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Short message service-based agricultural advisory systems: usage patterns and farmer response behavior

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Abstract

According to the Food and Agriculture Organization, SMS-based advisory services reached an estimated 33 million farmers globally by 2020, making text messaging one of the most widely deployed digital extension tools in developing and transitional agricultural economies. This research examined usage patterns and farmer response behavior within an SMS agricultural advisory system operating across three Latvian agricultural regions. A mixed-methods study tracked 278 registered farmer subscribers over 12 months (January to December 2021), combining server log analysis of message delivery and read receipts with quarterly structured surveys measuring response behavior and perceived value. Read rates averaged 81.4% across the year but peaked at 91.2% during the active growing season (April to June). Action rates, defined as self-reported behavioral change following SMS receipt, averaged 33.8% but showed strong seasonal variation, peaking at 52.1% in May. Message timing and content relevance emerged as the strongest predictors of farmer response ($\beta = 0.38$ and 0.41 respectively, $p < 0.001$). The research proposes a response behavior model identifying four distinct farmer response types: immediate action, delayed action, information storage, and no response. Seasonal alignment of message content with farming operations was the single most important design factor for maximizing advisory impact.

Keywords: SMS advisory, mobile extension, farmer response, text messaging, agricultural information, digital advisory, usage patterns, message design, Latvia, ICT for agriculture

Introduction

As Aker ^[1] noted in her comprehensive review of ICT for agricultural extension, the mobile phone has become the most ubiquitous information technology in rural areas worldwide, yet our understanding of how farmers actually engage with mobile advisory content remains surprisingly shallow. Most evaluations of SMS agricultural services focus on whether messages were delivered and whether adoption rates changed, treating the space between delivery and action as a black box ^[2]. What happens when a farmer receives an advisory text message? Do they read it immediately or later? Do they act on it, share it, save it, or ignore it? And what determines which of these responses occurs?

The Baltic states offer an unusual research context for these questions. Latvia has near-universal mobile phone penetration even in rural areas, relatively high farmer literacy levels, and an agricultural sector dominated by small to medium-sized family farms transitioning from Soviet-era collective structures to market-oriented production ^[3]. The Latvian Rural Advisory Centre launched an SMS advisory service in 2018, providing registered farmers with weekly text messages covering crop management, pest alerts, market information, and regulatory updates. By 2021, the service had over 3,400 registered subscribers across the country ^[4].

This research analyzed usage patterns and response behavior among SMS advisory subscribers in three Latvian regions

over a 12-month period, combining objective server log data with farmer self-reports to develop a comprehensive model of advisory response behavior.

Conceptual Framework

The research adapted the Elaboration Likelihood Model from persuasion research to the agricultural SMS context ^[5]. Central route processing occurs when farmers carefully evaluate message content against their current farming situation, leading to considered behavioral responses. Peripheral route processing occurs when farmers use heuristic cues such as message source credibility and timing convenience to make quick judgments about message relevance. Message characteristics (timing, relevance, clarity) and farmer characteristics (literacy, experience, farm type) were hypothesized to determine which processing route predominated and consequently which response type resulted.

Materials and Methods

Materials

The research covered three Latvian agricultural regions: Zemgale, Kurzeme, and Latgale, between January and December 2021. The institutional base was the Department of Agricultural Economics, University of Latvia, Jelgava. Materials included server log data from the Latvian Rural Advisory Centre SMS platform recording delivery timestamps, read receipts, and subscriber interactions for all

messages sent during the research period. A structured quarterly survey (38 items, Cronbach alpha = 0.82) measured response behavior, perceived message value, and advisory impact on farming decisions. The sample comprised 278 registered subscribers who consented to participate. Ethical approval was obtained from the University of Latvia Research Ethics Committee (Protocol UL/REC/2020-089, approved November 2020).

Methods

A longitudinal observational design tracked message interactions over 12 months. Server logs provided objective

data on message delivery, read rates, and read timing. Quarterly surveys assessed self-reported response behavior categorized into four types: immediate action (behavioral change within 48 hours), delayed action (change within one month), information storage (saved for future reference), and no response. Analysis included descriptive statistics of monthly usage patterns, repeated measures ANOVA testing seasonal variation in read and action rates, and multiple regression identifying predictors of farmer response type. Qualitative data from 24 semi-structured interviews explored the reasoning behind different response patterns [6].

