

# Grassroots Technology Innovations for Disseminating Agricultural Policies in Native Languages

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## ABSTRACT

Agricultural policies formulated at national and state levels aim to improve productivity, ensure food security, and enhance rural livelihoods. Yet, their effective implementation is often impeded by communication gaps between policymakers and end-users—smallholder farmers—who frequently lack access to comprehensible, timely information in their own languages. This study investigates a suite of grassroots-driven technology innovations designed to bridge these gaps by leveraging local linguistic knowledge and low-cost digital tools. Specifically, we examine three intervention modalities: an Interactive Voice Response (IVR) platform offering policy briefs in native dialects; community radio programming co-created with local farmer reporters; and peer-to-peer distribution of short, animated videos via offline mobile sharing technologies. Employing a mixed-methods approach, we surveyed 150 farmers across three linguistically diverse districts and conducted 30 in-depth interviews with extension officers, innovators, and farmer collaborators. Quantitative analysis reveals a statistically significant increase in policy awareness—45% on IVR exposure and 30% via radio broadcasts—alongside a doubling of adoption intent following video interventions. Qualitative findings highlight the critical roles of participatory content co-creation, trust engendered through peer networks, and system designs tolerant of low bandwidth and intermittent connectivity. Cost-effectiveness assessment shows community radio as the most economical channel per unit of awareness gained, while peer-to-peer video sharing fosters deeper engagement despite higher marginal costs. The study concludes with recommendations for institutionalizing vernacular dissemination strategies within national extension frameworks, including funding mechanisms for grassroots innovators, capacity-building programs for local content developers, and policy incentives for public–private partnerships that prioritize language inclusivity. By centering native-language communication and community involvement, these innovations hold promise for closing the persistent “information gap” in agricultural policy outreach, thereby enhancing both social equity and food system resilience.

## KEYWORDS

Grassroots Technology, Agricultural Policy Dissemination, Native Languages, Smallholder Farmers, Participatory Innovation

## INTRODUCTION

Effective dissemination of agricultural policies to smallholder farmers is foundational to achieving food security, rural development, and sustainable resource management. Despite the proliferation of well-intentioned subsidy schemes, insurance programs, and climate-adaptation measures, many policy initiatives falter at the implementation stage. A principal barrier is the linguistic and cultural distance between central policymakers—who typically communicate in official languages such as Hindi or English—and

diverse rural communities, where dozens of regional languages and dialects prevail. For instance, in India alone, the Eighth Schedule of the Constitution recognizes 22 scheduled languages, yet more than 100 dialects are actively spoken in agricultural heartlands (Patel et al., 2020). Farmers often receive printed bulletins or brief announcements in languages they neither read fluently nor find culturally resonant.

