 1.2 | 35.0 | - | - |
| Knowledge Score (0-20 scale) | | | | | |
| Pre-Campaign Mean | 8.4 (SD=2.6) | 8.1 (SD=2.4) | 0.3 | 1.18 | 0.239 |
| Post-Campaign Mean | 16.7 (SD=2.8) | 8.9 (SD=2.7) | 7.8 | 28.45 | <0.001*** |
| Knowledge Gain | 8.3 | 0.8 | 7.5 | - | - |
| Comprehensive Understanding (%) | 68.9 | 28.2 | 40.7 | 13.94 | <0.001*** |
| Practice Implementation Confidence (1-5) | 4.2 (SD=0.7) | 2.6 (SD=0.9) | 1.6 | 19.82 | <0.001*** |

***$p < 0.001$

Table 1 demonstrates substantial effects of the PR campaign on both awareness and knowledge. Post-campaign awareness was 72.4% in the treatment group and 35.8% in the control group, representing a 36.6 percentage-point difference (t = 12.87, $p < 0.001$). The treatment group gained 36.2 percentage points in awareness, compared with only 1.2 points for controls, indicating minimal secular trends and strong campaign attribution. Knowledge scores increased dramatically from 8.4 to 16.7 (8.3-point gain) in the treatment group while controls showed minimal change (0.8-point gain). This 7.5-point difference (t = 28.45, $p < 0.001$) reflects substantial learning attributable to campaign exposure. Comprehensive understanding—defined as correctly explaining three or more CSA practices with implementation details—was achieved by 68.9% of campaign-exposed farmers, compared with 28.2% of controls. Practice implementation confidence increased significantly (4.2 vs 2.6, t = 19.82, $p < 0.001$), suggesting campaigns enhanced self-efficacy beyond mere knowledge transfer. These findings align with research demonstrating that digital information provision can drive significant behaviour change, particularly when combined with multiple touchpoints as observed in East African experiments.

*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393
**DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

**Table 2: PR Campaign Exposure Intensity and Behavioural Intention Toward CSA Adoption**

| Exposure Frequency Category | Number of Farmers | Mean Behavioural Intention Score (1-5) | Adoption Likelihood (%) | Mean Practices Intended | Intention-Action Gap (%) |
|---|---|---|---|---|---|
| **No Exposure (Control)** | 206 | 2.1 (SD=0.8) | 28.3 | 1.3 | 54.7 |
| **Single Exposure (1 contact)** | 28 | 2.8 (SD=0.7) | 42.9 | 2.1 | 48.2 |
| **Low Exposure (2-4 contacts)** | 64 | 3.4 (SD=0.6) | 59.4 | 3.2 | 38.5 |
| **Moderate Exposure (5-8 contacts)** | 78 | 4.1 (SD=0.5) | 76.9 | 4.8 | 22.4 |
| **High Exposure (≥9 contacts)** | 36 | 4.6 (SD=0.4) | 81.5 | 5.7 | 18.1 |
| Campaign-Exposed Overall | **206** | **3.8 (SD=0.8)** | **68.7** | **4.2** | **29.3** |
| F-statistic (ANOVA) | - | **F=94.38*** (p<0.001)** | **χ²=147.82*** (p<0.001)** | **F=86.52*** (p<0.001)** | - |

****p < 0.001*

Table 2 reveals dose-response relationships between campaign exposure intensity and behavioural outcomes. Behavioural intention scores increased systematically from 2.1 (no exposure) to 4.6 (high exposure), with ANOVA confirming significant differences across categories (F = 94.38, $p < 0.001$). Adoption likelihood—percentage expressing definite intention to implement CSA—ranged from 28.3% (controls) to 81.5% (high exposure), representing a 53.2 percentage point differential. Chi-square analysis confirmed highly significant associations ($\chi^2 = 147.82$, $p < 0.001$). The number of practices farmers intended to adopt increased from 1.3 (controls) to 5.7 (high exposure), indicating that repeated campaign contacts not only increase the likelihood of adoption but also broaden practice portfolios. Notably, the intention-action gap—discrepancy between stated intentions and actual behaviours—decreased with exposure intensity from 54.7% (controls) to 18.1% (high exposure), suggesting that comprehensive campaign exposure enhances both motivation and implementation capacity. This aligns with findings that promotion strategies for smart farming technology in sub-Saharan Africa require sustained engagement rather than one-time

*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393
**DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

interventions. The moderate exposure threshold (5-8 contacts) appears critical, with a 76.9% likelihood of adoption, suggesting diminishing marginal returns beyond this point.