Results

Table 1: SMS advisory usage patterns by season and farmer characteristics (n = 278)

Metric	Winter (Jan-Mar)	Spring (Apr-Jun)	Summer (Jul-Sep)	Autumn (Oct-Dec)
Mean read rate (%)	72.4	90.4	84.3	74.4
Mean action rate (%)	19.5	49.4	38.4	21.1
Median read time (min)	47	12	18	38
Info storage rate (%)	31.2	22.4	26.8	33.7
Perceived relevance (1-7)	3.4	5.9	5.0	3.5

Seasonal variation was pronounced across all metrics. Spring showed the highest read rates (90.4%), fastest read times (median 12 minutes), and strongest action rates (49.4%), coinciding with peak farming activity. Winter

messages were read more slowly (47 minutes) and more frequently stored for later reference (31.2%) rather than acted upon immediately.

Table 2: Multiple regression predicting SMS action rate from message and farmer characteristics (n = 278)

Predictor	Beta	SE	t	p-value
Content relevance to season	0.41	0.06	6.83	<0.001
Message timing (day of week)	0.38	0.07	5.43	<0.001
Message clarity rating	0.24	0.06	4.00	<0.001
Farming experience (years)	0.13	0.05	2.60	0.010
Farm size (hectares)	0.11	0.05	2.20	0.029

The model explained 47.2% of variance in action rates (adjusted R-squared = 0.472). Content relevance to the current farming season was the strongest predictor (beta = 0.41), followed by message timing (beta = 0.38). Messages

sent on Monday and Tuesday mornings received higher action rates than those sent later in the week, likely because farmers plan weekly activities at the start of the work week.

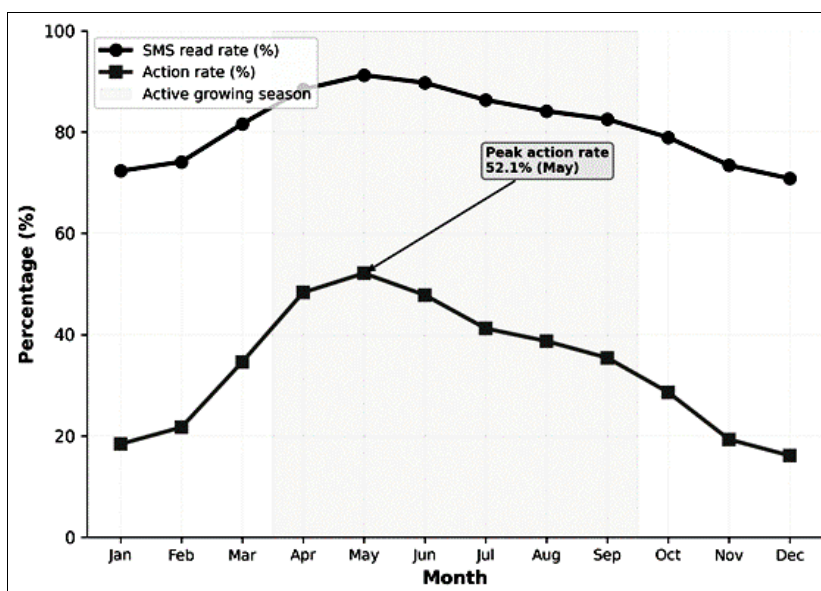


Fig 1: Monthly SMS read rates and action rates with growing season overlay (n = 278 subscribers, 12 months)

Read rates and action rates followed parallel seasonal curves but with a persistent gap averaging 47.6 percentage points. The gap narrowed during peak growing season (March to

June) when farming decisions were most time-sensitive, and widened during off-season months when advisory content was less immediately actionable.

