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Use of Personalized Reminders, Social Proof and Audio Guidance to Improve Digital-Payment Acceptance Among Rural Market Women In Ebonyi State, Nigeria.

Ogbu, N. Henry
Department of Computer Science
Ebonyi State University
Abakaliki, Ebonyi State, Nigeria
E-mail: ogbu.henry@ebsu.edu.ng
Phone: +2348037954462

ABSTRACT

Although digital-payment services are expanding in Nigeria, many women in rural and periodic markets still rely on cash. Common reasons include difficulty remembering transaction steps, uncertainty about the experiences of other traders, text-heavy interfaces and fear of fraud. This paper introduces MarketPay-Assist, a persuasive-technology framework that combines personalised market-day reminders, privacy-protected social proof and Igbo or English audio guidance to support safe and verifiable payments among rural market women in Ebonyi State. The system can operate through Android, SMS, IVR and USSD, using a consent-based profile, controlled message frequency and a calibrated random-forest model. Acceptance likelihood and support needs are estimated from trust, self-efficacy, previous use, literacy support, device access, network quality and interaction history. Because labelled field observations were unavailable, the design was examined through emulated benchmarks containing 480 balanced profiles in five intervention groups and 1,200 constructed profiles for model evaluation. Acceptance was 70.8% for the combined intervention, compared with 35.4% for basic information and 57.3% for audio guidance alone. Differences between the groups were significant ($\chi^2 = 27.32$, df = 4, $p < 0.001$). On the held-out test set, the selected random forest achieved 86.7% accuracy, 80.6% macro-F1 and an AUC of 0.838. Safeguards include no-PIN/no-OTP guidance, receipt checks, anonymous social-proof thresholds, opt-out options, human support and phased field validation. The results are engineering benchmarks rather than evidence of completed deployment, but they demonstrate that timely, locally trusted and literacy-sensitive assistance can be incorporated into a workable payment-support system.

Keywords: Digital Payments; Persuasive Technology; Rrural Market Women; Personalised Reminders; Audio Guidance; Ebonyi State

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1. INTRODUCTION

Digital payments can shorten transaction time, reduce cash handling and create records that traders can trace, but simply making the services available does not guarantee use. Global Findex evidence shows that women still use digital payments less often than men, and Nigeria continues to record a clear gender gap [1].

EFInA also reports substantial growth in digital financial services among Nigerian adults, although national totals conceal differences linked to gender, location, education and livelihood [2]. For a woman trading in a rural market, opening an account or gaining access to a transfer channel is only the beginning. She must trust the service, understand the procedure, have a suitable device and reliable connection, and see enough everyday value to move away from the familiar cash practices that shape face-to-face trading.

The challenge is evident in periodic markets, where trading takes place in a noisy, rushed and social setting. Some traders rely on a relative's phone, use basic handsets, find written instructions difficult or leave an unfamiliar screen when customers are waiting. A failed transfer can quickly lead to disagreement about whether the buyer was debited, while stories of fraud travel rapidly through trader networks. Gender gaps in smartphone ownership and mobile-internet use across low- and middle-income countries also make it unrealistic to assume every woman can depend on a data-intensive application [3]. Nigeria's Payments System Vision 2025 seeks broader, safer and more resilient electronic payments [4], but inclusion depends on designing interfaces around the realities of the people expected to use them.

Persuasive technology is appropriate only when it helps women make informed decisions without pressure, manipulation or deception. A personalised reminder can arrive before market or after unfinished practice, reducing the chance that an intended action is forgotten. Verified social proof can show that other cooperative members completed payments while keeping their identities private. Igbo or English audio prompts can be replayed and can confirm the beneficiary's name and payment amount before the final step. Each feature addresses a different difficulty, and their combined use may be more effective because remembering the task, trusting the process and completing the transaction are separate challenges.

MarketPay-Assist is a multimodal support system for rural market women in weak-connectivity areas of Ebonyi State. It neither holds funds nor replaces licensed providers. In practice, it works beside bank transfers, mobile-money services, agents and merchant-payment channels, provides consent-based support, and records whether an attempt was completed, abandoned or referred for help. A calibrated random-forest model estimates acceptance likelihood and recommends the most suitable available assistance. Independent safeguards control reminder frequency, prevent the display of unreliable social-proof messages and ensure that audio guidance never requests confidential payment credentials.

The study has four objectives: identify rural women's behavioural and interface needs; design an architecture combining personalised reminders, verified social proof and audio guidance; benchmark a machine-learning model for acceptance and support selection; and outline an ethical route to field validation. The system has not been deployed in communities. Before any wider community-based field implementation begins, the emulated assessment checks internal consistency, compares alternative options and establishes measurable expectations for a later pilot study.

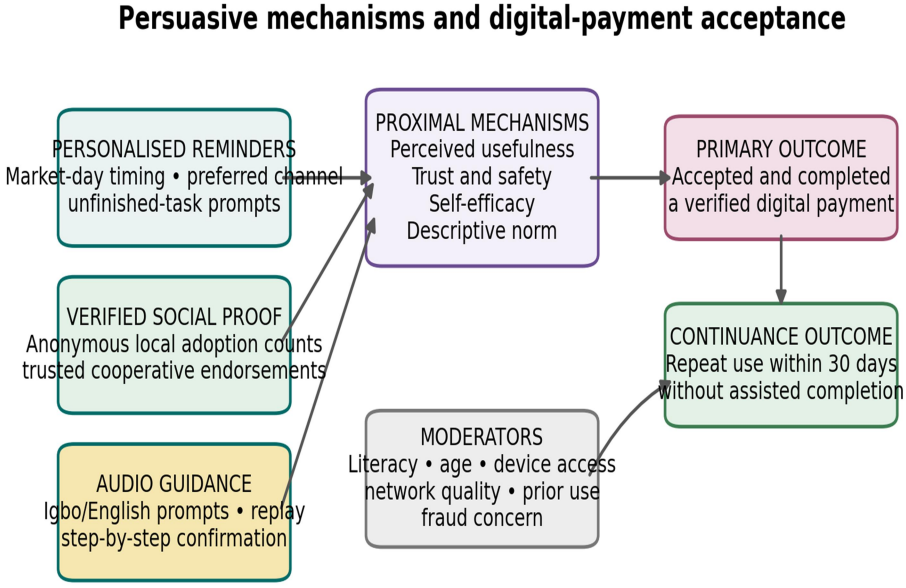

Figure 1: Conceptual Relationship Between Persuasive Supports, Proximal Mechanisms, Moderators and Digital-Payment Outcomes.

2. Related Work and Research Gap

2.1 Digital-Payment Acceptance Among Rural Women

Access to digital finance does not, by itself, become routine use in practice and over time. Whether an account is used regularly depends on location, education, earlier experience, household decision-making, service charges, trust and reliability. Nigerian evidence points to an urban-rural divide in women's mobile-money participation, with differences in access and socioeconomic circumstances explaining part of the gap [5]. Research on women's adoption of FinTech likewise indicates that financial literacy, perceived usefulness, institutional support and continued attachment to cash may either encourage or limit uptake [6].

