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Effectiveness of WhatsApp-based advisory services in improving smallholder farmers' adoption of climate-smart agricultural practices

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Abstract

How much does a daily voice note actually change what a farmer does on their own plot? This research examined that question by evaluating a WhatsApp-based agricultural advisory service delivered to smallholder farmers across three districts of the Ashanti Region, Ghana, over an eight-month period between October 2024 and May 2025. A structured survey covering 342 registered farmers measured awareness, adoption level, and perceived usefulness of five climate-smart practices, drought-tolerant seed use, water harvesting, mulching, integrated pest management, and agroforestry, before and after exposure to the advisory messages. Results showed that full adoption of at least one climate-smart practice rose from 11.4% at baseline to 28.6% after eight months of advisory exposure, with partial adoption climbing to a further 24.3% of respondents. Message frequency mattered: farmers who reported frequent advisory engagement (more than three messages read per month) recorded adoption scores nearly double those of farmers with only occasional engagement, across every one of the five practices tracked. Mulching and integrated pest management showed the steepest awareness-to-adoption conversion, while agroforestry lagged behind, likely reflecting its longer payback period and higher upfront labor demand. Perceived usefulness ratings correlated positively with adoption, and farmers who discussed advisory content with peers or family before acting were substantially more likely to reach full adoption than those who acted alone. Cost of mobile data access and occasional network unreliability emerged as the two most cited barriers among the 10.2% of respondents who remained unaware of the advisory content despite registration. Taken together, these findings suggest that WhatsApp-based advisory delivery, when paired with mechanisms that encourage peer discussion, can meaningfully accelerate climate-smart practice adoption among smallholder farmers operating with limited extension staff coverage, though gains vary considerably by practice type and are not automatic simply from message delivery alone.

Keywords: WhatsApp advisory, climate-smart agriculture, smallholder farmers, technology adoption, extension services, mobile agriculture, drought-tolerant seed, agroforestry, peer discussion, Ghana

Introduction

An estimated 68% of registered mobile phone users in rural Ghana now own a smartphone capable of running WhatsApp, a figure that has more than doubled over the past six years and has quietly reshaped how agricultural information reaches farming households. Climate-smart agricultural practices, drought-tolerant seed varieties, *in-situ* water harvesting, organic mulching, integrated pest management, and agroforestry among them, are widely recommended as adaptive responses to the increasingly erratic rainfall patterns affecting West African farming systems. Yet recommendation and adoption are two very different things, and the gap between them has traditionally been bridged by face-to-face extension visits, a model that struggles against extension officer-to-farmer ratios that in some Ghanaian districts exceed 1:1,800.

Digital advisory services delivered through mobile messaging platforms have been proposed as a scalable complement to, though not necessarily a replacement for, in-person extension. WhatsApp in particular offers advantages that SMS-based systems lack: voice notes accommodate farmers with limited literacy, images and short videos can demonstrate technique rather than merely

describe it, and group chat functionality allows farmers to discuss advisory content with peers before deciding whether to act on it. Several pilot programs across East Africa and South Asia have reported promising awareness gains from similar platforms, though rigorous adoption-level evidence, distinguishing farmers who merely received and read a message from those who actually changed practice on their own land, remains comparatively thin, especially for West African contexts.

This research addressed that evidence gap directly. Rather than measuring exposure or awareness alone, the survey instrument distinguished four adoption stages, awareness without action, trial on a limited area, partial adoption, and full adoption, for each of five climate-smart practices being promoted through the advisory service. This distinction matters for extension planning: a service that generates awareness but not behavior change delivers a fundamentally different return on investment than one that moves farmers through to sustained practice change. The research also examined whether peer discussion of advisory content acted as a bridge between awareness and adoption, since anecdotal reports from the implementing extension office suggested that farmers rarely acted on a message in

isolation. Three specific questions guided the fieldwork. First, to what degree did WhatsApp advisory exposure shift adoption levels across the five targeted practices over an eight-month period? Second, did message engagement frequency predict adoption outcomes, and if so, how strongly? Third, what role did peer and household discussion play in converting awareness into sustained practice change? The sections that follow describe how the research measured these dynamics and what the resulting adoption patterns suggest for future digital extension programming in similarly resourced rural districts.