**Table 3: Comparative Effectiveness of Communication Channels in Facilitating CSA Practice Adoption**

| Communication Channel | Reach Rate (%) | Message Retention (%) | Comprehension Score (1-10) | Mean Practices Adopted | Adoption Rate (%) | Cost per Adopter ($) |
|---|---|---|---|---|---|---|
| **Digital Platforms (WhatsApp/SMS)** | 67.5 | 83.2 | 8.4 (SD=1.2) | 5.2 | 78.4 | 12.30 |
| **Radio Programs** | 84.5 | 56.8 | 6.7 (SD=1.6) | 3.8 | 61.2 | 8.50 |
| **Demonstration Farms** | 42.7 | 91.5 | 9.2 (SD=0.9) | 5.9 | 84.7 | 28.60 |
| **Extension Agents (Interpersonal)** | 58.3 | 88.4 | 8.9 (SD=1.1) | 5.5 | 82.1 | 35.40 |
| **Community Radio + WhatsApp** | 76.8 | 87.6 | 8.7 (SD=1.0) | 5.8 | 86.3 | 15.70 |
| **Integrated multi-channel** | 89.2 | 89.8 | 9.1 (SD=0.8) | 6.4 | 91.8 | 22.80 |

Table 3 provides nuanced insights into channel-specific effectiveness across multiple performance dimensions. Radio programs achieved the highest reach (84.5%) but relatively low message retention (56.8%) and moderate adoption rates (61.2%), suggesting limitations for complex behavioural messages despite broad accessibility. Digital platforms demonstrated strong retention (83.2%) and high adoption (78.4%) at low cost per adopter ($12.30), validating investments in ICT-based agricultural extension. However, reach constraints (67.5%) reflect ongoing challenges in the digital divide documented in rural South Africa and other sub-Saharan contexts.

Demonstration farms yielded exceptional outcomes—91.5% retention, 9.2 comprehension score, 84.7% adoption—confirming the power of experiential learning, though limited reach (42.7%) and high cost ($28.60 per adopter) constrain scalability. Extension agent interactions produced similarly strong results (88.4% retention, 82.1% adoption) but incurred higher costs ($35.40) and had limited reach (58.3%). The integrated multi-channel approach achieved superior performance across all dimensions: 89.2% reach, 89.8% retention, 9.1% comprehension, 6.4% practice adoption, and 91.8% overall adoption rate. While moderately expensive ($22.80 per adopter), this represents excellent value given comprehensive outcomes.

The combined radio-WhatsApp strategy emerged as particularly cost-effective, balancing broad reach (76.8%), strong retention (87.6%), and high adoption (86.3%) at a reasonable cost

*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393
**DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

($15.70). These findings support arguments that digitalisation in agriculture requires hybrid approaches that address both technological and traditional communication channels, with smart integration overcoming limitations of individual channels.

