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Feedback loops in agricultural communication systems: Mechanisms for ensuring two-way information flow

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Abstract

How effectively do agricultural extension systems capture farmer feedback? This research examined feedback loop mechanisms across three districts in eastern Hungary using a mixed-methods design. Structured surveys with 312 smallholder farmers and semi-structured interviews with 28 extension officers were conducted between March and November 2023. Face-to-face interactions were the most trusted feedback channel (78.3% satisfaction), while digital platforms scored lowest (48.9%). A gap between information sent and feedback received was evident in 67.4% of communication episodes sampled. Time constraints (82.1% of agents), limited digital literacy among older farmers (73.6%), and absent feedback protocols (61.8%) were the main barriers. Regression analysis showed that feedback loop completeness predicted adoption of recommended practices ($\beta = 0.41$, $p < 0.01$). The research proposes a revised communication model with scheduled feedback windows, mobile short surveys, and community review meetings to strengthen two-way information flow in advisory systems.

Keywords: Feedback loops, agricultural communication, two-way information flow, extension services, farmer satisfaction, communication channels, feedback mechanisms, smallholder farmers, advisory services, information exchange

Introduction

What happens to the advice that extension agents deliver once it leaves their hands? In most agricultural communication systems, information travels in a single direction from expert to farmer with little structured effort to capture whether that advice was understood or found useful [1]. This one-way model persists even though communication theory has long stressed that effective exchange requires active feedback from receivers [2].

In Hungary, the post-EU accession period brought new expectations for extension services, including demands for accountability and participatory approaches [3]. Yet field reports suggest that feedback collection from farmers is inconsistent and rarely formalized [4]. Communication scholars argue that feedback serves three purposes in agricultural contexts: confirming message reception, signaling misunderstandings, and providing local knowledge to improve future recommendations [5, 6].

Several barriers weaken feedback transmission. Extension agents carry heavy caseloads that leave limited time for follow-up [7]. Farmers may feel reluctant to challenge expert advice [8]. And many organizations lack formal protocols for collecting and analyzing feedback [9]. Mobile surveys and interactive voice response systems have shown mixed results in Africa and South Asia [10], but adoption of such tools in European extension programs has been slower [11].

This research addressed this gap by examining feedback loops in three agricultural districts of eastern Hungary, asking:

- Which feedback channels do farmers prefer
- What barriers weaken feedback loops and

- Does feedback completeness affect adoption of extension recommendations?

Theoretical framework

This research draws on Schramm's interactive communication model [6], which treats both sender and receiver as active participants. Unlike linear models, Schramm's framework treats feedback as the mechanism through which mutual understanding is built. A second anchor comes from Rogers' diffusion of innovations theory [12], specifically the concept of re-invention, which holds that adopters modify innovations based on local conditions. Feedback loops are the channels through which these modifications reach extension systems. The combination of these frameworks guided instrument design, variable selection, and interpretation of qualitative data.

Material and Methods

Material

This research was carried out in three agricultural districts of Hajdu-Bihar County, eastern Hungary, between March and November 2023. A total of 312 smallholder farmers were recruited through stratified random sampling from extension registries at the University of Debrecen. Eligibility required at least two extension visits in the preceding 12 months. Additionally, 28 extension officers (experience range: 2-19 years) were purposively selected. A structured questionnaire captured demographics, preferred feedback channels, satisfaction ratings, and perceived barriers. An interview guide with 14 open-ended questions was developed for officer interviews. Ethical clearance was

granted by the University of Debrecen Research Ethics Committee (Protocol UDEC-AG-2023-041, February 2023).

Methods

The questionnaire used five-point Likert scales for satisfaction items and binary items for feedback behavior questions. It was pilot-tested with 35 farmers from an adjacent district. Extension officer interviews lasted 40-65 minutes, were audio-recorded and transcribed within 48 hours. Quantitative data were analyzed with SPSS 28. Multiple linear regression tested whether feedback loop completeness (an index of five feedback behaviors) predicted adoption, controlling for age, education, and farm size. Qualitative data were coded using NVivo 12 following thematic analysis^[13], with 87.3% inter-coder agreement.