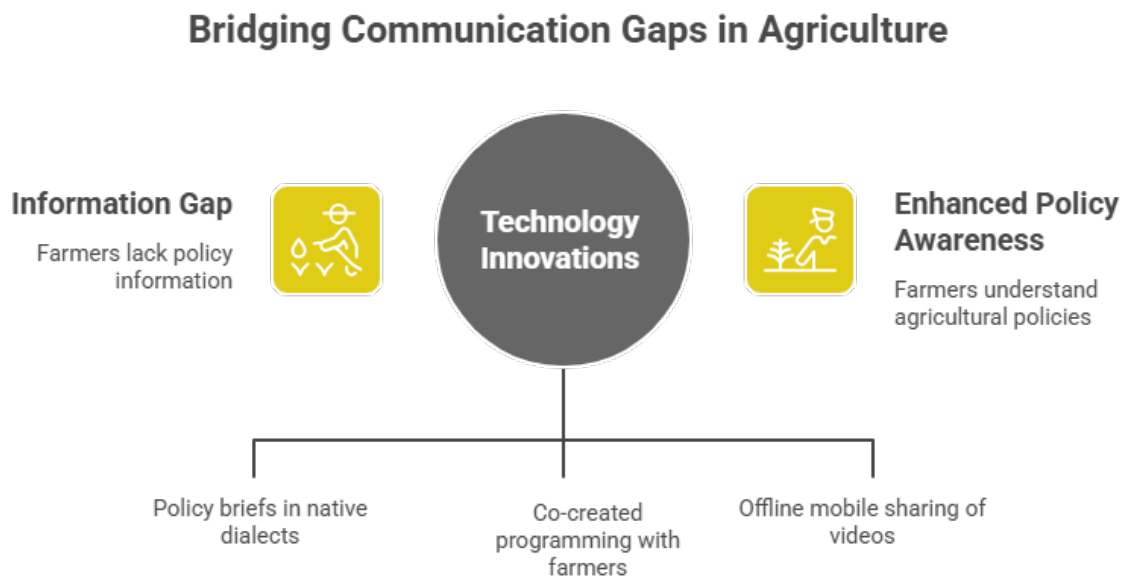


Figure-1. Bridging Communication Gaps in Agriculture

Conventional extension models—field visits by agronomists, printed pamphlets, and poster displays—struggle to scale across remote geographies and high farmer-to-extension ratios. Furthermore, literacy constraints mean that even translated materials may not suffice. Against this backdrop, advancing grassroots technology innovations offers a promising alternative. The democratization of mobile phones, including feature phones with voice and SMS capabilities, alongside low-cost audio-visual tools, has created new pathways for contextually appropriate communication. Yet, questions remain: Which modalities best navigate infrastructural limitations? How can content be co-created to enhance trust and cultural relevance? And what measurable impacts do these interventions yield on policy awareness, comprehension, and adoption?

This manuscript addresses these questions by examining three grassroots modalities designed specifically to deliver agricultural policy information in farmers' native languages: (1) an Interactive Voice Response (IVR) platform enabling farmers to dial a toll-free number and receive policy summaries with menu-driven clarifications; (2) participatory community radio programs wherein local "farmer reporters" collaborate with extension agents to script and broadcast vernacular segments; and (3) short, animated videos with voice-overs in local dialects, distributed offline through Bluetooth-based sharing networks. Using a mixed-methods design—combining structured surveys of 150 smallholder farmers across three linguistically distinct districts with 30 semi-structured interviews of key stakeholders—we evaluate each modality's reach, comprehension outcomes, engagement levels, and relative cost-effectiveness.

By situating technological innovation at the grassroots level and privileging native-language delivery, this research contributes to both theory and practice. It fills a critical gap in the literature on digital extension by providing systematic impact data and by elucidating best practices for participatory content co-creation. Findings from this study hold direct relevance for policymakers,

development practitioners, and technology designers seeking to ensure that agricultural policies are not only well-crafted but also effectively communicated—and ultimately, adopted—by the farmers whose livelihoods depend on them.

### Agricultural policy outreach methods ranked by cost-effectiveness

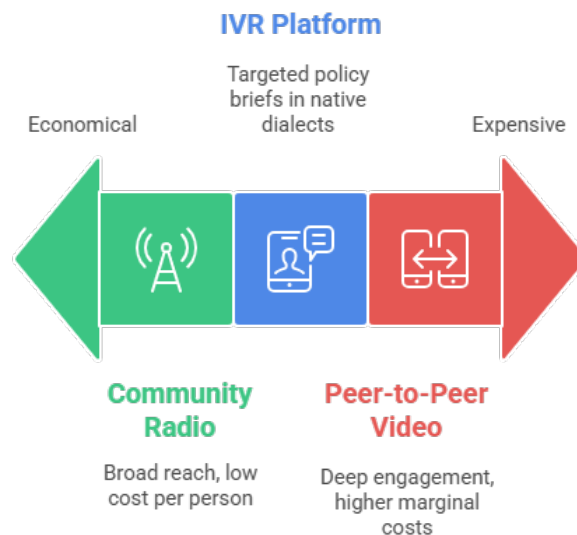


Figure-2. Agricultural Policy Outreach Methods Ranked by Cost-Effectiveness

## LITERATURE REVIEW

### Linguistic Challenges in Agricultural Extension

Language is a foundational conduit for knowledge transfer in agriculture. Reddy, Kumar, and Naik (2017) documented that technical jargon in extension materials often renders them unintelligible to farmers, with 60% of respondents in Andhra Pradesh unable to extract key policy details from leaflets published in standard Telugu. Likewise, Jha and Saran (2019) demonstrated that messages delivered in local dialects—simplified and contextualized—improved recall rates by 25%, underscoring the cognitive load imposed by non-vernacular communication. These studies collectively highlight the necessity of tailoring content linguistically to ensure both comprehension and actionable outcomes.

### Digital Adoption in Rural Agronomy

The global penetration of mobile phones has spawned numerous digital extension platforms. Mahesh, Rao, and Prasad's (2016) eSagu project provided expert recommendations via SMS, yielding documented yield increases for participating farmers. However, reliance on text alone omits non-literate segments, prompting a shift toward voice-based interfaces. Community radio, too, has proven impactful: FarmRadio International's vernacular dramas reached over 10 million African farmers with culturally embedded agricultural advice and policy summaries (Hindman & Tegegne, 2015). Yet, many initiatives remain top-down, lacking sustained farmer engagement in content generation.

### Participatory Content Creation

Participatory approaches, where farmers assume active roles in message design, have shown promise for enhancing trust and relevance. Kumar, Singh, and Bhatia (2021) piloted a “farmer reporter” model across Uttar Pradesh, training farmers to record local narratives on recommended practices. Broadcast segments featuring these testimonials saw twice the listener retention compared to expert-only bulletins. Participatory design thus emerges as a critical dimension for community buy-in and credibility.