**Table 4: Hypothesis Testing - Difference in CSA Adoption between Campaign-Exposed and Non-Exposed Farmers**

| Adoption Measures | Treatment Group (n=206) | Control Group (n=206) | Mean Difference | t-statistic | p-value | Effect Size (Cohen's d) |
|---|---|---|---|---|---|---|
| Number of CSA Practices Adopted | 4.7 (SD=1.8) | 1.8 (SD=1.2) | 2.9 | 18.34 | <0.001*** | 1.87 (Large) |
| Conservation Tillage Adoption (%) | 73.3 | 31.6 | 41.7 | - | <0.001*** | - |
| Improved Variety Adoption (%) | 81.6 | 42.7 | 38.9 | - | <0.001*** | - |
| Integrated Soil Fertility Mgmt (%) | 68.9 | 28.2 | 40.7 | - | <0.001*** | - |
| Water Conservation Practices (%) | 64.1 | 23.8 | 40.3 | - | <0.001*** | - |
| Agroforestry Integration (%) | 52.4 | 18.4 | 34.0 | - | <0.001*** | - |
| Overall CSA Adoption Index (0–100) | 71.8 (SD=14.3) | 32.6 (SD=12.7) | 39.2 | 28.76 | <0.001*** | 2.88 (Large) |
| Regression: Campaign Effect | $\beta = 0.829$ (SE = 0.042) | $R^2 = 0.687$ | F = 198.45*** | $p < 0.001$ | | |

***$p < 0.001$

Table 4 provides robust evidence for rejecting Hypothesis 1's null statement. Campaign-exposed farmers adopted significantly more CSA practices (4.7 vs 1.8; t = 18.34, $p < 0.001$), with a large effect size (Cohen's d = 1.87), indicating both statistical and practical significance. Practice-specific adoption rates consistently favoured the treatment group by 34-41 percentage points across all CSA components. Conservation tillage adoption reached 73.3% in the

*Torkwase Journal of Agricultural Research,* Volume 3, Issue 1, January 2026, EISSN: 2006-3393
**DOI:** https://doi.org/10.5281/10.5281/zenodo.18346315; **Article History:** Received, 1 November 2025; Revised, 5 December 2025; Accepted, 20 December 2025.

treatment group versus 31.6% in controls; improved varieties 81.6% versus 42.7%; integrated soil fertility management 68.9% versus 28.2%; water conservation 64.1% versus 23.8%; and agroforestry 52.4% versus 18.4%.

The overall CSA adoption index—a composite measure that weights all practices—showed a treatment group mean of 71.8 and a control group mean of 32.6, a 39.2-point difference ($t = 28.76$, $p < 0.001$), with an exceptionally large effect size (Cohen's $d = 2.88$). Regression analysis confirmed campaign exposure as a strong predictor ($\beta = 0.829$, $p < 0.001$), accounting for 68.7% of the variance in adoption ($R^2 = 0.687$, $F = 198.45$, $p < 0.001$). This exceeds typical effect sizes in agricultural extension interventions, suggesting that well-designed PR campaigns can drive transformative behavioural change. The findings validate theoretical predictions that examining farmers' behavioural drivers through comprehensive communication strategies can significantly influence technology adoption, as demonstrated in wetland farming contexts and climate-smart agriculture adoption studies across rural Ghana.

**Table 5: Hypothesis Testing - Communication Channel Effects on Message Retention and Behavioural Change**

| Channel Type | Sample Size | Message Retention (%) | Behavioural Change Score (0-10) | Adoption Completion Rate (%) | Time to First Adoption (days) |
|---|---|---|---|---|---|
| **Digital-Dominant** | 72 | 83.2 (SD=8.4) | 7.8 (SD=1.3) | 76.4 | 42.3 (SD=12.6) |
| **Traditional-Dominant** | 68 | 62.4 (SD=11.2) | 5.9 (SD=1.7) | 58.8 | 67.5 (SD=18.4) |
| **Balanced Mix** | 66 | 87.9 (SD=6.8) | 8.6 (SD=1.1) | 87.9 | 38.7 (SD=10.2) |
| ANOVA Results | - | **F=142.67*** ($p<0.001$)** | ***F=78.94**** ($p<0.001$)** | **$\chi^2$=28.45*** ($p<0.001$)** | **F=89.23*** ($p<0.001$)** |
| Post-hoc (Tukey HSD) | **All pairwise comparisons are significant at p<0.001** | | | | |
| Regression Model | **Channel Type: F=156.32***, $R^2$=0.694, p<0.001** | | | | |
| Effect of Extension Verification | **Verified: 77.9% adoption | Unverified: 42.1% adoption | $\chi^2$=38.67*** (p<0.001)** | | |

$^{***}p < 0.001$

Table 5 provides compelling evidence for rejecting the null hypothesis of Hypothesis 2, demonstrating that communication channel type significantly affects both message retention and behavioural outcomes. Message retention varied substantially: 87.9% for balanced mix approaches, 83.2% for digital-dominant, and 62.4% for traditional-dominant channels. ANOVA confirmed highly significant differences (F = 142.67, $p < 0.001$), with Tukey post hoc tests revealing that all pairwise comparisons were significant at $p < 0.001$.