Trust is important because users cannot see the infrastructure that processes a payment. They judge it through interface cues, provider reputation, agent conduct, complaint resolution and the experiences reported by people they know. Evidence from women who use mobile payments suggests that perceived financial and performance risks reduce trust and satisfaction, while self-confidence supports continued use [7]. For a market trader, the problem becomes immediate when a customer says that a transfer has been made but no credit alert arrives. Support must therefore help users distinguish genuine receipts from screenshots, follow a secure verification procedure and reach a complaint channel when settlement remains uncertain.

2.2 Personalised Reminders and Timely Action

Messages sent at the wrong time are often ignored. Personalisation matters when it reflects a trader's market timetable, language preference, recent practice history and chosen communication channel. The reminder is not a promotional message. It is a short, practical cue that might ask the user to check her receiving account before going to market or to complete a safe-payment exercise that she previously stopped. Timing and relevance are treated as design decisions, while firm limits on frequency protect attention and preserve voluntary participation. Reminders can reduce the effort of remembering payment steps and can help a trader prepare for a transaction. They become intrusive when they arrive during worship, household duties or bargaining. MarketPay-Assist therefore uses contact periods selected during enrolment, offers SMS or voice, and pauses reminders after two unanswered prompts. A participant may easily opt out by text, keypad selection or through an authorized market ambassador.

2.3 Social Proof, Trust And Network Effects

Social influence can shape interest in financial technology, although its effect depends on the setting and on whether users trust the people being referenced [8]. Studies of payment adoption in emerging economies also connect use with social attitudes, perceived control, ease of use and financial knowledge [9]. A general statement that millions of people make transfers may mean little to a rural trader. A verified local message, such as '18 members of your cooperative completed at least one payment this week,' is more credible because it concerns people facing similar language, network and market conditions in daily commercial practice. Used poorly, social proof may exaggerate popularity or pressure users to copy others. MarketPay-Assist therefore displays only verified and aggregated events, and withholds counts until at least ten people are represented. Names, telephone numbers and payment amounts are excluded. Comments from association leaders are labelled as endorsements rather than presented as evidence of group behaviour. This distinction follows research showing that persuasive systems should explain how influence is being used and should leave people free to make informed choices [10].

2.4 Audio Guidance and Low-Literacy Interaction

Digital-payment screens contain dense wording, unfamiliar icons, technical error messages and confirmation notices that disappear. Accessibility research highlights difficulties involving memory, attention, comprehension and recovery after mistakes [11]. Guidance for low-literacy design recommends plain language, familiar visual cues, step-by-step disclosure and feedback that concentrates on the action instead of long menus [12]. Audio provides a way through the process, particularly when each instruction is brief, repeatable and closely linked to the current screen or USSD step.

MarketPay-Assist uses approved Igbo and English recordings rather than unrestricted speech generation. The clips remain fixed and reviewable. Each clip explains one action, shows what should appear and warns before an irreversible step. Voice-interface research supports brevity, clear turns, recovery and confirmation of key details [13]. The system repeats the beneficiary's name and amount, never reads out a PIN or OTP, and securely directs the trader to a person after two unsuccessful attempts.

Table 1. Evidence Relevant to The Proposed Persuasive-Payment System

Source	Context	Method	Transferable finding	Remaining gap
World Bank [1]	Global financial inclusion	Demand-side survey	Digital-payment gender gaps persist; receiving a digital payment can deepen use	Does not test persuasive support in Nigerian markets
EFInA [2]	Nigeria financial services	National survey	Digital-finance use has risen, but demographic and livelihood gaps remain	No intervention-level design
Adeleke [5]	Nigerian women	Secondary survey analysis	Urban–rural differences in mobile-money use require targeted inclusion	No interface or behavioural experiment
Igamo et al. [6]	Women and FinTech	Extended TAM	Literacy, support, usefulness and status-quo value shape adoption	Not tailored to rural Nigerian market routines
Yadav et al. [7]	Female mobile-payment users	Survey/SEM	Risk affects trust; self-efficacy supports continuance	Focuses existing users rather than first acceptance
Hoque et al. [8]	FinTech gender gap	Interview survey	Compatibility, experience and social influences matter	Social proof is not implemented as a system feature
Ly and Ly [9]	Emerging-economy payments	TAM/TPB with PLS-SEM	Ease, usefulness, literacy and behavioural control predict adoption	No multimodal persuasive prototype
Dai et al. [11]	Digital-payment accessibility	Literature review	Cognitive accessibility and error recovery require explicit design	Not specific to rural women
Srivastava et al. [12]	Low-literate smartphone users	Design framework	Actionable low-literacy UI guidelines improve inclusion	Does not combine audio with payment verification
Murad et al. [13]	Voice interfaces	Meta-analysis	Short, repairable and confirmatory voice interactions are preferred	No payment-domain field model

2.5 Research Gap and Contribution

Research explains factors shaping digital-payment intention and offers principles for accessible interfaces. Much less attention has been given to a system that links a rural trader's schedule and assistance needs to three limited persuasive features, records whether the task was completed and applies safeguards appropriate to payments. Studies of reminders often stop once a message is delivered, social-influence research measures attitudes without showing verified local behaviour, and voice assistance is frequently examined outside payment settings. This work contributes a modular architecture, a model for selecting support, intervention rules, diagrams, an emulated comparison and a field-acceptance protocol. Refusal and withdrawal are treated as valid outcomes. Persuasion is considered successful only when a participant makes an informed and verifiable payment decision without sharing credentials or becoming identifiable through reports about her social group.

3. METHODOLOGY

3.1 Study area and proposed market clusters

Ebonyi State has an agrarian economy, and its rural and peri-rural markets bring together farmers, transporters, processors and small retailers. The Ebonyi State Government identifies Eke Imoha in Onueke as one of the oldest and largest markets in the state and as a centre in the Ezza economy [14]. Its periodic market cycle, cooperative activity and diverse trading population make it a reference location for a pilot. Ezzamgbo, Iboko, Nkalagu, Ishiagu and Onicha are also proposed as clusters because they represent differences in road access, network reliability, commodities and settlement patterns.

These are proposed clusters, not evidence of completed recruitment, network testing or community surveys. Final sites require agreement with market unions, local authorities, licensed payment companies and women's organizations. Before a pilot begins, field assessment should document market days, language preferences, agent availability, network variation, reports of fraud, phone ownership and safe locations where participants can receive assisted practice.