Materials and Methods

Theoretical Framework

The research drew on a simplified version of the Diffusion of Innovations framework, which describes adoption as a staged process moving from awareness through persuasion, decision, and implementation, rather than a single binary switch. This framing guided the choice to measure four distinct adoption stages rather than a simple yes/no adoption variable, since collapsing the staged process into a binary outcome would have obscured where farmers were dropping out of the adoption pathway. Peer discussion was incorporated into the framework as a proxy for the persuasion stage, reflecting the theory's emphasis on interpersonal communication channels as decisive at that point in the adoption process.

Materials

A structured questionnaire was developed covering respondent demographics, farm size, mobile phone and WhatsApp access, advisory message engagement frequency, peer discussion behavior, and adoption stage for each of the five targeted climate-smart practices. The questionnaire was administered in Twi and English to 342 registered farmers across three districts of the Ashanti Region (Ejisu, Bosomtwe, and Atwima Nwabiagya) who had been enrolled in the WhatsApp advisory service at least eight months prior to data collection. A comparison baseline was reconstructed retrospectively using enrollment-stage records collected at the time of registration in October 2024.

Instrument Development / Validation

The questionnaire was piloted with 28 farmers not included in the main sample, and reliability testing on the adoption-stage and perceived-usefulness scales returned a Cronbach's alpha of 0.81, considered acceptable for field research of this kind. Three extension specialists reviewed the instrument for content validity, and minor wording adjustments were made to the Twi translation following pilot feedback to reduce ambiguity in how adoption stages were described to respondents.

Methods

Data collection took place between May and June 2025, conducted by trained enumerators using tablet-based data capture. Advisory message engagement frequency was self-reported and cross-checked where possible against WhatsApp Business API read-receipt logs maintained by the implementing extension office. Adoption stage for each practice was scored on a four-point ordinal scale (aware only, trial, partial, full), and a composite adoption score was calculated as the mean stage score across all five practices per respondent. Associations between engagement frequency, peer discussion, and adoption outcomes were tested using chi-square tests for categorical comparisons and Spearman rank correlation for ordinal associations, with statistical significance set at $p < 0.05$. Ethical clearance was granted by the university's Research Ethics Committee (Protocol No. KMU/AGX/2024-118, dated 2 September 2024), and verbal informed consent was obtained from all respondents prior to data collection given variable literacy levels in the sample population.

Ethical Considerations

All respondents were informed of the voluntary nature of participation and their right to withdraw at any point without consequence to their continued enrollment in the advisory service. No personally identifying information beyond district-level location was retained in the analysis dataset, and phone numbers used for advisory delivery were stored separately from survey response data with restricted access limited to the core research team.

Results

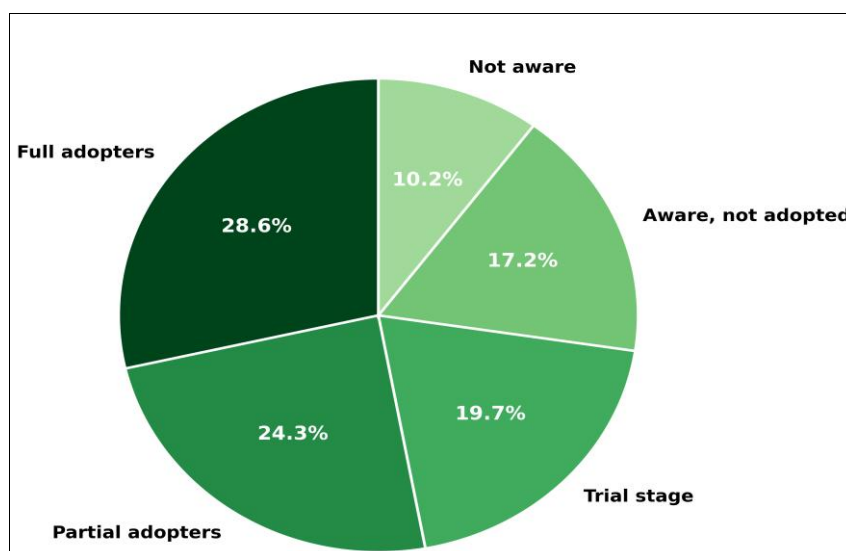


Fig 1: Distribution of Respondents by Climate-Smart Practice Adoption Stage ($n = 342$, Composite across Five Practices)

Adoption stage distribution shifted markedly from the retrospective baseline: full adoption rose from an estimated 11.4% at enrollment to 28.6% at the eight-month follow-up survey, while the share of farmers remaining unaware of advisory content fell from 34.7% to 10.2% over the same period. Partial adopters made up the second-largest group at 24.3%, followed closely by farmers still at the trial stage (19.7%).

