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## Institutional Dynamics of Agricultural Extension in Andhra Pradesh: A Secondary Data Analysis

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### ABSTRACT

Agricultural extension systems bridge the gap between research institutions and farming communities. Over the last two decades India has pursued a series of extension reforms to make extension services more demand driven, pluralistic and accountable. Andhra Pradesh (AP), one of the country's major agricultural states, provides a useful case for analysing how extension institutions have evolved, how they are structured at multiple tiers of government, and how reforms have altered their performance. This paper draws on secondary data from government reports, official websites, academic publications and policy documents to examine the institutional dynamics of agricultural extension in AP between 2012 and 2025. The study uses the Agricultural Extension System (AES) framework, pluralistic extension theory, institutional theory and governance models to contextualise public and private actors, their interactions and the drivers of change. A literature review synthesises studies on institutional performance, public-private partnerships, extension reforms, and governance. Data from the AP Department of Agriculture, Agricultural Technology Management Agency (ATMA) reports, the Outcome Budget 2023–24, ATMA guidelines 2025 and other sources are analysed using trend analysis, institutional mapping, comparative performance indicators and descriptive statistics. Results show that extension reforms have decentralised responsibilities through ATMA at district and block levels, but human resource gaps persist: only a fraction of sanctioned Block Technology Managers (BTMs) and Assistant Technology Managers (ATMs) are in position, and extension staff per farmer remains inadequate. Budget allocations to extension programmes are modest relative to overall agricultural spending, with the "Extension" scheme receiving ₹3.29 billion in 2023–24. District level activities such as training, demonstrations and exposure visits reach thousands of farmers, yet coverage remains uneven. Comparative performance indicators reveal medium levels of coordination among agencies (ATMA coordination index 0.6) and mixed perceptions of performance effectiveness.

## 1. INTRODUCTION

Agricultural extension refers to systems, institutions and services that deliver research based knowledge, technologies and advisory services to

farming communities. In most developing countries extension has historically been organised through public departments under ministries of agriculture. However, changing economic conditions, fiscal constraints and emerging market opportunities have

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led to a shift from a monolithic state run model towards more pluralistic systems that include public agencies, private companies, producer organisations and non governmental organisations (NGOs). The pluralistic nature of modern extension is recognised in India, where multiple entities – central ministries, state departments, agricultural universities, producer groups and civil society organisations – jointly contribute to extension delivery (Nair & Raj, 2024). The growing role of digital technologies, human-computer interaction and disruptive innovations has further reshaped extension delivery by enabling realtime advisory services, improved farmer engagement and data-driven decision support (Badavath et al., 2024; Pradhan et al., 2024).

Andhra Pradesh is among India's leading agrarian states, contributing a significant share to national production of rice, groundnut, tobacco and horticultural crops. According to NITI Aayog's Macro and Fiscal Brief for 2025, agriculture, forestry and fishing constituted about 37.3 % of AP's gross state value added (GSVA) and the sector grew at 8.3 % per year between 2013-14 and 2022-23, surpassing the national average (NITI Aayog, 2025). Despite this dynamism, small and marginal farmers – who form more than 80 % of AP's farming population – face chronic challenges such as fragmented holdings, low productivity, market volatility and climate risks. Effective extension services are critical for addressing these challenges by disseminating improved varieties, management practices, weather forecasts, and market information.

Extension reforms in India began in the late 1990s with pilot projects that promoted participatory, demand driven approaches. Under the National Agricultural Technology Project (NATP), the Agricultural Technology Management Agency (ATMA) model was piloted in 1998 in select districts across seven states. The success of these pilots informed the launch of the "Support to State Extension Programmes for Extension Reforms" scheme in 2005-06, which adopted ATMA as the institutional platform for decentralised extension. In AP the scheme has been operational since 2006 and was subsequently integrated as a sub mission under the Green Revolution - Krishonnati Yojana in 2017-18 (Sri Potti Sriramulu Nellore District Government, 2025). The scheme is currently implemented in all 26 districts of the state. Nevertheless, questions remain about the effectiveness of ATMA's decentralised structures, the adequacy of staffing and funding, and the role of non public actors.