Table 2. Proposed Pilot Clusters and Field-Confirmation Requirements

Cluster	Indicative setting	Primary design concern	Field confirmation required
Eke Imoha/Onueke	Large periodic market and cooperative activity	High transaction volume; mixed device access	Recruitment space, network mapping, union consent
Ezzamgbo	Northern transport and trading cluster	Intermittent connectivity; agent dependence	Coverage by operator and payment-provider presence
Iboko	Agricultural market cluster	Shared devices and cash-dominant exchange	Commodity groups, literacy support and travel pattern
Nkalagu	Road-linked rural commerce	Network hand-off and settlement delay	Safe help point and complaint channel
Ishiagu	Mining/agricultural corridor	Mixed-value transactions and fraud concern	Provider risk controls and transaction limits
Onicha	Southern rural market cluster	Distance to service points	Agent liquidity and human-support availability

3.2 Research Design and Prototype Scope

The study follows a design-and-evaluation approach. Evidence from financial inclusion, technology acceptance and accessibility research is converted into intervention rules and software requirements. Each participant-week record captures eligibility, support exposure, practice or payment outcome, confidence, context and any error flag. The primary outcome is acceptance, defined as completing a payment or receipt-verification exercise and confirming the result without exposing protected information. Expressing an intention to use the service is not counted as acceptance. Since no approved field data were available, two emulated datasets were prepared. The intervention dataset contains 480 balanced profiles, 96 per arm: basic information, personalised reminders, verified social proof, audio guidance and the combined package. Another 1,200 constructed profiles benchmark the models. The values overlap across outcome categories, contain missing observations and remain within plausible ranges reported by earlier studies, but no profile represents an actual participant. The second dataset was divided using an 80/20 stratified split for classifier testing.

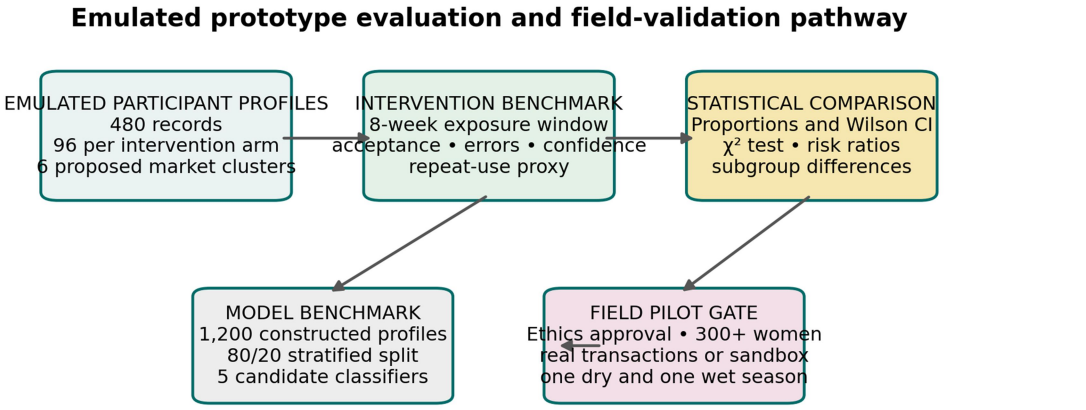

Figure 2. Emulated Evaluation Design and The Required Transition to Field Validation.

Table 3: Prototype Data Dictionary

Variable	Symbol/unit	Measurement or derivation	Operational role
Accepted payment	Y (0/1)	Verified completion and correct receipt check	Primary behavioural outcome
Repeat use	R (0/1)	Second independent completion within 30 days	Continuance proxy
Trust	T (1–5)	Confidence in provider, process and dispute resolution	Risk and credibility
Self-efficacy	E (1–5)	Confidence in completing steps without unsafe help	Capability
Literacy support need	L (0–1)	Derived from reading comfort and observed task difficulty	Audio/UI adaptation
Prior use	P (0/1)	Any completed digital payment in previous six months	Experience
Network quality	Q (0–1)	Recent success, latency and availability index	Feasibility context
Fraud concern	F (0–1)	Normalised concern about loss, screenshots and impersonation	Safety barrier
Reminder response	M (0–1)	Opened/listened and acted within defined window	Message relevance
Social-proof engagement	S (0–1)	Viewed/heard eligible verified local evidence	Descriptive norm
Audio completion	A (0–1)	Completed/replayed guided steps	Low-literacy support
Critical error	C (0/1)	PIN/OTP sharing attempt, wrong beneficiary or false receipt acceptance	Safety outcome

Table 4. Emulated Intervention Arms

Arm	N	Intervention content	Implementation constraint
Basic information	96	One safety briefing and neutral payment instructions	Comparator; no repeated persuasive support
Personalised reminders	96	Market-day/time-tailored SMS or voice cue; unfinished-task prompt	Maximum two prompts per market day
Verified social proof	96	Anonymous cooperative-level count and labelled endorsement	Minimum group size 10; no amounts or identities
Audio guidance	96	Igbo/English step-by-step clips with replay and confirmation	No PIN/OTP; stop after two failed cycles
Combined intervention	96	Eligible reminder, verified social proof and adaptive audio	Least-burdensome sequence; user can disable any module

3.3 Outcome Measures and Statistical Analysis

Proportions summarize acceptance, completion, critical errors and repeat use. Wilson 95% confidence intervals were chosen because they perform well with moderate samples. Pearson's chi-square test compares acceptance across the five groups. For the combined package, results are reported as a percentage-point increase and a risk ratio relative to basic information. Subgroup findings remain descriptive because the emulated sample lacked power for formal interaction testing across the observed groups.

Models are evaluated using accuracy, macro-precision, macro-recall, macro-F1 and receiver-operating-characteristic area (AUC). Macro-F1 is emphasized because overall accuracy can hide weak prediction for users needing support. The confusion matrix is examined for false acceptances, since such errors may withhold assistance from uncertain users. Final selection also considers inference speed and whether explanations are understandable to field staff rather than relying on a single headline accuracy figure.

4. SYSTEM DESIGN AND IMPLEMENTATION

4.1 Personalised Reminder Engine

The reminder service stores each participant's market timetable and one or two contact periods. Activity determines whether the next message is a readiness cue, a practice prompt or a follow-up. A readiness message may ask her to check her receiving account and charge her phone before travelling. Practice prompts appear when enrolment is complete but the demonstration has not been finished. A follow-up is considered after an abandoned attempt only when no security concern or unsafe action occurred.

4.2 Verified Social-Proof Module

A transaction can be included in social proof only after its receipt has been verified and time has passed for a disputed record to be corrected. Eligible events are grouped by market cluster and, where consent exists, by cooperative. A number is displayed only when it represents at least ten participants and is still recent. The interface may state the count or proportion of traders who completed a payment, but it does not reveal identities or suggest that all members should make the same choice.

Every social-proof message states the observation period, verification method, sample size and update. If the privacy threshold is not met, the system shows neutral educational information instead. This prevents artificial popularity and reduces the possibility that a small-group report could expose the behaviour of one participant.

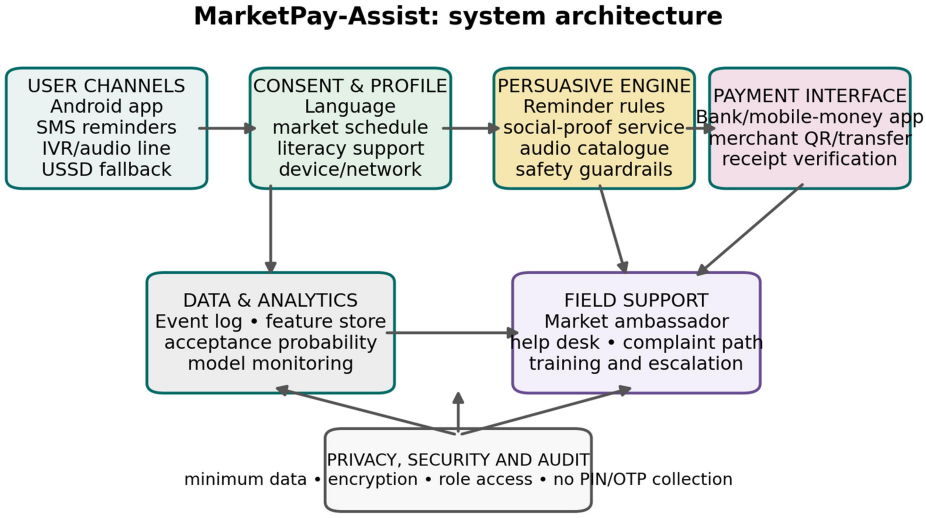

Figure 3. End-to-end Architecture of Marketpay-Assist and Its Relationship With Regulated Payment Interfaces.