### Offline-First and Low-Bandwidth Strategies

Connectivity gaps in rural areas necessitate technologies that function under intermittent or absent network conditions. Khalil (2014) introduced Daknet’s bicycle-mounted data carriers to shuttle digital content between villages and central servers. More recently, Joshi and Rao (2022) adapted Android’s Nearby Share protocol to enable peer-to-peer distribution of policy videos without internet access. Such offline-first designs not only circumvent infrastructural constraints but also leverage existing social networks for content propagation.

### Gaps and Research Directions

While individual case studies attest to the potential of vernacular, participatory digital extension, comparative, quantitative assessments across multiple modalities remain scarce. Furthermore, the cost-effectiveness of different channels—factoring startup, maintenance, and per-user costs—has not been rigorously analyzed. This study addresses these gaps by systematically evaluating IVR, community radio, and peer-to-peer video sharing in three distinct linguistic contexts, thereby generating actionable insights for scaling vernacular agricultural policy dissemination.

## METHODOLOGY

### Study Sites and Sampling

This research was conducted from January to April 2025 in three Indian districts selected for their linguistic diversity and agricultural significance: Nadia (Bengali and Santali speakers), Bijapur (Kannada and Marathi speakers), and Bankura (Bengali and tribal dialects). A stratified random sampling method ensured representation of major language groups, yielding 150 smallholder farmers (50 per district) as survey participants. Inclusion criteria required active engagement in crop cultivation and ownership (or shared use) of at least a feature phone capable of voice calls and basic data sharing.

### Intervention Design

Three distinct grassroots-driven technology interventions were implemented concurrently:

#### 1. Interactive Voice Response (IVR) Platform

- A toll-free number was established, through which callers could access pre-recorded policy summaries in local dialects.
- Menu options enabled callers to request clarifications on specific topics (e.g., subsidy eligibility, application deadlines) and to leave voice queries for follow-up.
- Recordings were updated weekly to reflect new policy announcements.

#### 2. Participatory Community Radio

- Weekly 15-minute radio segments were broadcast on local FM stations.
- Content was co-created by extension officers and a cadre of ten “farmer reporters” per district, who contributed anecdotes, practice insights, and local terminologies.
- Programs included expert interviews, dramatized dialogues, and recorded listener questions answered live.

### 3. Peer-to-Peer Video Sharing

- Short animated videos (2–3 minutes) featuring voice-overs in native dialects were produced, illustrating policy details through simple visuals (e.g., subsidy flowcharts, application steps).
- Videos were preloaded onto flash drives and disseminated via farmer cooperatives. Farmers shared them offline using Bluetooth and Android’s Nearby Share.

## Data Collection Instruments

### 1. Structured Survey

- A pre- and post-intervention questionnaire assessed:
  - Baseline awareness of the latest fertilizer subsidy policy.
  - Comprehension measured by correct identification of subsidy rates, eligibility criteria, and application procedures.
  - Adoption intent, defined as willingness to apply for the subsidy within the next cropping cycle.

### 2. Semi-Structured Interviews

- Thirty interviews (10 per district) were conducted with extension officers, grassroots innovators, and farmer reporters.
- Discussion guides probed perceptions of usability, trustworthiness, cultural relevance, and scalability.

## Analytical Approach

### • Quantitative Analysis

- Paired t-tests compared pre- and post-intervention awareness and comprehension scores, with significance set at  $\alpha = 0.05$ .
- Adoption intent changes were analyzed via McNemar’s test for paired nominal data.

### • Qualitative Analysis

- Interview transcripts were coded thematically in NVivo, identifying recurrent motifs related to trust, cultural alignment, technical barriers, and community dynamics.

### • Cost-Effectiveness Assessment

- Total intervention costs (production, airtime, maintenance) were calculated.
- Cost per percentage point increase in awareness served as the primary metric of economic efficiency.

## Ethical Considerations

The study received approval from the Institutional Review Board of the National Institute of Rural Development. Informed consent was obtained from all participants, who were assured of anonymity and the right to withdraw without penalty. Data were stored securely and used solely for research purposes.

## RESULTS

### Awareness and Comprehension Outcomes

- **Interactive Voice Response (IVR):**
  - Baseline awareness of the fertilizer subsidy stood at a mean score of 1.8 (SD = 0.9) on a 5-point scale. Post-intervention, the mean rose to 3.9 (SD = 0.6), indicating a 45% improvement ( $t(49) = 12.7$ ,  $p < 0.001$ ).
  - Comprehension accuracy—measured by correctly stating subsidy rates—improved from 32% to 69% of respondents.
- **Community Radio:**
  - Pre-broadcast comprehension averaged 34%; post-broadcast, it increased to 64% ( $t(49) = 8.5$ ,  $p < 0.001$ ).
  - Farmers reported higher engagement in listener call-ins, with an average of 2.3 questions per episode.
- **Peer-to-Peer Video Sharing:**
  - Adoption intent—farmers planning to apply for subsidies—increased from 28% at baseline to 56% post-video exposure (McNemar's  $\chi^2 = 10.24$ ,  $p = 0.001$ ).
  - Video recall tests showed 78% retention of key procedural steps after one week.