Behavioural change scores followed similar patterns: balanced mix (8.6), digital-dominant (7.8), and traditional-dominant (5.9), with a significant ANOVA (F = 78.94, $p < 0.001$). Adoption completion rates—percentage of farmers who fully implemented intended practices—reached 87.9% for balanced mix, 76.4% for digital-dominant, and 58.8% for traditional-dominant approaches ($\chi^2 = 28.45$, $p < 0.001$). Time to first adoption averaged 38.7 days for a balanced mix, significantly faster than 42.3 days (digital) or 67.5 days (traditional), suggesting that multi-channel approaches accelerate behavioural change timelines (F = 89.23, $p < 0.001$).

Regression analysis modelling behavioural change as a function of channel type yielded $R^2$ = 0.694 (F = 156.32, $p < 0.001$), indicating that channel selection explains 69.4% of the variance in behavioural outcomes—a remarkably high proportion, suggesting that strategic channel management is critical for campaign success. The role of information source verification emerged as an additional critical factor: extension-verified messages achieved 77.9% adoption, compared with 42.1% for unverified content ($\chi^2 = 38.67$, $p < 0.001$), underscoring the centrality of trust-building. This aligns with research on building trust and bridging divides through digital champions in African farming contexts and validates human-in-the-loop AI approaches, emphasising the role of trusted intermediaries even in technology-mediated communication.

## Discussion

This study provides substantial empirical evidence on the effectiveness of public relations (PR) campaigns in promoting climate-smart agriculture (CSA), achieving a 36.6 percentage-point increase in awareness (72.4% in the treatment vs. 35.8% in the control). This awareness translated into behavioural change, with exposed farmers adopting an average of 4.7 CSA practices, compared with 1.8 among controls (t = 18.34, $p < 0.001$). The identified dose-response relationship indicated that adoption likelihood increased from 28.3% to 81.5% as the number of contacts exceeded 9, suggesting that a threshold of 5–8 contacts balances effectiveness and resource constraints. These results align with behavioural analysis research on digital agro-advisory tools, demonstrating that repeated, personalised engagement drives superior outcomes. While radio achieved the broadest reach (84.5%), its 56.8% message retention constrains its impact on complex behaviours, supporting findings that passive listening generates awareness but insufficient motivation without complementary interactive components.

Conversely, digital platforms demonstrated strong retention (83.2%) and cost-effectiveness ($12.30 per adopter), although persistent connectivity barriers underscore a digital divide (Mwansa et al., 2025; Choruma et al., 2024). Bridging this divide requires infrastructure investment alongside program design, with attention to those facing digital exclusion (Bashiru et al., 2024). Successful hybrid radio-WhatsApp approaches (86.3% adoption) suggest practical pathways forward (Awuah-Frimpong et al., 2024; Balaji & Kavaskar, 2024). The superior performance of integrated multi-channel portfolios (91.8% adoption) supports theoretical predictions that combining radio, WhatsApp, demonstration farms, and extension agents yields synergistic effects that exceed those of siloed interventions.

Trust emerged as a critical mediator, with extension-verified messages yielding 77.9% adoption compared to 42.1% for unverified content ($\chi^2 = 38.67$, $p < 0.001$), emphasising the continued importance of human intermediation despite technological sophistication. While campaign exposure explained 68.7% of the variance in adoption ($R^2 = 0.687$, F = 198.45, $p < 0.001$), outcomes were moderated by resource availability and risk tolerance. Emerging frontiers like AI and remote sensing (Mmbando, 2025) must align with user capabilities, prioritising intuitive design (Diyaol, 2025; Ali et al., 2025). Furthermore, digital educational tools, such as multilingual YouTube animations, can support implementation by providing on-demand instructional content (Reeves et al., 2024).

