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Anand Karthikeyan
Associate Professor and Head
(Agricultural Extension),
Department of Agricultural
Extension and
Communication, Vanavarayar
Institute of Agriculture,
Pollachi – 642 103,
Coimbatore District, Tamil
Nadu, India

Sankri Karthikeyan
Assistant Professor
(Agricultural Extension),
Department of Agricultural
Extension and
Communication, Vanavarayar
Institute of Agriculture,
Pollachi – 642 103,
Coimbatore District, Tamil
Nadu, India

Future capacity building needs, constraints and a strategic model for empowering extension personnel as information managers

Anand Karthikeyan¹, Sankri Karthikeyan²

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ABSTRACT

Information management performance among extension personnel depends not only on their present acquisition, processing and dissemination behaviour but on whether future capacity building is targeted at the areas, venues, durations, methods and trainers they themselves prefer, and on removing the constraints that presently limit each stage of the information management cycle. This study assessed the future capacity building needs and constraints of 121 extension personnel (Agricultural/Horticultural Officers and Assistant and Deputy Directors) of Tamil Nadu's State Department of Agriculture in Coimbatore, Tiruppur and Erode districts, and proposed a strategic model for empowering them as "Information Managers". Among 31 subject matter areas rated, MS Word (7.51), text document preparation (7.30), word processing in general (7.24), MS PowerPoint (7.22) and developing a script for radio talk (7.06) recorded the highest aggregate need scores (maximum attainable 9, summed across cadres). Tamil Nadu Agricultural University's main campus (2.74), Krishi Vigyan Kendras in the districts (2.37) and the Joint Director of Agriculture's office (2.21) were the most preferred training venues, three to five days the most preferred duration (47.11%), lecture with audio-visual aids (7.09) the most preferred method, and TNAU main-campus scientists (2.79) the most preferred trainers. Non-availability of latest journals in the office library (65.29%), lack of chances for attending trainings, seminars and workshops (57.02%) and limited guidance from higher officials (44.63%) were the leading constraints in information acquisition; more time spent on miscellaneous work (73.55%) and inadequate time (71.07%) dominated information processing constraints; and inadequate funds (76.86%) and lack of conveyance facilities or mobile audio-visual units (69.42%) dominated dissemination constraints. These findings indicate that future capacity building for this cadre should be built around short (three to five day), TNAU/KVK-anchored, lecture-cum-AV-aid programmes on digital documentation and presentation skills, while institutional constraints of time, funds and library access are addressed in parallel, and are synthesised into a strategic model linking capacity building, constraint removal and cadre-specific training design to transform extension personnel into future "Information Managers".

Keywords: Capacity building needs, Constraints, Information management, Strategic model, Extension personnel

Introduction

Agricultural extension systems worldwide are undergoing a sustained digital transition in which extension personnel are expected to function not merely as technology disseminators but as active managers of information, drawing it from an expanding range of sources, processing it for local relevance, and pushing it out through an equally expanding range of channels (Roy *et al.*, 2025) [2]. Realising this transition depends on whether capacity building programmes are designed around what extension personnel themselves say they need, rather than around a generic, one-size-fits-all training calendar, since a recent multi-state review of Krishi Vigyan Kendra personnel found that the lack of training opportunity, rather than infrastructure availability or cost, was the single largest constraint reported to ICT tool adoption (Singh *et al.*, 2026) [1], and a systematic review of climate-resilient extension services across Africa similarly identified interpreting data, using digital tools and systems-based reasoning as the specific competency gaps underlying weaker service delivery, ahead of the more commonly discussed problems of advisor-to-farmer ratios and funding alone (Nkhwashu *et al.*, 2026) [3].

This need-based framing matters because digital competency among extension professionals in India remains, on the most recent standardised assessment available, only medium for close to half of those surveyed (Mukherjee *et al.*, 2026) [4], despite widespread awareness of digital tools, indicating that awareness and even access have outpaced structured, targeted skill-building. Evidence from a comparable Farm Science Centre training-needs study likewise found that assessed needs, rather than administrators' assumptions, produced sharply different priority rankings for subject matter, venue, duration, method and trainer preference among extension functionaries (Khan *et al.*, 2023) [5], reinforcing that capacity building planned

Corresponding Author:

Anand Karthikeyan
Associate Professor and
Head (Agricultural
Extension), Department of
Agricultural Extension and
Communication,
Vanavarayar Institute of
Agriculture, Pollachi – 642
103, Coimbatore District,
Tamil Nadu, India

without directly assessing personnel preferences risks investing training resources in areas or formats extension personnel are least likely to act on.