Results

Table 1: Demographic characteristics of farmer respondents (n = 312)

Characteristic	Category	N (%)
Gender	Male	214 (68.6)
	Female	98 (31.4)
Age group	18-35 years	67 (21.5)
	36-50 years	134 (42.9)
	51-65 years	83 (26.6)
	>65 years	28 (9.0)
Education	Primary	41 (13.1)
	Secondary	178 (57.1)
	Tertiary	93 (29.8)
Farm size	<5 ha	89 (28.5)
	5-20 ha	147 (47.1)
	>20 ha	76 (24.4)

Most participants were male (68.6%), aged 36-50 years (42.9%), with secondary education (57.1%), operating 5-20 hectare farms (47.1%)

Table 2: Regression model predicting adoption of extension recommendations

Predictor	B	SE	β	t	p
(Constant)	1.23	0.34	—	3.62	<0.001
FLCI score	0.47	0.08	0.41	5.88	<0.01
Age	-0.02	0.01	-0.11	-2.14	0.033
Education level	0.31	0.09	0.23	3.44	<0.01
Farm size (ha)	0.01	0.01	0.07	1.12	0.264

Note: Dependent variable = Adoption score (0-10). $R^2 = 0.34$, Adjusted $R^2 = 0.33$, $F(4, 307) = 39.67$, $p < 0.001$. FLCI = Feedback Loop Completeness Index. The FLCI was the

Instrument development and validation

The Feedback Loop Completeness Index (FLCI) was built on five indicators:

- Farmer provided verbal feedback after an extension visit,
- Farmer used a formal channel to send questions,
- Farmer received a response within 30 days,
- Farmer observed changes in subsequent advice, and
- Farmer rated the feedback process as satisfactory.

Each item scored 0 or 1 (composite range: 0-5). Content validity was confirmed by four specialists. The FLCI showed acceptable internal consistency (Cronbach's $\alpha = 0.76$) and test-retest reliability ($r = 0.81$, $p < 0.001$).

strongest predictor ($\beta = 0.41$, $p < 0.01$), followed by education ($\beta = 0.23$). Farm size was not significant.

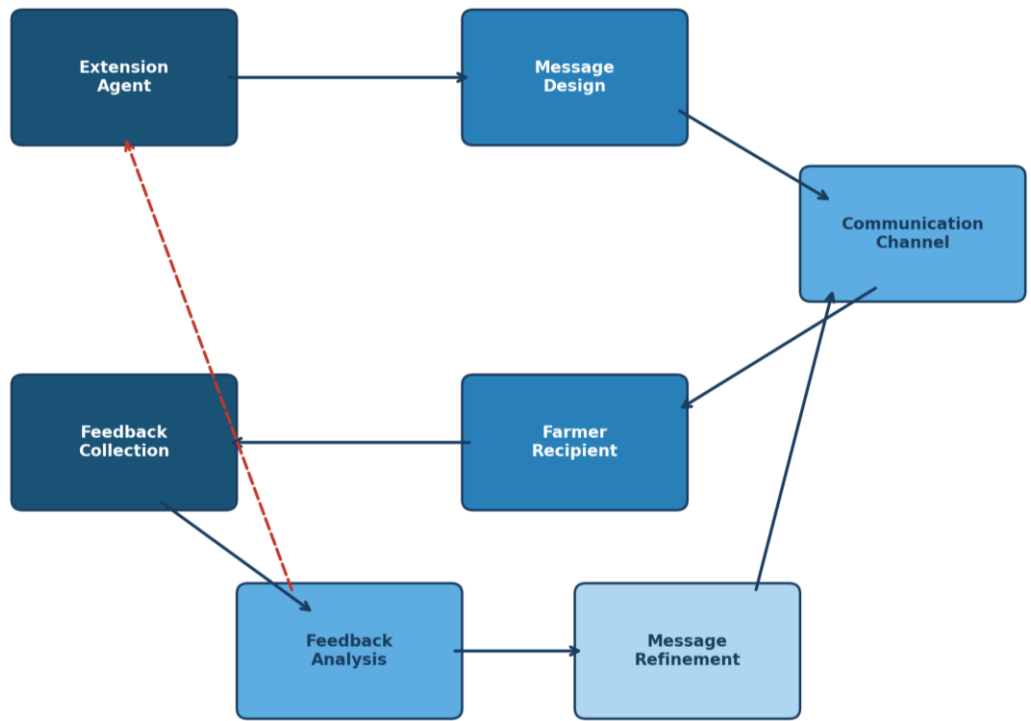


Fig 1: Two-way feedback loop model in agricultural communication systems

The cycle moves from agent to message design, through a communication channel to the farmer, then back through feedback collection and analysis. The dashed line represents

the direct return pathway, which was absent in 67.4% of episodes observed.