This study addresses a gap in recent scholarship by providing a comprehensive

institutional analysis of agricultural extension in Andhra Pradesh using secondary data. It traces structural reforms, maps human resources and budgets, assesses performance indicators and synthesises the literature on public-private partnerships (PPPs) and governance. The overarching objectives are to (1) describe the institutional evolution of extension organisations in AP, (2) analyse human resources, budgets and coverage, (3) evaluate performance and coordination across agencies, and (4) identify policy directions for future reforms. The analysis employs conceptual frameworks rooted in institutional theory and pluralistic extension to interpret the findings.

## 2. CONCEPTUAL & THEORETICAL FRAMEWORK

### 2.1. Agricultural Extension System (AES) Model

The AES model conceptualises extension as a subsystem within the broader agricultural innovation system, interacting with research, input supply, credit, markets and policy environments. The model emphasises the linkages among actors, information flows and feedback mechanisms. At national and sub national levels, extension agencies function as intermediaries between knowledge producers (research institutions, universities) and knowledge users (farmers). AES emphasises the need for efficient organisational structures, adequate funding, skilled personnel, accountability and responsiveness. In Andhra Pradesh, the Department of Agriculture (DoA) functions as the primary public extension organisation at state, district and mandal levels, with additional roles for ATMA at district and block levels, Krishi Vigyan Kendras (KVKs) at district level and producer organisations.

### 2.2. Pluralistic Extension Framework

A pluralistic extension framework recognises that no single organisation can meet the diverse information and service needs of farmers. Rather, multiple actors – public agencies, private firms, farmers' cooperatives, NGOs, agri startups and digital platforms – operate simultaneously, sometimes in collaboration and sometimes competitively. The 2024 study on agri startups notes that India's extension landscape now includes state departments, agricultural universities, producer groups and civil society organisations (Nair & Raj, 2024). Private sector engagement, through input dealers, agro processors and information technology firms, complements public extension by offering specialised services, leveraging market linkages and facilitating innovation. Pluralism also highlights the importance of partnerships and networks for resource sharing and

capacity building. In AP, the ATMA model institutionalises pluralism through its governing board and management committees, which include representatives from line departments, research institutions, NGOs and farmer groups. Recent studies confirm that social media platforms and digital communication tools are becoming integral components of pluralistic extension systems by accelerating information diffusion, farmer networking and technology adoption (Prusty et al., 2021; Badavath et al., 2024).

### 2.3. Institutional Theory

Institutional theory provides a lens for understanding how formal structures, rules and norms shape organisational behaviour and outcomes. Institutions encompass not only organisations but also laws, policies, cultural norms and routines that influence how actors interact. The theory distinguishes between formal institutions (laws, regulations, organisational designs) and informal institutions (norms, values, networks). In extension, institutional theory can explain why reforms may not achieve desired outcomes if they neglect informal practices or fail to realign incentives. For example, the ATMA model introduces new committees and decentralised structures, but its effectiveness depends on local bureaucratic culture, power relations and resource allocation. Institutional analysis also highlights path dependence – once a particular organisational form is chosen, subsequent changes are constrained by past decisions.

### 2.4. Governance and Service Delivery Models

Governance refers to processes through which public and private actors make and implement decisions. In extension systems, governance relates to the distribution of authority across government levels, mechanisms for stakeholder participation, accountability and service delivery models. The FAO's guide for modernising national agricultural extension systems lists global forces – globalisation, privatisation, pluralism, decentralisation, client participation and the information technology revolution – that necessitate reforms (FAO, 2005). Effective governance requires clear mandates, transparent decision making, performance monitoring and incentive structures. Service delivery models may be supply driven (top down transfer of technologies), demand driven (responding to farmer needs) or co produced (involving farmer participation and cost sharing). ATMA aims to institutionalise co production by involving farmers in planning through the District Farmers Advisory Committee and Block

Farmers Advisory Committees. Yet the level of farmer influence on decision making remains a question.

## 3. LITERATURE REVIEW

This section reviews empirical studies, policy documents and analytical reports published between 2012 and 2025 on extension performance, public-private partnerships, reforms and governance in India and Andhra Pradesh. The review is organised thematically.