A composite Information Management Index has already been reported for Tamil Nadu's extension cadre, together with item-level detail on the specific sources, processing methods and dissemination channels underlying it, but this body of work has so far described only present information management behaviour, leaving unanswered the forward-looking question of what future capacity building extension personnel themselves consider necessary, in which subject matter areas, through which venue, duration, method and trainer, and which specific constraints currently limit their information acquisition, processing and dissemination. Without this evidence, capacity building investment for this cadre risks being generic rather than targeted, and constraint-removal efforts risk being generic rather than stage-specific. The present study addresses this gap by assessing the future capacity building needs and the acquisition, processing and dissemination constraints of the same extension personnel population, and synthesising the results into a strategic model for empowering them as future "Information Managers".

Materials and Methods

The study was conducted in Coimbatore, Tiruppur and Erode districts of Tamil Nadu using an ex post facto research design (Singh, 1980) [6] during 2013-14, covering all blocks in the three districts. Of 154 extension personnel in position, comprising Agricultural/Horticultural Officers (AO/HO, $n = 64$), Assistant Directors of Agriculture/Horticulture (ADA/ADH, $n = 33$) and Deputy Directors of Agriculture/Horticulture (DDA/DDH, $n = 24$), 121 responded to a structured, pre-tested mailed questionnaire, the same sample and instrument previously used to construct this population's composite Information Management Index (Anand *et al.*, 2014) [7]. Future capacity building needs were assessed across four preference dimensions, namely subject matter area (31 items), venue of training (14 options), method of training (35 options) and choice of trainer (8 options), each rated by respondents on a three-point continuum (most needed/preferred = 3, needed/preferred = 2, not needed/preferred = 1). A mean score (maximum attainable 3) was computed separately for the AO/HO, ADA/ADH and DDA/DDH cadres for every item, and the three cadre-wise mean scores were summed to obtain an aggregate score (maximum attainable 9) used to rank items overall; duration of training (6 options) was assessed as the percentage of respondents preferring each option and ranked accordingly. Constraints in information management were assessed separately for the three sequential components of the information management cycle, namely acquisition, processing and dissemination, using pre-tested constraint statements administered on a two-point (Yes/No) scale; the number and percentage of respondents reporting each constraint were computed and constraints within each component were ranked accord-

ingly. Data for all dimensions were pooled across the AO/HO, ADA/ADH and DDA/DDH cadres and are presented descriptively as aggregate scores, percentages and ranks, consistent with the need-assessment and constraint-identification objective of this communication; no statistical significance testing was performed, and all data were collected with the respondents' informed consent.

Reliability and validity of the schedule

The mailed questionnaire comprised four parts covering profile characteristics, attitude towards ICT tools, information management patterns with constraints, and capacity building needs; all four parts, including the capacity-building and constraint sections used in the present study, were pre-tested on a non-sample group of extension personnel in an adjoining district and refined before administration. The psychometric soundness of the schedule is further supported by the independent validation carried out for the embedded ICT-attitude scale forming part of the same instrument: a split-half reliability coefficient of 0.698 (Spearman-Brown corrected, significant at one per cent probability) and a content validity index of 2.82 against a 2.5 acceptance threshold based on thirty subject-matter judges' ratings (Anand *et al.*, 2014) [8], both comfortably exceeding the minimum thresholds conventionally accepted for schedules comparing group means. Since the capacity-building and constraint items were drawn from the same pre-tested, expert-vetted instrument and administered to the same respondents under identical conditions, this independently validated reliability and validity of the co-administered attitude scale provides converging evidence for the soundness of the data reported here.

Results

Future capacity building needs in subject matter areas

Of the 31 subject matter areas rated (Table 1), digital documentation and presentation skills dominated the highest-ranked needs: MS Word (7.51), text document preparation (7.30), word processing in general (7.24) and MS PowerPoint (7.22) were the four most needed areas, followed by developing a script for radio talk (7.06), multimedia usage (6.76), the MS Excel package (6.64) and developing a script for TV talk (6.64). Composing mail through online mode (6.44) and transferring an idea into a popular article (6.60) completed the top ten. The lowest-ranked needs were preparing an Interactive Multimedia Compact Disc (IMCD) (4.17) and developing an audio cassette with field experience (4.10), the two most specialised and least routinely used skills among those assessed. Since these two aggregate scores are computed by summing three cadre-wise means (maximum attainable 9 per item, see Materials and Methods), the highest-need items (aggregate scores above 7.0, or a cadre-wise mean above 2.33 out of 3) represent needs that at least two of the three cadres independently rated close to "most needed", rather than needs driven disproportionately by any single cadre.