4.3 Audio-Guidance Module

Igbo and English scripts are recorded by local speakers, locally reviewed by payment-safety personnel and tested for familiar wording. Each clip lasts between six and fifteen seconds. The first recording introduces the task, the middle clips describe one screen or USSD action at a time, and the final message asks the user to confirm the beneficiary, amount and genuine receipt.

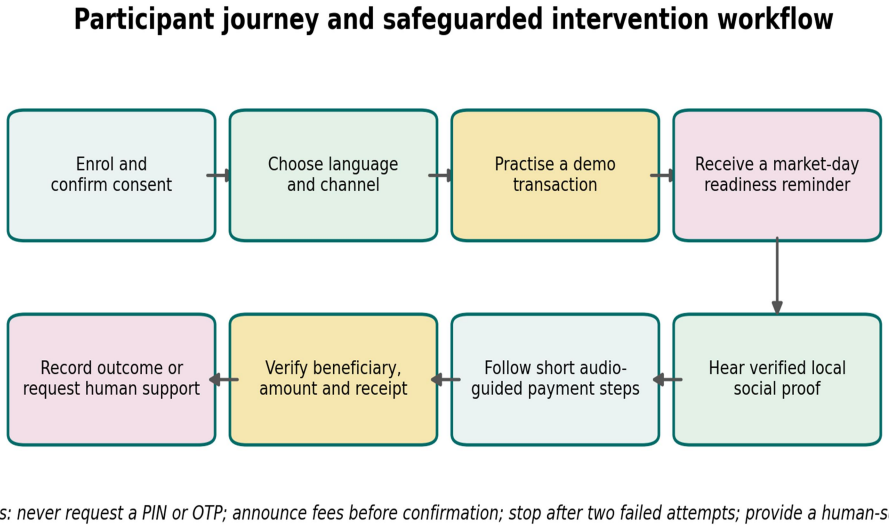

Figure 4. Participant Journey From Enrolment to Verified Completion with Explicit Safety Gates.

Replay remains available throughout; on IVR, one key repeats the instruction and another requests assistance. Guidance is separated from the entry of private information. One prompt may state, 'Enter your PIN yourself now; never say it aloud or show anyone.' Keypad entries are not recorded. When the application cannot verify the current screen, the guidance stops rather than guessing what she sees. Two unsuccessful cycles open a support case, and further persuasive messages remain paused until staff have examined the problem.

4.4 Machine-Learning Architecture and Intervention Selection

Prediction uses static, contextual and interaction features. Static information covers age category, device type, language and previous payment use. Context variables describe market day, connectivity and available payment routes. Interaction features capture reminder responses, audio replay, observed mistakes, social-proof exposure and changes in confidence. Before support is chosen for each participant, missing values remain because absent responses may signal difficulty with a channel. Five models are tested: logistic regression, decision tree, random forest, gradient boosting and support vector machine. The 250-tree random forest uses depth limits, class weighting and probability calibration post-training. Gradient boosting records higher accuracy, but the random forest is chosen for stronger macro-F1 and more balanced recall in the emulated test. It also offers importance measures and explanations that field staff can review and understand.

Table 5. Selected model and training configuration

Component	Configuration	Rationale
Input window	Current profile plus previous four intervention events	Captures recent response without long surveillance history
Classifier	Random forest, 250 trees, class weighted	Handles nonlinear interactions and mixed features
Validation	80/20 stratified split; five-fold tuning within training set	Separates tuning from final benchmark
Calibration	Isotonic calibration on held-out validation fold	Makes probability bands more interpretable
Decision threshold	0.50 for benchmark; configurable by safety cost	Supports emphasis on false-assistance or missed-support cost
Explanation	Permutation importance and top local contributors	Allows review by field supervisor
Drift trigger	>8-point macro-F1 fall or >10-point subgroup gap	Requires review before continued automation
Retraining	After ≥500 consented field outcomes and quarterly review	Prevents routine retraining on small, unstable samples

4.6 Software Stack, Security and Resilience

Table 6. Proposed software components and interfaces

Layer	Suggested technology	Responsibility
Mobile/field client	Android/Flutter progressive interface	Profile, reminders, audio, practice and consent
SMS/IVR/USSD gateway	Licensed communications provider	Low-data reminders and voice fallback
API service	Python/FastAPI or equivalent	Authentication, rules, event validation and queues
Database	PostgreSQL with encrypted fields	Pseudonymous profiles, schedules, outcomes and audit history
Model service	Python/scikit-learn	Feature processing, calibration and explanations
Content service	Versioned Igbo/English audio catalogue	Approved scripts, checksum and playback logs
Dashboard	Web interface with role access	Market-level monitoring, referrals and quality review
Monitoring	Metrics and alerting service	Latency, delivery, drift, opt-out and security incidents

Each device and staff account has an identity. Communications are encrypted, administrator access requires multi-factor authentication, and role separation keeps market ambassadors from viewing model-development records. Audit logs show who changed a schedule, repeated an assisted demonstration or closed a referral. Participants' voices are not recorded. The platform stores only a protected event indicating that an approved audio clip was played or that its sequence was completed. Continuity uses locally cached messages, unique idempotent event codes and fallback channels. Network failure never creates a false record of acceptance. If the service is unavailable, safety instructions can still be played and practice outcomes can be stored on the device. Once connectivity returns, synchronization verifies sequence and removes duplicates before any aggregated social-proof total is updated.

5. RESULTS OF THE EMULATED BENCHMARK

5.1 Participant-Profile Characteristics

The 480 constructed profiles were shared equally among the five intervention groups. They represent different assistance needs rather than describing Ebonyi women as a population in detail. Overall, mean age was 43.8 years; 42.5% had a high need for literacy support; 56.9% owned a smartphone; 34.8% had completed a digital payment within the previous six months; 63.1% belonged to a cooperative or traders' association; 67.7% had high concern about fraud; and 58.5% experienced weak or intermittent connectivity. Baseline trust was 2.6 on a five-point scale. These constructed figures must not be treated as population estimates.