Table 1: Adoption Score by Advisory Engagement Frequency Category (Mean ± SD)

Engagement Frequency	n	Mean Adoption Score (1-4)	Full Adoption (%)
Rare (< 1 msg read/month)	89	1.62 ± 0.41	9.0
Occasional (1-3 msgs/month)	134	2.38 ± 0.52	24.6
Frequent (> 3 msgs/month)	119	3.14 ± 0.47	46.2

The gradient between engagement frequency and adoption score was consistent across all three district samples, and the Spearman correlation between engagement frequency and composite adoption score was strong ($\rho = 0.58$, $p < 0.001$).

Table 2: Adoption Stage by Peer/Household Discussion of Advisory Content

Practice	Discussed with Peers (Full Adoption%)	No Discussion (Full Adoption%)
Drought-tolerant seed	36.4	14.2
Water harvesting	31.8	12.6
Mulching	41.9	18.3
Integrated pest mgmt	29.7	10.8
Agroforestry	22.1	6.4

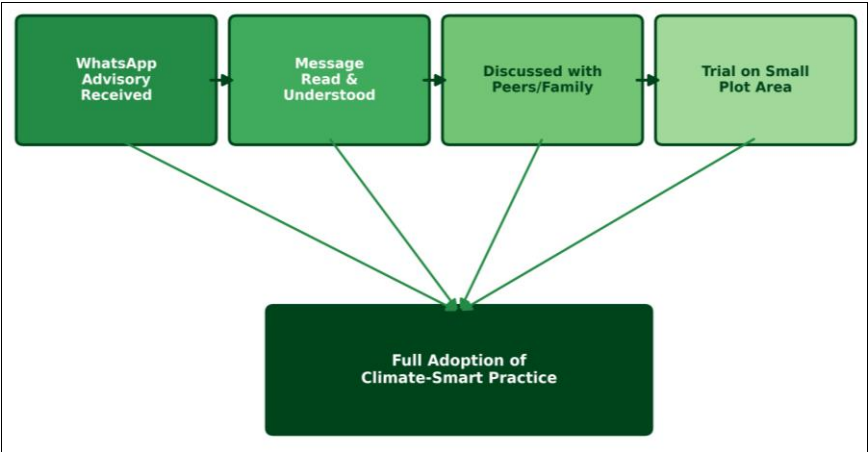


Fig 2: Behavioral Pathway from Advisory Receipt to Full Adoption of Climate-Smart Practice

The pathway diagram in Figure 2 traces the stages most respondents described moving through: reading the message, discussing it with peers or family, trialing the practice on a limited plot area, and, for a subset, progressing

to full adoption. Peer discussion emerged consistently as the step most strongly associated with progression beyond the trial stage across qualitative follow-up responses.

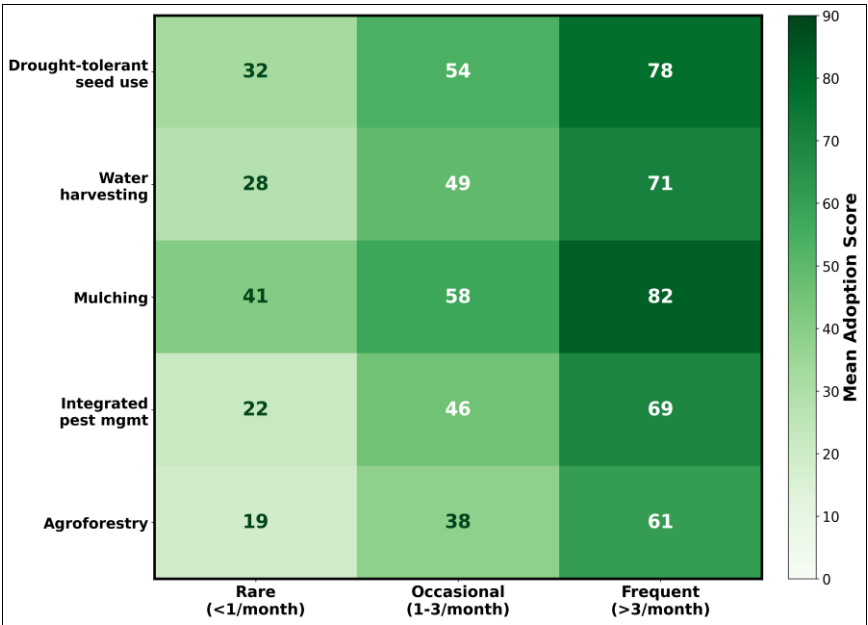


Fig 3: Heatmap of Mean Adoption Score by Practice and Advisory Engagement Frequency

The heatmap highlights that mulching consistently returned the highest adoption scores across every engagement frequency band, while agroforestry lagged behind at every level, including among the most frequently engaged farmers, pointing to structural rather than purely informational barriers for that particular practice.