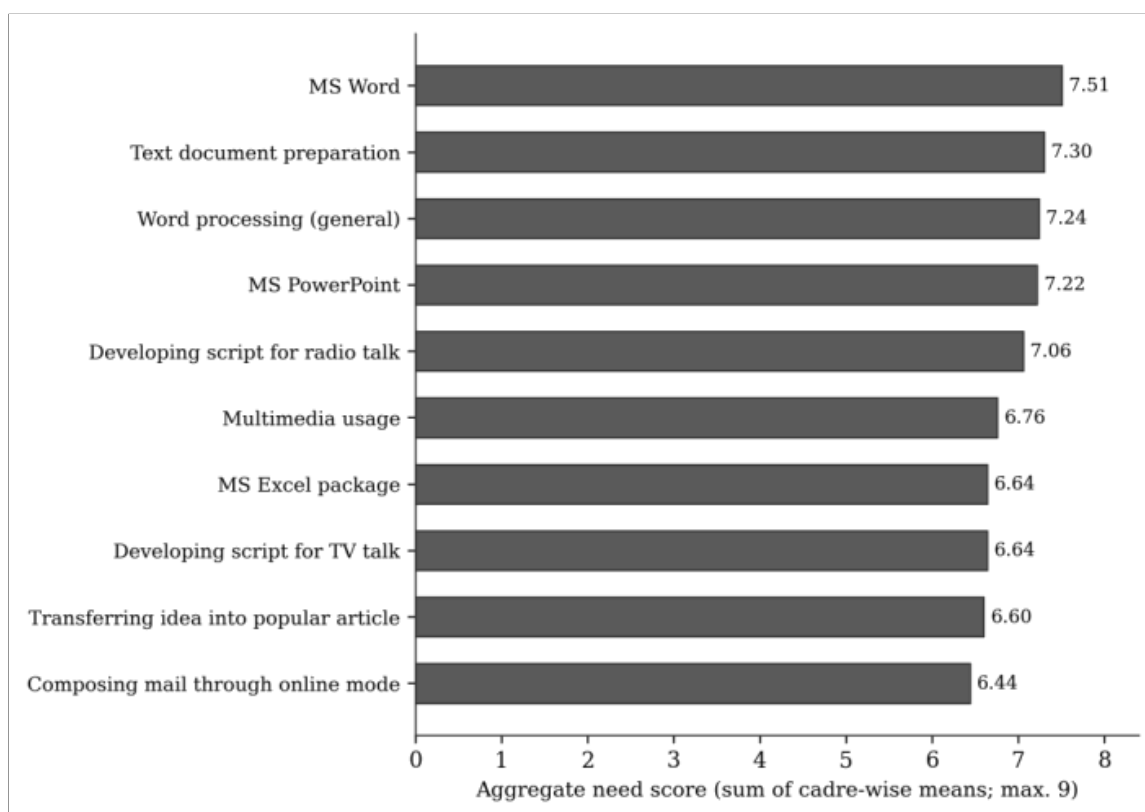


Figure 1. Top ten subject matter areas for future capacity building of extension personnel ($n = 121$)

Table 1. Top ten subject matter areas for future capacity building of extension personnel ($n = 121$)

Rank	Subject matter area	Aggregate score
1	MS Word	7.51
2	Text document preparation	7.30
3	Word processing (general)	7.24
4	MS PowerPoint	7.22
5	Developing script for radio talk	7.06
6	Multimedia usage	6.76
7	MS Excel package	6.64
7	Developing script for TV talk	6.64
9	Transferring idea into popular article	6.60
10	Composing mail through online mode	6.44

Note: Aggregate score = sum of the mean need-intensity scores (each on a 3-point continuum, maximum 3) of the AO/HO, ADA/ADH and DDA/DDH cadres for that item; maximum attainable aggregate score 9, $n = 121$.