Table 7. Overall Characteristics of the Emulated Participant Profiles

Characteristic	Emulated value
Age, years	43.8 ± 11.6
High literacy-support need	42.5%
Personal smartphone access	56.9%
Prior digital-payment completion	34.8%
Cooperative/trader-association membership	63.1%
High fraud concern	67.7%
Intermittent/weak network	58.5%
Baseline trust score (1–5)	2.6 ± 0.9
Baseline self-efficacy (1–5)	2.5 ± 1.0

5.2 Intervention outcomes

Table 8. Emulated intervention outcomes (n = 96 per arm)

Arm	Accepted payment % (95% CI)	Task completion %	Repeat use among adopters %	Critical error %	Post-confidence /5
Basic information	35.4 (26.6–45.4)	42.7	38.2	27.1	2.84
Personalised reminders	45.8 (36.2–55.8)	55.2	56.8	18.8	3.23
Verified social proof	47.9 (38.2–57.8)	59.4	65.2	15.6	3.33
Audio guidance	57.3 (47.3–66.7)	69.8	50.9	8.3	3.58
Combined intervention	70.8 (61.1–79.0)	83.3	79.4	4.2	3.68

Acceptance varied significantly among the five groups ($\chi^2 = 27.32$, df = 4, $p < 0.001$). Compared with basic information, the combined package increased acceptance by 35.4 percentage points and yielded a risk ratio of 2.00.

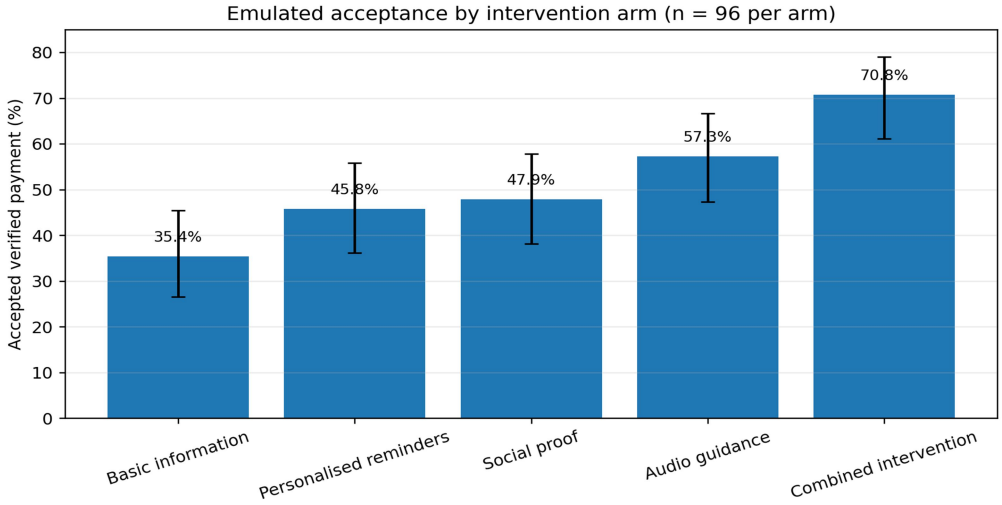

Figure 5: Accepted Verified Payment By Intervention Arm With Wilson 95% Confidence Intervals.

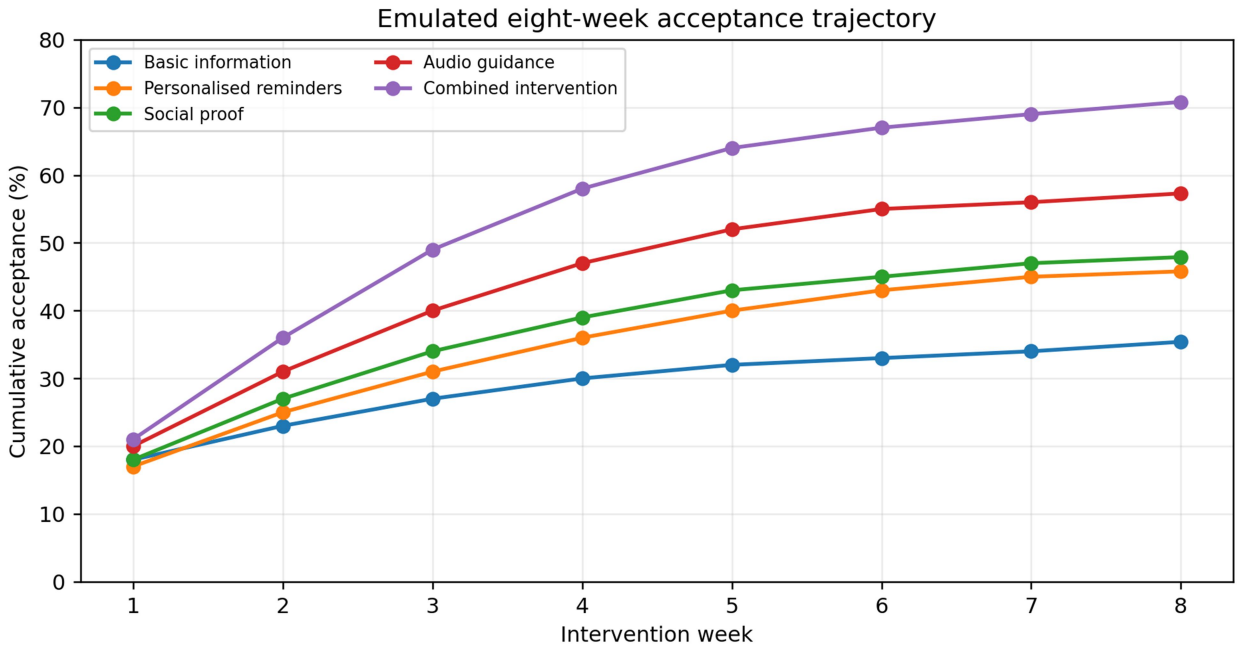

Figure 6. Emulated Cumulative Acceptance Over The Eight-Week Intervention Window

5.3 Acceptance-Prediction Model

Table 9. Emulated classifier benchmark on 240 held-out profiles

Model	Accuracy %	Macro precision %	Macro recall %	Macro-F1 %	AUC	Latency ms
Logistic regression	76.2	69.9	76.6	71.1	0.829	4.1
Decision tree	79.6	71.7	76.1	73.2	0.806	3.0
Random forest (selected)	86.7	80.6	80.6	80.6	0.838	12.8
Gradient boosting	87.1	84.4	75.5	78.6	0.821	9.6
Support vector machine	82.9	75.5	79.6	77.1	0.833	18.4

On held-out data, the random forest classified 208 of 240 profiles correctly, achieving 86.7% accuracy. Its 80.6% macro-F1 surpassed every alternative, including gradient boosting, which had slightly better accuracy but lower recall for non-acceptance. The matrix contained 37 true non-acceptances, 171 true acceptances, 16 false acceptances and 16 false non-acceptances. False acceptance means the system assumes help is unnecessary although a participant may remain unsure. The threshold should be lowered when missing needed support carries a high cost. This balance matters when uncertain users may otherwise receive no assistance. Trust and self-efficacy ranked highest, followed by previous use, network quality and fraud concern. This ranking is plausible but not causal. Field data may reorder the variables across markets, providers, handsets or interviewers. Monitoring should report overall and subgroup performance, while local explanations should support review rather than serve as definitive accounts of individual behaviour during field implementation and review.