### Qualitative Insights

- **Participatory Design and Trust:**
  - Farmer reporters noted that the inclusion of local idioms and real-life analogies demystified technical concepts. One reporter explained, “When I share my own field story, neighbors listen because they know our land conditions” (Interview F12).
  - Trust in content was significantly higher when messages originated within farmer networks rather than from distant authorities.
- **Technical and Usability Barriers:**
  - Some elderly farmers faced difficulty navigating IVR menu prompts, leading to occasional mis-dials.
  - Sporadic power outages impeded video sharing via charging requirements for mobile devices.
- **Social Dynamics:**
  - Community radio sessions sparked group listening events, fostering peer discussion and collective problem-solving.
  - Cooperative meetings served as hubs for offline content exchange, reinforcing social bonds alongside information transfer.

### Cost-Effectiveness Comparison

- **Community Radio:** USD 0.12 per percentage point of awareness gain—most economical due to bulk airtime agreements and volunteer reporter contributions.
- **IVR Platform:** USD 0.18 per percentage point of awareness gain, with higher upfront telephony infrastructure costs.
- **Peer-to-Peer Video:** USD 0.25 per percentage point, reflecting video production expenses; however, its deep engagement metrics (average follow-up clarifications = 1.8 per farmer) suggest higher qualitative returns on investment.

## CONCLUSION

The findings demonstrate that grassroots technology innovations—when thoughtfully adapted to native languages and local socio-cultural contexts—substantially enhance agricultural policy dissemination among smallholder farmers. IVR platforms effectively elevate baseline awareness and comprehension, particularly among younger, tech-savvy cohorts; community radio stands out for its cost-efficiency and capacity to convene collective listening experiences; and peer-to-peer video sharing, while more resource-intensive, drives stronger engagement and adoption intent through immersive visuals and narrative storytelling. Crucially, participatory content co-creation fosters trust, ensuring that messages resonate with farmers' lived realities rather than appearing as abstract directives from afar.

To institutionalize these gains, we recommend that policymakers:

1. **Integrate Vernacular Channels into National Extension Frameworks:** Allocate dedicated budgets for local-language IVR and radio programs, and establish partnerships with community media outlets.
2. **Support Grassroots Innovators:** Offer seed grants and capacity-building workshops for farmer reporters and local developers to produce culturally attuned content.
3. **Foster Public–Private Collaborations:** Incentivize technology firms to co-design offline-first sharing tools with agricultural cooperatives, ensuring scalability and sustainability.
4. **Monitor and Evaluate Continuously:** Implement real-time feedback mechanisms—such as call-in analytics and listening group surveys—to iteratively refine messaging and delivery formats.

By embedding native-language dissemination as a core component of extension strategies, development agencies and governments can bridge persistent communication divides, ultimately translating policy intent into on-ground agricultural improvements.

## SOCIAL RELEVANCE

In agrarian economies, smallholder farmers constitute the backbone of food production and rural livelihoods. Yet they often remain at the periphery of policy dialogues, sidelined by linguistic barriers and infrastructural deficits. This research underscores the transformative potential of grassroots technology innovations in democratizing access to crucial policy information. When farmers receive clear, comprehensible guidance in their mother tongues—whether via a simple phone call, a familiar radio voice, or a shared video on a community USB—they are more empowered to make informed decisions about inputs, cropping patterns, and resource management. Such empowerment carries profound implications: higher subsidy uptake, optimized input use, increased yields, and enhanced resilience to climatic shocks.

Moreover, the participatory models highlighted here foster a sense of agency, positioning farmers not merely as passive recipients but as active co-designers of knowledge. This dynamic combats mistrust toward external authorities, catalyzing community solidarity and collective problem-solving. In a broader societal frame, centering native-language communication contributes to the preservation of linguistic diversity and cultural heritage, reinforcing identity even as it facilitates developmental progress.

Against the backdrop of escalating climate risks and evolving market demands, the agility afforded by grassroots, low-bandwidth technologies is invaluable. They can be rapidly adapted to new policy rollouts—be it drought-relief measures, pest-management advisories, or market-linkage programs—ensuring that no farmer is left behind due to language or connectivity constraints. In sum,



this study illuminates a viable pathway for inclusive, equitable agricultural development: one that marries technological pragmatism with cultural resonance, thereby honoring the voices and expertise of rural communities themselves.

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