Preferred venue, duration, method and trainer for future training

Regarding venue (Table 2, aggregate score, maximum attainable 9), Tamil Nadu Agricultural University's main campus at Coimbatore (2.74) was the most preferred, followed by Krishi Vigyan Kendras in the districts (2.37) and the Office of the Joint Director of Agriculture in the concerned district (2.21). For duration, close to half of the extension personnel (47.11%) preferred a three-to-five day programme, well ahead of two days (31.40%) and two weeks (10.74%). Among training methods, lecture combined with audio-visual aids (7.09) was clearly preferred, followed by group discussion (6.48), exhibitions (6.28), field trips (6.26) and brainstorming (6.22); at the other end, individualised instruction (3.60) was the least preferred method among the 35 assessed. For choice of trainer, TNAU main-campus scientists (2.79) were most preferred, followed by subject matter specialists from Krishi Vigyan Kendras (2.24) and experts from other State institutes (2.21), with corporate officials (0.64) and NGO functionaries

(0.33) least preferred. The consistent preference for public-sector, institutionally familiar venues and trainers over corporate or NGO alternatives is consistent with the adoption literature's general finding that a locally credible, trusted source strengthens receptivity to a training message independently of its technical content, while the sharply peaked preference for a three-to-five day duration reflects the practical constraint that extension personnel cannot be released from field duties for longer without disrupting service delivery to farmers.

Table 2. Preferred venue, duration, method and trainer for future capacity building of extension personnel ($n = 121$)

Dimension	Leading preference	Score / %
Venue (Rank I)	Tamil Nadu Agricultural University, main campus, Coimbatore	2.74
Venue (Rank II)	Krishi Vigyan Kendra in the district	2.37
Venue (Rank III)	Office of Joint Director of Agriculture, district	2.21
Duration (Rank I)	Three to five days	47.11%
Duration (Rank II)	Two days	31.40%
Method (Rank I)	Lecture with audio-visual aids	7.09
Method (Rank II)	Group discussion	6.48
Method (Rank III)	Exhibitions	6.28
Trainer (Rank I)	TNAU main-campus scientists	2.79
Trainer (Rank II)	Subject matter specialists, Krishi Vigyan Kendras	2.24
Trainer (Rank III)	Experts from other State institutes	2.21

Note: Venue, method and trainer scores are aggregate preference scores (sum of the AO/HO, ADA/ADH and DDA/DDH cadre-wise mean scores,

(continued on next page)

each out of 3; maximum attainable 9); duration figures are percentage of respondents ($n = 121$).

Constraints in information acquisition, processing and dissemination

Constraints reported by extension personnel differed by stage of the information management cycle (Table 3). In information acquisition, non-availability of the latest scientific or popular journals in the office library (65.29%) was the leading constraint, followed by lack of ade-

quate chance for attending trainings, seminars and workshops (57.02%) and limited guidance from higher officials (44.63%). In information processing, more time spent on miscellaneous work (73.55%) and inadequate time (71.07%) were the two leading constraints, well ahead of lack of updated information (52.07%). In information dissemination, inadequate funds (76.86%) and lack of conveyance facilities or mobile audio-visual units (69.42%) were the two leading constraints, followed by the large number of clients to be served (45.45%).