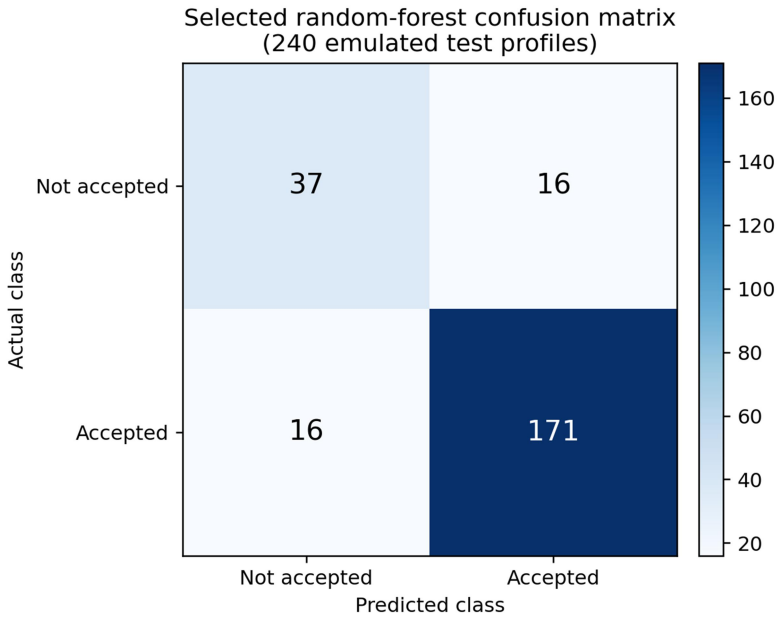

Figure 7. Confusion Matrix for The Selected Random-Forest Model On The Emulated Test Set

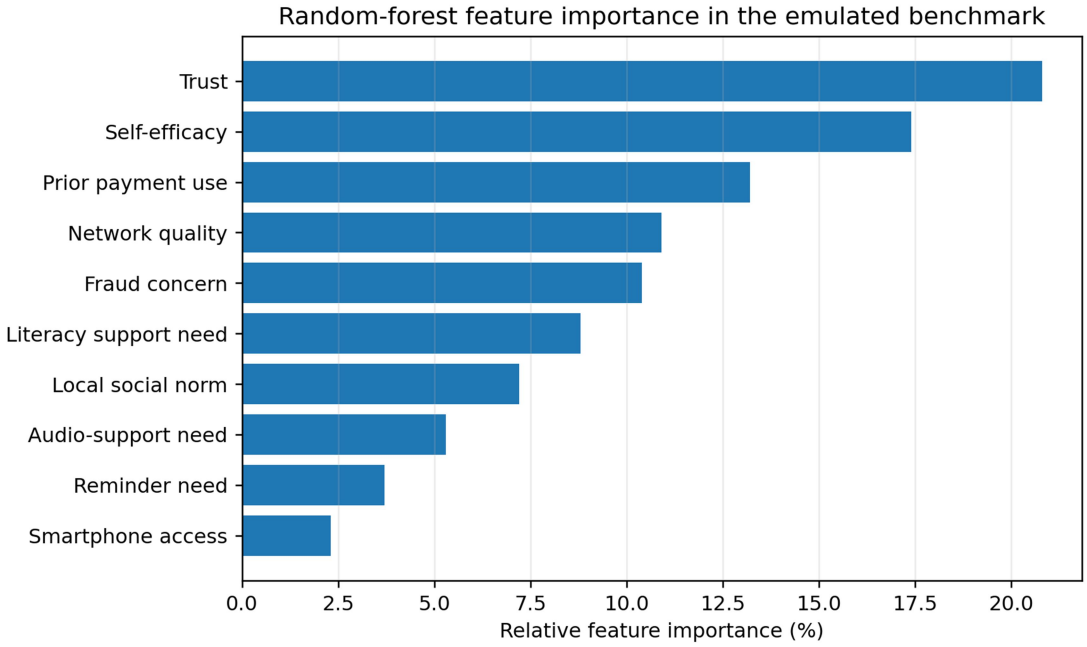

Figure 8. Relative Feature Importance for the Selected Model.

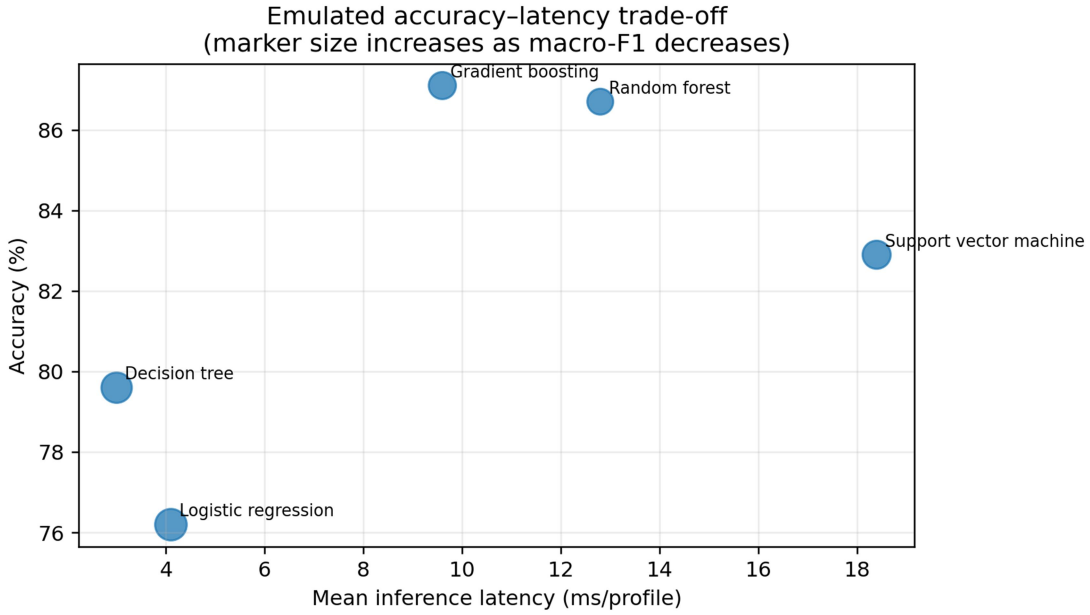

Figure 9. Accuracy–Latency Trade-Off Across Candidate Classifiers

5.4 Subgroup and Market-Readiness Views

Table 10. Illustrative acceptance comparison within selected subgroups

Subgroup	Basic information %	Combined intervention %	Absolute uplift (points)
Low literacy support	27	65	+38
Higher literacy support	42	75	+33
Age below 45 years	38	74	+36
Age 45 years and above	33	68	+35
Personal smartphone	39	75	+36
Shared/basic phone	31	65	+34

The combined approach outperformed basic information in every subgroup shown. The largest improvement occurred among participants who needed literacy support, consistent with audio guidance. Comparable gains across age and device categories are clearly encouraging, but constructed data cannot establish fairness. A field study must recruit adequate numbers within each subgroup, report confidence intervals and pause automated support whenever error rates differ by more than ten percentage points.