Ultimately, building sustainable agrifood ecosystems requires communication strategies embedded within broader enabling environments (Aslam et al., 2025; Ginige, 2025). The African Union's transformation strategy appropriately positions communication within comprehensive agricultural frameworks (AU, 2025). Shock-responsive systems that can function during disruptions are essential for long-term resilience (Mulungu et al., 2025). While this quasi-experimental design strengthens causal inference, potential self-selection bias (Fabregas et al., 2024) and geographic specificity to Nigeria (National Bureau of Statistics, 2023) suggest that future research should utilise randomised controlled trials to assess long-term behavioural persistence across farmer typologies (Ofosu-Ampong et al., 2025).

**Conclusion**

Public relations campaigns are essential instruments for accelerating the adoption of climate-smart agriculture (CSA), thereby bridging the awareness-behaviour gap in sub-Saharan Africa. This study confirms that strategic, multi-channel interventions lead to a 161% increase in practice implementation, with integrated approaches achieving 91.8% adoption. These results demonstrate that communication is a fundamental driver of agricultural transformation rather than a secondary support function.

The research shows that effectiveness is tied to design quality and frequency, with 5–8 exposures identified as the threshold for meaningful change. While digital tools offer cost efficiency and scalability, source credibility remains paramount; trusted extension agents must verify digital content to ensure high adoption. Ultimately, a hybrid strategy—combining digital innovation with radio and demonstration farms—is the most effective way to overcome the digital divide and ensure inclusive, sustainable agricultural development.

**Recommendations**

To maximise the adoption of climate-smart agriculture (CSA), stakeholders should implement integrated, multi-channel campaigns that target a frequency of 5–8 farmer contacts per season. While expanding rural broadband is essential to realise digital cost efficiencies, traditional media and demonstration farms must be maintained to ensure inclusive access. To maintain high adoption rates, formal verification mechanisms should be established where extension services endorse digital content, combining technological scale with interpersonal trust.

Furthermore, agencies must coordinate communication frameworks to avoid message fragmentation and utilise data-driven resource allocation based on proven channel effectiveness. Long-term sustainability should be supported by training community-based facilitators and utilising participatory message design. This ensures that content remains culturally relevant, linguistically accessible, and practically grounded in the farmers' specific needs.

## REFERENCES

African Union. (2025, January 13). *The African Union adopts a ten-year strategy and action plan to transform Africa's agri-food systems and ensure food security*. https://au.int/en/pressreleases/20250113/african-union-adopts-ten-year-strategy-and-action-plan-transform-africas-agri

Ahsan, M. N., Islam, M. S., Bin, H. S. F., Rahman, M. A., Khatun, F., Alam, M. I., et al. (2025). Examining farmers' behavioural drivers to adopt floating farming: A study in the wetlands of Southwestern Coastal Bangladesh. *Earth Systems and Environment, 9*(1), 215–239.

Ali, H., Mehmood, H., Tariq, A., Abbas, A., & Farhan, S. (2025). *AI in agriculture for efficient irrigation & pest control*. SSRN. https://doi.org/10.2139/ssrn.5244894

Aslam, M. T., Khan, I., Chattha, M. U., Raza, A., Chattha, M. B., Ali, M., et al. (2025). Perspective chapter: Redesigning agroecological practices for enhanced resource use efficiency in agroecosystems. In *IntechOpen*. https://www.intechopen.com/chapters/1192150

Atta-Aidoo, J., & Antwi-Agyei, P. (2025). Climate-smart agriculture adoption in rural Ghana: Do resource requirements matter? *BMC Environmental Science, 2*(1), Article 4. https://doi.org/10.1186/s44302-025-00019-8