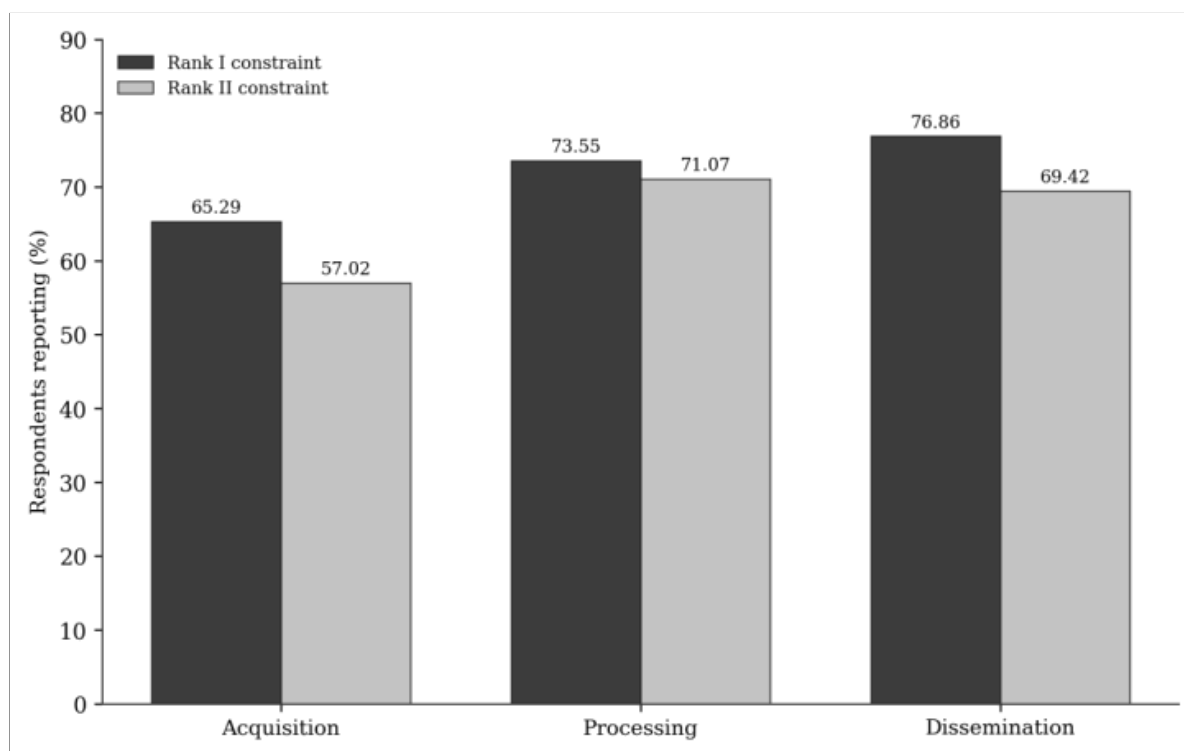


Figure 2. Leading constraints reported by extension personnel in information acquisition, processing and dissemination ($n = 121$)

Table 3. Leading constraints in information acquisition, processing and dissemination reported by extension personnel ($n = 121$)

Component	Leading constraint	%	Rank
Acquisition	Non-availability of latest journals in office library	65.29	I
Acquisition	Lack of chance for trainings/seminars/workshops	57.02	II
Acquisition	Limited guidance from higher officials	44.63	III
Processing	More time spent on miscellaneous work	73.55	I
Processing	Inadequate time	71.07	II
Processing	Lack of updated information	52.07	III
Dissemination	Inadequate funds	76.86	I
Dissemination	Lack of conveyance facilities / mobile AV units	69.42	II
Dissemination	Large number of clients to be served	45.45	III

Discussion

The concentration of the highest capacity-building needs in MS Word, text and PowerPoint document preparation, ahead of more specialised digital skills such as multimedia usage or IMCD planning, indicates that a large share of this cadre's future training demand lies in consolidating routine digital documentation and presentation competency rather than in advanced or niche digital skills. This is consistent with recent evidence that digital competency among Indian extension professionals remains only medium for close to half of those assessed despite general awareness of digital tools (Mukherjee *et al.*, 2026) [4], suggesting that the present sample's own stated needs correctly identify basic-to-intermediate documentation skill, not exotic digital tools, as the priority training gap to close first.

The strong preference for short, three-to-five day, TNAU/KVK-anchored, lecture-with-AV-aids training, and for TNAU or KVK scientists as trainers rather than corporate or NGO resource persons, mirrors a broader Indian pattern in which extension functionaries' assessed training-needs priorities for subject matter, venue, duration, method and trainer diverge from what administrators typically assume, and points to the same practical implication: capacity building anchored in familiar public-sector institutions, delivered in short, AV-aid-supported formats, is more likely to be attended and acted upon than longer or externally-sourced alternatives (Khan *et al.*, 2023) [5]. It is also consistent with a wider systematic review finding that the specific competency gaps limiting extension service delivery lie in interpreting data and using digital tools rather than in advisor numbers or funding alone, reinforcing that skill-specific, format-appropriate training, rather than broader staffing or budget increases in isolation,

is the more directly actionable lever available to training planners (Nkhwashu *et al.*, 2026) [3].