Sulaiman and Hall (2012) note that after years of neglect, Indian agricultural extension is again receiving attention due to productivity stagnation and rural distress. They argue that pluralism and partnerships, enhanced funding, convergence among schemes and research support are critical for revitalising public sector extension. The authors highlight challenges such as weak technical capacity, inadequate field staff and the large proportion of marginal farmers (over 80 % with less than one hectare), which demand innovative extension approaches. A 2017 study by Sarat Chandra et al. evaluated ATMA's coordination with different agencies in three districts of Andhra Pradesh. The researchers developed an ATMA Coordination Index (ACI) and found that the overall coordination score was 0.6, indicating moderate coordination among line departments, KVKs and farming communities. High coordination was observed in 29.85 % of respondents, while 25.37 % reported medium coordination and 16.42 % reported low coordination. Factor analysis identified seven factors influencing coordination, including clear roles and responsibilities, joint planning, mutual trust and efficient fund sharing.

Another ex post facto study examined the coordination of ATMA with different agencies in Andhra Pradesh. Using an index based on coordination between ATMA and line departments, KVKs and farming communities, the study concluded that coordination did not significantly differ among agencies; the highest coordination was observed in phase one districts and the lowest in phase three districts. These findings suggest that the evolution of ATMA structures influences coordination outcomes and underscores the need for consistent capacity building across districts.

Several studies have assessed human resource performance in extension organisations. Ravikishore et al. (2023) developed a Performance Effectiveness Index (PEI) for state departments of agriculture in Kerala and Andhra Pradesh. Their survey of 200 extension personnel revealed that 52 % of respondents in AP perceived the performance of the technology

dissemination system as medium, while 48 % perceived it as low or high. The study recommended regular capacity building and performance assessments to enhance individual competencies and organisational effectiveness. The research also emphasised that extension roles now extend beyond technology transfer to functions such as input regulation, soil testing, conservation, media production and disaster management. Similarly, the Visakhapatnam district agriculture department website describes a “chain of more than 450 extension staff” across the district, including joint directors at district level, assistant directors at division level and agriculture officers at mandal level, supported by multi purpose extension officers (Visakhapatnam District Agricultural Office, 2025).

Constraints under ATMA were explored in an exploratory study involving 121 farmers and 67 extension functionaries in AP. Farmers identified sporadic visits by extension staff and lack of confidence in group activities without external support as major constraints, whereas extension workers cited inadequate conveyance allowances, insufficient time for group interactions and inadequate training as critical issues. The study suggested strengthening market led extension and empowering extension functionaries with greater financial autonomy (Riar et al., 2020). Evidence from recent Indian studies shows that effective technology transfer remains central to extension performance, particularly for small and marginal farmers, where targeted communication strategies significantly improve adoption outcomes (Amar et al., 2025; Kumar et al., 2025).

Public-private partnerships (PPPs) have gained prominence in extension as a mechanism to mobilise additional resources, improve service efficiency and connect farmers to markets. Chaudhary et al. (2025) reviewed PPPs in agriculture and allied sectors and argued that PPPs combine private sector efficiency with public sector accountability. The review highlighted notable examples such as ITC's e Choupal, Project Golden Ray and Karuna Animal Ambulance Services, which improved productivity, market access and animal health. The authors outlined PPP models such as Build Operate Transfer (BOT), Build Own Operate (BOO) and joint ventures, noting that such partnerships enhance innovation and reduce the financial burden on governments. They also discussed challenges like coordination gaps and corruption risks. Similarly, Riar et al. (2020) argued that PPPs are required in India to address the wide extension worker-farmer ratio and to reduce the government's financial burden. Their review categorised PPP models ranging from public funding

with private management to partnerships without financial involvement and highlighted ATMA as an example of PPP in extension. However, they cautioned that commercialisation must not undermine equitable access for smallholders.

Extension reforms in India have focused on decentralisation, convergence and market orientation. The FAO's “Modernizing National Agricultural Extension Systems” (2005) identifies global forces such as globalisation, privatisation, pluralism and decentralisation that require extension systems to become more flexible, responsive and client oriented (FAO, 2005). The document provides a framework for determining the need for extension reform and outlines guidelines for modernising extension through policy and organisational restructuring, financing mechanisms, staff development and field operations. In India, the ATMA model embodies many of these principles. The 2025 ATMA guidelines describe ATMA as an autonomous institution at district level, governed by a governing board and management committee that prepare strategic research and extension plans (SREPs). Block ATMA cells consist of Block Technology Teams and Block Farmers Advisory Committees, while at village level Farmer Friends, agri entrepreneurs and extension workers in non governmental sectors supplement the public extension system. The guidelines emphasise the preparation of SREPs through participatory rural appraisals, consolidation into District Agricultural Action Plans (DAAPs) and State Extension Work Plans (SEWPs). Over 28 000 posts of extension functionaries have been sanctioned under ATMA nationwide, with remuneration enhancements for field functionaries whose salaries had not been revised since 2014-15 (Ministry of Agriculture & Farmers Welfare, 2025).