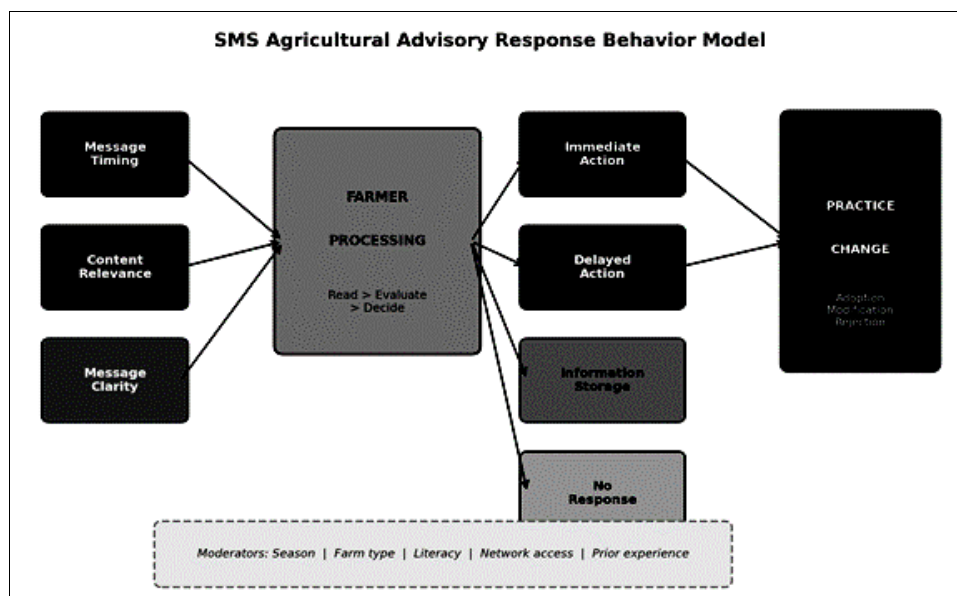


Fig 2: SMS agricultural advisory response behavior model showing message characteristics, processing stages, and response types

The model identifies three message input characteristics (timing, relevance, clarity) that feed into farmer cognitive processing, producing four distinct response types. Immediate and delayed action lead to practice change outcomes, while information storage represents latent value that may convert to action in future seasons. Seasonal alignment, farm type, literacy, and prior experience moderate transitions throughout the model.

Comprehensive Interpretation

The data reveal that SMS advisory effectiveness is fundamentally seasonal. The same message content can produce dramatically different response rates depending on whether it arrives during a period of active farming decision-making. Content relevance and timing together explained more variance in farmer response than all farmer demographic characteristics combined, suggesting that system design factors are more amenable to optimization than farmer characteristics.

Discussion

The seasonal pattern in SMS advisory response confirms what Cole and Fernando^[7] observed in Indian agricultural advisory services: farmers engage most actively with information that aligns with their current decision-making needs. The Latvian data extend this finding by showing that even read behavior, not just action, follows seasonal patterns. During off-season months, farmers shifted toward information storage behavior, saving messages as future reference rather than acting immediately. This suggests that SMS systems should differentiate between actionable season-specific advisories and reference content designed for storage and later retrieval^[8].

The importance of message timing within the week has not been previously documented in agricultural SMS research. The Monday-Tuesday effect likely reflects farm planning

routines where weekly work schedules are set at the beginning of the week. Extension services typically design message schedules around content production workflows rather than farmer decision-making rhythms, representing a missed optimization opportunity^[9]. Aligning delivery timing with farmer planning cycles could improve action rates without any change to message content itself.

Policy Recommendations

SMS advisory systems should adopt seasonally adaptive content calendars that concentrate actionable advisories during active farming periods and shift toward informational and planning content during off-seasons. Message delivery should be scheduled for early-week mornings to align with farmer planning rhythms. Systems should allow farmers to save and retrieve past messages, recognizing that information storage is a legitimate and valuable response type that may convert to action in future seasons.

Limitations

Read receipt data confirm message opening but not actual reading. Self-reported action rates may overestimate behavioral change due to social desirability bias. The Latvian context with high literacy and mobile penetration may not represent SMS advisory effectiveness in lower-literacy settings. The 12-month observation period captures one growing cycle, limiting conclusions about year-over-year behavior patterns.

Conclusion

This research demonstrated that SMS agricultural advisory response behavior is strongly seasonal, with read rates and action rates peaking during the active growing season. Content relevance and message timing were the strongest predictors of farmer response, outweighing demographic factors. The four-type response model (immediate action,

delayed action, information storage, no response) provides a more nuanced framework for evaluating SMS advisory effectiveness than binary read-or-not metrics. Advisory system designers should optimize message timing and seasonal content alignment as the most impactful and most modifiable factors affecting farmer engagement with SMS-based extension services.

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