The constraint pattern observed here, dominated by non-availability of library resources and training opportunity in acquisition, time pressure in processing, and funds and mobility in dissemination, aligns closely with the finding that lack of training opportunity, ahead of infrastructure availability or cost, is the largest constraint reported to ICT-enabled extension work in a comparable cadre (Singh *et al.*, 2026) [1], and echoes an evolving view of extension as fundamentally an information-management function whose effectiveness depends on removing stage-specific bottlenecks across the full acquisition-processing-dissemination cycle rather than addressing any one stage in isolation (Roy *et al.*, 2025) [2]. Notably, the leading constraint in each of the three components (library non-availability, miscellaneous workload, and inadequate funds) is largely outside the individual extension officer's control, indicating that institutional and administrative remedies, rather than officer-level skill deficits alone, are what training design must be paired with if capacity building gains are to translate into improved information management performance.

These findings are broadly consistent with a training-needs assessment of extension functionaries elsewhere in India, which similarly found that specific, locally-anchored institutional venues and structured need-based content, rather than generic training calendars, produced the highest reported training-need alignment among comparable functionaries (Khan *et al.*, 2023) [5], strengthening confidence that the present findings reflect a generalisable capacity-building pattern for public extension cadres rather than a purely local one.

Taken together, the capacity building needs, preferences and constraints reported here support a strategic model (Figure 3) in which subject-matter needs, training-format preferences and profile/attitudinal determinants jointly inform cadre-specific, need-based training interventions anchored in TNAU and KVK institutions, delivered in short, lecture-cum-AV-aid formats; these interventions, paired with institutional removal of the funds, time and library-access constraints identified above, are proposed to strengthen the acquisition-processing-dissemination cycle across cadres and progressively transform extension personnel into future "Information Managers" equipped to serve the farming community more effectively.

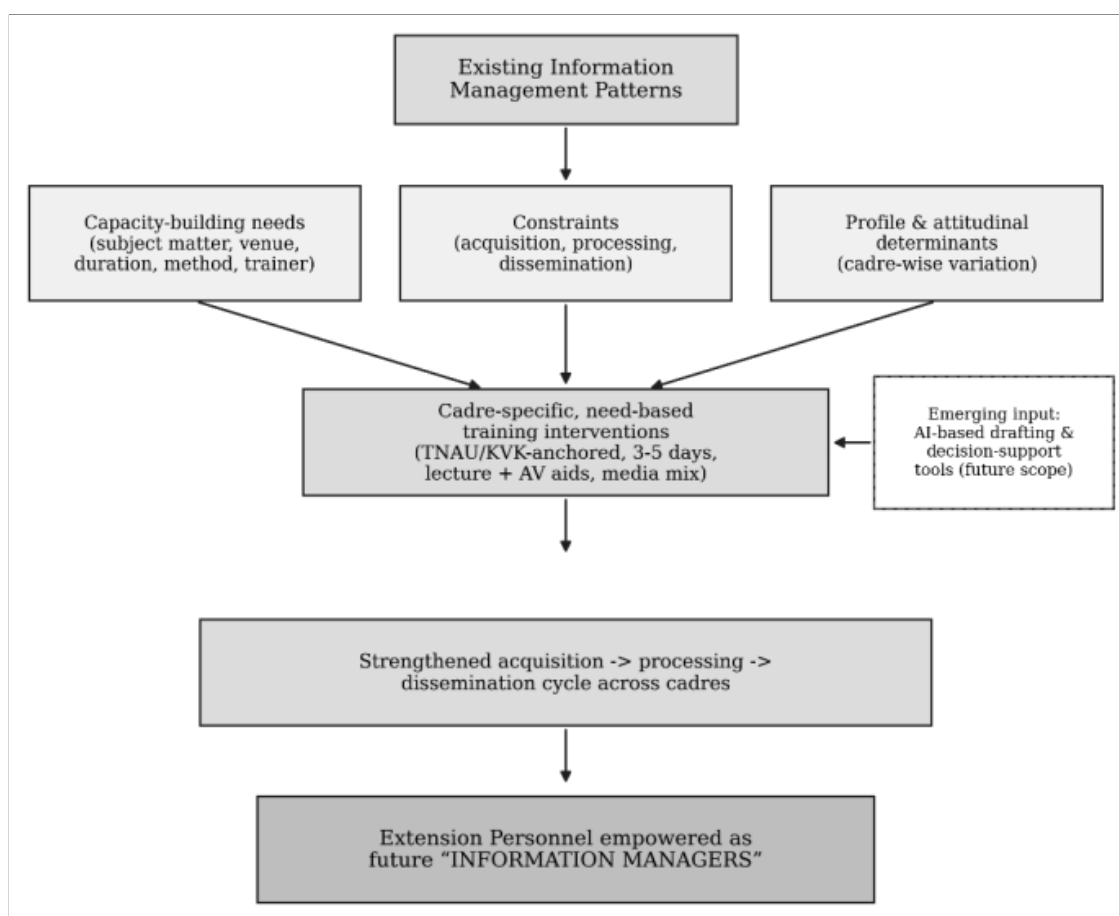


Figure 3. Proposed strategic model for empowering extension personnel as future "Information Managers"