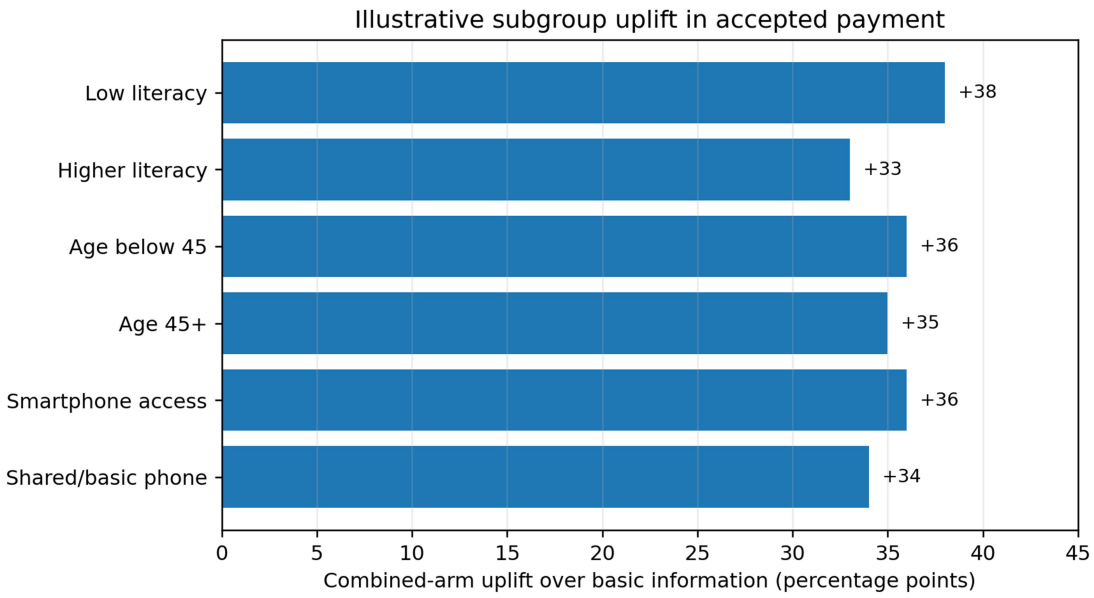

Figure 10. Illustrative Subgroup Uplift of the Combined Intervention Over Basic Information.

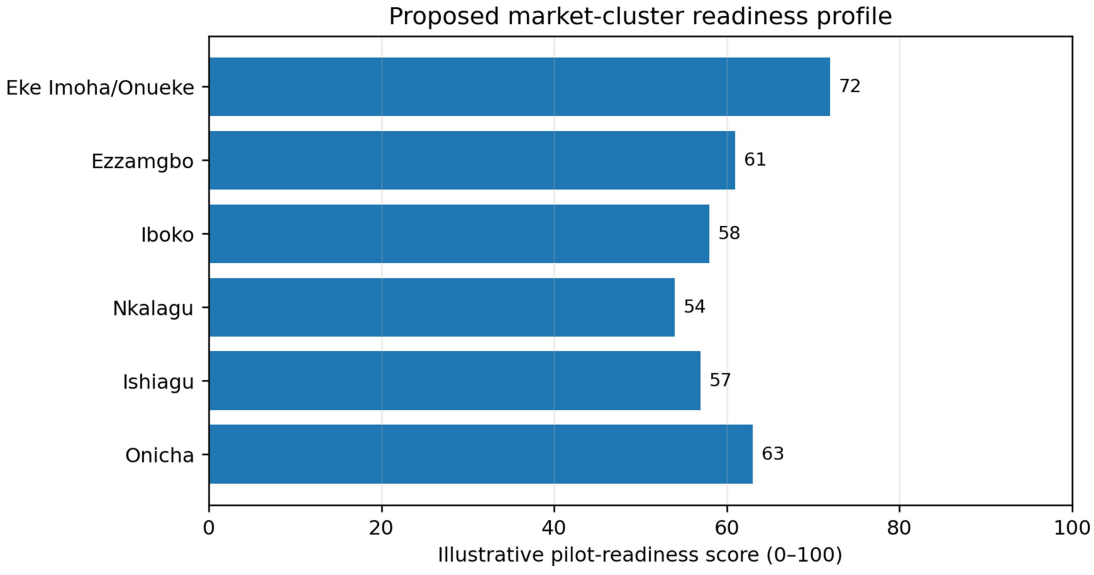

Figure 11. Illustrative Readiness Scores for The Six Proposed Market Clusters; Scores are Planning Inputs, Not Measured Rankings.

6. DISCUSSION

The benchmark divides payment acceptance into three practical stages: preparation, credibility and execution. Personalised reminders helped participants prepare, but they could not remove fear of fraud or make a confusing interface easier to read. Verified social proof made the behaviour locally credible, although it did not explain the payment steps.

Audio guidance increased confidence and reduced serious mistakes, yet distrust of the provider could still cause a user to refuse. The combined package produced the strongest outcome because it addressed all three stages and allowed any component to be withheld when eligibility or safety requirements were not met. The audio result agrees with accessibility research that payment procedures demand memory and comprehension [11]. Even so, voice support should strengthen a clear interface rather than replace it. Spoken prompts disappear, can be overheard and may become inaccurate when an application changes. MarketPay-Assist uses short recordings, replay controls, matching visual cues and strict version management. When a bank alters the relevant screen, the associated recording is removed until staff fully review and reapprove it.

Social proof requires careful control. In a close-knit community, an anonymous number can expose one person's behaviour when groups are small. Minimum group sizes, wider reporting periods and the removal of payment values reduce risk. Messages report only verified behaviour and never imply that the same decision is right for everyone. Transparency in persuasive design protects autonomy [10]. Women who choose cash, lack a stable connection or are dealing with unresolved losses should not be described as resistant or incapable. The random forest helps identify the least burdensome eligible support. A purely rule-based system would either present the same sequence to every user or require many manually designed combinations. The model can detect interactions, such as high fraud concern occurring with low self-efficacy, while still allowing supervisors to inspect the variables that influenced the recommendation. Some studies have also used machine-learning classification and interpretation in research on trust and human-technology relationships [16,17]. Essential safety requirements remain outside the model, ensuring that a small accuracy gain can never displace basic protection.

Institutional arrangements determine practical success. Market ambassadors need training, referrals and limits: they may explain interfaces but never enter a participant's PIN. Providers should resolve disputes quickly and identify authorized agents clearly. Associations may organize training and confirm aggregated information used for social proof, but they should have no access to acceptance records. Without these protections, technically accurate predictions could increase exposure while doing little to improve confidence or access to redress. MarketPay-Assist fits Nigeria's national goal of secure, reliable and inclusive electronic-payment services [4]. Adoption programmes should fund user assistance, complaint resolution and infrastructure, rather than concentrating only on technology. Counts of accounts, agents or downloads do not demonstrate use. Evaluation should measure independently completed and verified payments, security errors, withdrawal, repeated use and the time required to resolve disputed transactions.

7. LIMITATIONS AND FIELD-VALIDATION PROTOCOL

The main limitation is the absence of field observations. Emulated profiles tested the proposed design rather than describing Ebonyi market women's behaviour. Statistical significance from constructed data cannot establish causality. Future field evidence must confirm or replace the reported acceptance rates, predictive performance, feature ranking and subgroup gains. Likewise, readiness scores are planning examples, not comparative rankings of communities, markets or infrastructure; fieldwork must test them directly under real market conditions and participant experiences. A confirmatory pilot should recruit at least 300 consenting women across six clusters. Recruitment should be stratified by earlier payment experience and literacy-support need, randomizing participants or market sessions while limiting contamination.