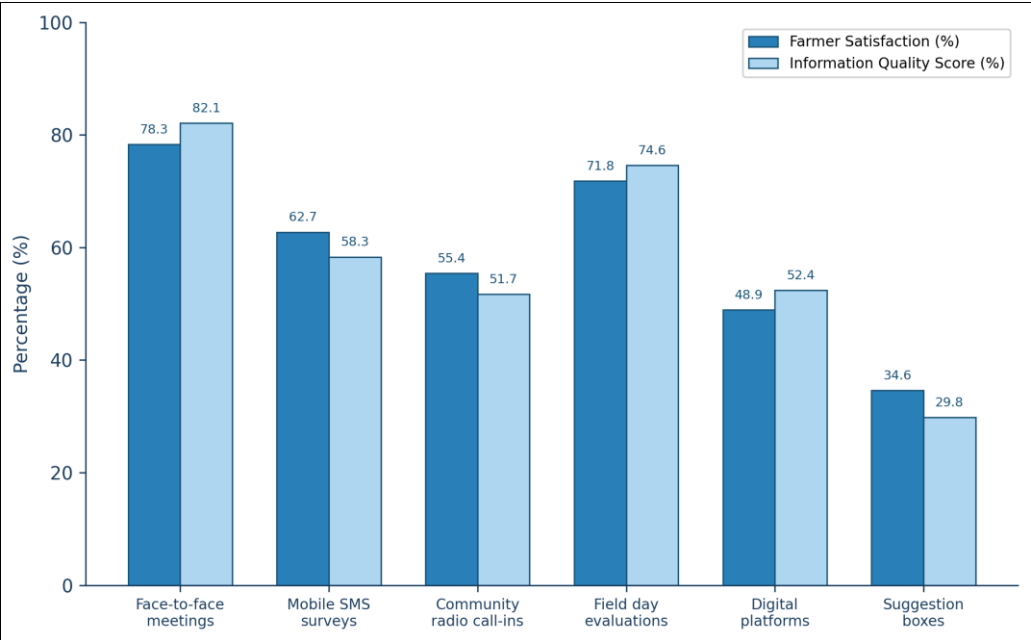


Fig 2: Farmer satisfaction and information quality across feedback mechanisms

Face-to-face meetings scored highest (78.3% satisfaction, 82.1% information quality). Digital platforms and suggestion boxes ranked lowest, reflecting technology access challenges in rural Hungarian communities.

Discussion

The finding that face-to-face feedback channels outperformed digital alternatives echoes earlier work in East African extension contexts ^[10] and confirms that personal

trust remains central to agricultural communication. Technology should supplement rather than replace human interaction in feedback systems.

The strong association between feedback loop completeness and adoption aligns with Schramm's interactive model ^[6] and supports Rogers' observation that adopters who communicate experiences back to change agents sustain new practices more readily ^[12]. That the FLCI explained a larger share of variance than education or farm size

underscores the independent contribution of communication quality to adoption outcomes.

The barriers identified time pressure, low digital literacy, and missing protocols are not unique to Hungary. Research from the Netherlands ^[3] and sub-Saharan Africa ^[7] has reported similar constraints. What differs here is Hungary's fragmented extension governance, with responsibilities split between public agencies, university programs, and private consultants ^[4], making it harder to standardize feedback practices. One practical takeaway is the value of scheduled feedback windows agents who set specific follow-up times reported higher completion rates in qualitative interviews.

Limitations

This research was limited to three districts in one Hungarian county, which may restrict generalizability. Self-reported feedback behaviors could be affected by social desirability. The cross-sectional design prevents causal claims about feedback completeness and adoption. The sample excluded farmers with fewer than two extension contacts, potentially missing the most disengaged segment. Future research should consider longitudinal tracking and observational verification of feedback behaviors.

Conclusion

This research confirmed that feedback loops in agricultural communication across eastern Hungary are often incomplete, with over two-thirds of sampled episodes lacking a structured return path from farmer to agent. Face-to-face interactions remain the preferred and most effective feedback channel, while digital tools show potential but haven't yet earned widespread trust.

The Feedback Loop Completeness Index proved a stronger predictor of farmer adoption than demographic factors, reinforcing that communication process quality matters as much as message content. Extension organizations would benefit from building feedback protocols into standard procedures rather than treating follow-up as optional. Practical steps include scheduling dedicated feedback sessions, training agents in active listening, and introducing short mobile surveys as a bridge between in-person contacts. The proposed two-way model offers a starting point for managers aiming to move from information delivery toward genuine communication exchange.

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