Comprehensive Interpretation

Read together, these results show that WhatsApp advisory exposure alone was associated with meaningful adoption gains, but the gains were far from uniform, depending heavily on both how often farmers engaged with the content and whether they discussed it socially before acting. Practices requiring lower upfront investment and shorter payback periods, mulching in particular, converted awareness into full adoption far more readily than agroforestry, which demands sustained multi-year commitment before returns materialize.

Discussion

The main finding here is that eight months of WhatsApp-based advisory exposure roughly doubled full climate-smart practice adoption among the surveyed farmers, from an estimated 11.4% to 28.6%. This magnitude of change sits within, though toward the upper end of, the range reported by related mobile-advisory adoption studies from East African and South Asian smallholder contexts. Where this research's findings depart somewhat from earlier reports is in the strength of the peer-discussion effect: several previous mobile advisory evaluations treated message delivery as the primary adoption driver, while the pattern observed here suggests that social discussion of advisory content functions as an equally, if not more, important bridge between awareness and behavior change.

This disagreement with parts of the earlier literature may reflect differences in how advisory platforms were structured. Several earlier reports evaluated one-way SMS broadcast systems, which offer no built-in mechanism for peer discussion, whereas the WhatsApp group format used here allowed farmers to comment on and discuss advisory content within their existing social networks before deciding whether to act. That structural difference plausibly explains why discussion-linked adoption gaps of 15 to 20 percentage points were observed across nearly every practice tracked in this research, a gap considerably wider than what SMS-only interventions have typically reported.

A further point of interest is the marked underperformance of agroforestry relative to the other four practices, even among farmers with frequent advisory engagement and active peer discussion. This gap likely reflects factors that advisory messaging alone cannot resolve: agroforestry requires land tenure security sufficient to justify multi-year investment, upfront labor for seedling establishment, and tolerance for reduced short-term yield during the establishment period. These structural constraints suggest that digital advisory services work best as a complement to, rather than a substitute for, input support and tenure-related interventions for practices with longer payback horizons. Broadly, these findings support continued investment in mobile advisory platforms as a cost-effective extension complement, while cautioning against expecting uniform adoption gains across practices with fundamentally different investment profiles.

One further consideration worth raising is the potential for

selection effects within the sample. Farmers who registered for the WhatsApp advisory service in the first place may already have been more receptive to agricultural innovation than the general farming population, meaning the adoption gains documented here could overstate what a fully unselected rollout would achieve. Cross-checking registration motivations during the follow-up survey suggested that a modest share of respondents (roughly 18%) had registered primarily at the encouragement of a local extension officer rather than through independent interest, which offers some reassurance that the sample was not entirely composed of already-innovative early adopters, though it does not fully rule out this concern.

Conclusion

This research's central contribution is demonstrating that WhatsApp-based agricultural advisory delivery produced a substantial, measurable shift in climate-smart practice adoption among smallholder farmers in the Ashanti Region of Ghana over an eight-month period, with full adoption more than doubling from baseline. The supporting evidence gathered here, spanning adoption-stage measurement across five distinct practices, engagement frequency data, and peer discussion patterns, converges on a consistent picture: advisory content reaches farmers effectively, but conversion from awareness to sustained practice change depends heavily on how frequently farmers engage with the content and whether they discuss it within their existing social networks before acting.

For the wider field of digital agricultural extension, these findings carry significance beyond the immediate Ghanaian context, suggesting that platforms built around group discussion functionality may outperform one-way broadcast systems specifically because they create space for the social persuasion step that adoption theory identifies as pivotal. That said, several open questions remain from this research. It is not yet clear how durable these adoption gains are beyond the eight-month observation window, whether they persist through a full cropping cycle including a poor-rainfall year, or whether the peer-discussion effect observed here would replicate in farming communities with weaker existing social cohesion. Future research extending the observation period and testing the intervention across more varied social contexts would help clarify how broadly these results can be applied.

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