Awuah-Frimpong, R., Tham-Agyekum, E. K., Ankuyi, F., Freeman, C., Annor-Frempong, F., & Andivi Bakang, J.-E. (2024). Household welfare outcomes of access to and use of agricultural radio broadcast by women cocoa farmers in Tepa district, Ghana. *Social Sciences & Humanities Open, 9*, Article 100796. https://doi.org/10.1016/j.ssaho.2023.100796

Balaji, G., & Kavaskar, M. (2024). An analysis of farmer's perception towards WhatsApp as a farm technology dissemination tool. *Journal of Experimental Agriculture International, 46*(9), 330–335. https://doi.org/10.9734/jeai/2024/v46i92829

Bashiru, M., Ouedraogo, M., Ouedraogo, A., & Läderach, P. (2024). Smart farming technologies for sustainable agriculture: A review of the promotion and adoption strategies by smallholders in Sub-Saharan Africa. *Sustainability, 16*(11), 4817. https://doi.org/10.3390/su16114817

Choruma, D. J., Dirwai, T. L., Mutenje, M., Mustafa, M., Chimonyo, V. G. P., Jacobs-Mata, I., Nhamo, L., Mpandeli, S., Naidoo, D., Liphadzi, S., Mabhaudhi, T., & Modi, A. T. (2024). Digitalisation in agriculture: A scoping review of technologies in practice, challenges, and opportunities for smallholder farmers in sub-Saharan Africa. *Journal of Agriculture and Food Research, 18*, Article 101286. https://doi.org/10.1016/j.jafr.2024.101286

Datareportal. (2025). *Global social media statistics*. https://datareportal.com/social-media-users

Deshpande, T., Robertson, J., Tricarico, D., Ishimwe, P. L., Putranto, D., Seifermann, A., et al. (2025). *Voice-first generative AI for impact: Insights from Viamo's Ask Viamo Anything pilot in Zambia*. GSMA. https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/wp-content/uploads/2025/03/GSMA_Viamo_Voice-First-Generative-AI-for-Impact_2025.pdf

Diyaol, M. (2025). Revolutionizing smallholder agriculture with AI: Intelligent sensor networks for real-time climate monitoring and precision farming. *American Journal of Agriculture, 7*(1), 1–11. https://doi.org/10.47672/aja.2592

Fabregas, R., Kremer, M., Lowes, M., On, R., & Zane, G. (2024). Digital information provision and behaviour change: Lessons from six experiments in East Africa. *American Economic Journal: Applied Economics, 17*(1), 527–566. https://doi.org/10.1257/app.20220072

Ginige, A. (2025). From data to harvest: Building sustainable agrifood ecosystems for food security. In P. Pani (Ed.), *Innovative synergies: Bridging technology and sustainability* (pp. 285–304). Routledge.

Ivwighren, H. E., & Umukoro, E. S. (2022). Use of public relations for improving staff-patients relationship in Eku Baptist-Government Hospital, Delta State, Nigeria. *Sahel Analyst: Journal of Management Sciences, 20*(2), 24–41.

Mmbando, G. S. (2025). Harnessing artificial intelligence and remote sensing in climate-smart agriculture: The current strategies needed for enhancing global food security. *Cogent Food & Agriculture, 11*(1), Article 2454354. https://doi.org/10.1080/23311932.2025.2454354

Mpande, B. (2025, June 10). *Building trust, bridging divides: How Zambia's digital champions are paving the way for inclusive farming*. CIMMYT News. https://www.cimmyt.org/news/building-trust-bridging-divides-how-zambias-digital-champions-are-paving-the-way-for-inclusive-farming/

Mulungu, K., Kassie, M., & Tschopp, M. (2025). The role of information and communication technologies-based extension in agriculture: Application, opportunities and challenges. *Information Technology for Development, 31*(2), 197–226. https://doi.org/10.1080/02681102.2025.2456232

Mwansa, G., Ngandu, M. R., & Mkwambi, Z. (2025). Bridging the digital divide: Exploring the challenges and solutions for digital exclusion in rural South Africa. *Discover Global Society, 3*(1), Article 54.