The design covers one baseline week, four to eight intervention weeks and a 30-day follow-up for continued use. Real payments should be low-value, disclose charges and specify clear reversal or compensation procedures. Later, independent assessors should verify outcomes rather than staff delivering the intervention. Field acceptance should require at least 85% delivery through chosen channels, a statistically supported improvement over basic information, fewer than 5% critical errors in the combined group, no collection of PINs or OTPs, and no subgroup macro-F1 gap above ten points. The study should pause after a privacy breach, coerced recruitment, misleading social-proof message or unresolved financial loss. A pilot should test seasonal changes in connectivity and whether Igbo payment terms remain stable across communities.

Table 11. Staged Implementation And Decision Gates

Phase	Indicative Duration	Main Activity	Decision Gate
0. Co-design and approvals	4–6 weeks	Market unions, women traders, provider and ethics review	Approved protocol, scripts and referral map
1. Usability and safety test	3–4 weeks	20–30 participants; sandbox tasks; audio comprehension	≥90% correct safety comprehension; no credential capture
2. Small randomised pilot	8–10 weeks	≥300 participants across six clusters	Primary effect, error and opt-out thresholds met
3. Expanded field validation	One dry and one wet season	Real network/provider variation; model retraining	Stable subgroup performance and dispute resolution
4. Operational integration	12 months	Provider, association and regulator reporting	Quarterly audit and independent evaluation

Table 12. Minimum field-acceptance criteria

Dimension	Proposed acceptance threshold
Persuasive-message delivery	≥85% within selected contact window
Accepted verified payment	Pre-specified significant improvement over comparator
Critical safety error	<5% in combined arm
Credential protection	Zero stored or spoken PIN/OTP events
Social-proof privacy	100% of messages meet minimum aggregation threshold
Opt-out execution	Completed within 24 h through any supported channel
Model performance	Macro-F1 ≥80% and AUC ≥0.80 on field hold-out
Equity check	No major subgroup macro-F1 gap >10 percentage points
Complaint response	≥90% acknowledged within stated service target
Serious incident	Automatic pause and independent review

8. CONCLUSION

This article presents a persuasive-technology framework for improving digital-payment acceptance among rural market women in Ebonyi State. Reminders improve preparedness, verified social proof provides local reassurance, and audio guidance supports low-literacy task execution. A consent-based profile, calibrated random forest and explicit safety controls link these elements. In practice, the controls restrict message frequency, preserve anonymity, forbid collection of credentials and refer repeated difficulties to trained human support.

In the benchmark, the combined package doubled basic-information acceptance and reduced critical errors. The selected classifier balanced predictive performance and interpretability well. These results are not field evidence. Their value lies in showing that the components form a coherent, measurable system suitable for a governed pilot. Participatory co-design, ethical approval and validation across markets, networks and payment providers should proceed through careful implementation, monitoring and continued community feedback.

REFERENCES

[1] A. Demirgüç-Kunt, L. Klapper, D. Singer & S. Ansar, “The Global Findex Database 2021: Financial inclusion, digital payments, and resilience in the age of COVID-19”, World Bank, Washington, DC (2022). https://doi.org/10.1596/978-1-4648-1897-4.

[2] Enhancing Financial Innovation & Access, “Access to Financial Services in Nigeria 2023 Survey: Key highlights”, EFInA, Lagos (2024).

[3] GSMA, “The Mobile Gender Gap Report 2024”, GSMA, London (2024).

[4] Central Bank of Nigeria, “Payments System Vision 2025”, CBN, Abuja (2022).

[5] R. Adeleke, “Urban–rural differences in women’s use of mobile money and the underlying determinants: Evidence from Nigeria Demographic and Health Survey”, Women’s Studies International Forum 104 (2024) 102919. https://doi.org/10.1016/j.wsif.2024.102919.

[6] A. M. Igamo, R. A. Rachmat, M. I. Siregar, M. I. Gariba, V. Cherono, A. S. Wahyuni & B. Setiawan, “Factors influencing FinTech adoption for women in the post-COVID-19 pandemic”, Journal of Open Innovation: Technology, Market, and Complexity 10 (2024) 100236. https://doi.org/10.1016/j.joitmc.2024.100236.

[7] P. Yadav, A. Kumar, S. K. Mishra & K. Kochhar, "Financial equality through technology: Do perceived risks deter Indian women from sustained use of mobile payment services?", International Journal of Information Management Data Insights 4 (2024) 100266. https://doi.org/10.1016/j.jjimei.2024.100266.

[8] M. Z. Hoque, N. J. Chowdhury, A. A. Hossain & T. Tabassum, "Social and facilitating influences in FinTech user intention and the FinTech gender gap", Heliyon 10 (2024) e23457. https://doi.org/10.1016/j.heliyon.2023.e23457.

[9] R. Ly & B. Ly, "Digital payment systems in an emerging economy", Computers in Human Behavior Reports 16 (2024) 100517. https://doi.org/10.1016/j.chbr.2024.100517.

[10] R. Wang, J. Bush, R. Grossklags & I. Bilogrevic, "Transparency in persuasive technology, immersive technology, and online marketing: Facilitating users' informed decision making and practical implications", Computers in Human Behavior 139 (2023) 107545. https://doi.org/10.1016/j.chb.2022.107545.

[11] J. Dai, J. Miedema, S. Hernandez, A. Sutton-Lalani & K. Moffatt, "Cognitive accessibility of digital payments: A literature review", Proceedings of the 20th International Web for All Conference (2023) 116. https://doi.org/10.1145/3587281.3587294.

[12] A. Srivastava, S. Kapania, A. Tuli & P. Singh, "Actionable UI design guidelines for smartphone applications inclusive of low-literate users", Proceedings of the ACM on Human-Computer Interaction 5 (2021) 1. https://doi.org/10.1145/3449210.

[13] C. Murad, H. Candello & C. Munteanu, "What's the talk on VUI guidelines? A meta-analysis of guidelines for voice user interface design", Proceedings of the 5th International Conference on Conversational User Interfaces (2023) 1. https://doi.org/10.1145/3571884.3597129.

[14] Ebonyi State Government, "Towns and villages profile: Onueke and Eke Imoha", Ebonyi State Government, Abakaliki (accessed 14 July 2026).

[15] Federal Republic of Nigeria, "Nigeria Data Protection Act, 2023", Official Gazette, Abuja (2023).

[16] U. U. Ibekwe et al., "A machine learning sentiment classification of factors that shape trust in smart contracts", Journal of the Nigerian Society of Physical Sciences 7 (2025) 2177. https://doi.org/10.46481/jnsps.2025.2177.

[17] G. James, I. Umoren, A. Ekong, S. Inyang & O. Aloysius, "Analysis of support vector machine and random forest models for classification of the impact of technostress in COVID and post-COVID era", Journal of the Nigerian Society of Physical Sciences 6 (2024) 2102. https://doi.org/10.46481/jnsps.2024.2102.