Future outlook: role of Artificial Intelligence in extension information management

The present findings also carry a forward-looking implication that extends beyond the 31 subject matter areas originally assessed: since data collection for this study, generative Artificial Intelligence (AI) and large language model (LLM)-based tools have emerged as a further, high-potential input to exactly the documentation, scripting and dissemination tasks that dominate the top of Table 1. A structured field study of 240 extension agents in Benin found that generative AI use was positively associated with improved advisory effectiveness, functioning as a decision-support aid that increased the speed, precision and relevance of the advice given, although agents' actual behavioural intention to adopt it remained more cautious than their attitudes toward it, reflecting professional accountability and trust con-

cerns rather than technological resistance as such (Gouroubera *et al.*, 2026) [9]. A bibliometric analysis of 337 Scopus-indexed studies on AI in agricultural extension published between 2010 and 2025 similarly concluded that hybrid systems, in which AI supplements rather than replaces human extension judgement, are likely to be the most successful future extension model, combining scalability with the inclusive, locally-adapted advisory relationship that farmers value (Saha *et al.*, 2026) [10]. Closer to the present study's own setting, a recent technical evaluation of AI-based advisory tools piloted with roughly 800 farmers in Bihar, India and Kenya reported strong user satisfaction with LLM-based, voice-enabled advisory systems that integrate weather, soil and market data with curated agricultural knowledge bases, while also flagging language coverage and knowledge-base maintenance as continuing practical challenges (AIEP Initiative *et al.*, 2026) [11].

Read against the present results, these developments suggest two concrete extensions to the strategic model proposed here. First, several of the highest-ranked capacity-building needs identified in this study, including document and presentation preparation, radio- and TV-script writing, and popular-article writing, are precisely the tasks that generative AI tools can accelerate as a drafting aid without displacing the extension officer's own technical judgement and local knowledge; AI-assisted document and content generation therefore merits inclusion as an emerging subject-matter area in future iterations of this needs assessment, delivered through the same TNAU/KVK-anchored, short-duration, lecture-cum-hands-on format already preferred by this cadre. Second, AI-based decision-support tools offer a direct, low-cost lever against the leading processing and dissemination constraints identified in Table 3, namely time pressure from miscellaneous workload and inadequate funds and mobility for reaching farmers, since AI-assisted drafting and translation can reduce the time cost of preparing information materials and voice- or chatbot-based dissemination can partially substitute for physically constrained outreach. These extensions are offered as a research and policy direction rather than as tested findings of the present study, and are consistent with the hybrid, AI-supplementing-rather-than-replacing-human-judgement model that the wider literature currently recommends for extension services.

Conclusion

Assessing the future capacity building needs and constraints of 121 extension personnel in Tamil Nadu, using a schedule pre-tested for this population and independently supported by the split-half reliability and content validity established for its co-administered ICT-attitude scale, shows that the largest training demand lies in consolidating basic-to-intermediate digital documentation and presentation skills, best delivered through short, TNAU/KVK-anchored, lecture-cum-AV-aid programmes led by familiar public-sector scientists, while the leading constraints across information acquisition, processing and dissemination are predominantly institutional (library access, training opportunity, time and funds) rather than skill-based. This distinction matters for policy because it indicates that capacity building investment alone, without parallel institutional remedies for the identified constraints, is unlikely to fully translate into stronger information management performance. The strategic model proposed here, linking capacity-building needs, format preferences and constraint removal to cadre-specific training design, offers extension administrators a practical, evidence-based basis for empowering extension personnel as future "Information Managers" for the benefit of the farming community, with the emerging role of AI-based decision-support and drafting tools identified as a concrete direction for extending this model as such tools mature. As a descriptive, single-population study, these findings are illustrative for Tamil Nadu's State Department of Agriculture cadre; replicating this need-and-constraint assessment across other States and departments, and empirically testing AI-assisted capacity building interventions against the priorities identified here, would help establish how generalisable and how actionable the present findings are elsewhere in India.

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