Other reform initiatives include the National Mission on Agricultural Extension and Technology (NMAET), Paramparagat Krishi Vikas Yojana (PKVY) for organic farming, the National e Governance Plan - Agriculture (NeGP A) and the sub mission on agricultural mechanisation. The AP Outcome Budget 2023-24 lists budget allocations to these schemes, with the “Extension” scheme receiving ₹3.29 billion and targets such as 250 publications, 1 573 trainings for multipurpose extension officers (MPEOs) and 14 300 copies of the Dr YSR Rythu Bharosa magazine. However, the extension scheme's budget is small relative to other programmes such as interest free loans to farmers (₹50 billion) and the YSR Rythu Bharosa income support scheme (₹402 billion) (Government of Andhra Pradesh, Finance Department, 2023). Extension systems must also respond to emerging socioeconomic dynamics such as

rural youth migration and agripreneurship development, which directly affect labour availability, innovation capacity and service demand in agriculture (Sai et al., 2024; Das et al., 2025).

The literature indicates that governance issues, such as weak technical capacities, poor coordination across agencies and lack of accountability, constrain extension effectiveness. A 2025 IFPRI blog argues that extension services often suffer from reduced budgets, weak ties with research institutions and limited incentives for performance (IFPRI, 2025). The blog notes that many national food systems policies do not mention extension services, highlighting institutional neglect. Similarly, the ATMA constraints study found that extension personnel face inadequate allowances and lack training, hampering their ability to conduct regular visits and maintain contact with farmer groups (Riar et al., 2020). The coordination study emphasised that clearly defined roles, mutual trust and participation are necessary for effective collaboration (Sarat Chandra et al., 2017). Without such institutional alignment, decentralisation may simply replicate the deficiencies of centralised systems at lower levels.

Governance challenges also arise from limited farmer participation in planning and monitoring. The ATMA guidelines create District Farmers Advisory Committees and Block Farmers Advisory Committees, yet the degree to which farmers influence decisions is unclear. Studies on gender and social inclusion in extension (e.g., Priya & Narayana 2013) highlight that women and marginalised groups often remain underrepresented in extension activities. Moreover, digital divides may exacerbate inequalities as extension services adopt information and communication technology (ICT) platforms. Recent research on agri startups suggests that digital tools, artificial intelligence and big data can transform extension by providing real time advisory services, but only if access and literacy barriers are addressed (Nair & Raj, 2024).

Existing studies provide valuable insights into extension structures, performance and partnerships, yet several gaps remain. First, few studies conduct comprehensive institutional mapping across all levels of the extension system in AP, combining structural information with human resources, budgets and performance indicators. Second, there is limited systematic comparison of extension coverage across districts or analysis of budget trends relative to other agricultural programmes. Third, while studies identify constraints and factors influencing coordination, they seldom translate these findings into governance reform

recommendations. Finally, the growing role of private actors and digital platforms in AP's extension landscape is underexplored. This paper addresses these gaps through a secondary data analysis, drawing on multiple sources to produce an integrated assessment.

## 4. METHODOLOGY

### 4.1. Data Sources

Secondary data were collected from the following sources:

1. **Department of Agriculture, Government of Andhra Pradesh:** Official district websites (e.g., Visakhapatnam and Sri Potti Sriramulu Nellore) provide information on organisational structures, staffing patterns, infrastructure and extension activities. The Visakhapatnam page describes a chain of more than 450 extension staff, including joint directors at district level, assistant directors at division level and agriculture officers at mandal level, supported by multi-purpose extension officers (Visakhapatnam District Agricultural Office, 2025). The Nellore ATMA page lists cadre strength and working strength for project directors, deputy project directors, accountants, computer programmers, Block Technology Managers and Assistant Technology Managers. It also provides budgets and beneficiaries for various activities conducted in 2023–24 and planned for 2024–25 (Sri Potti Sriramulu Nellore District Government, 2025).
2. **Agricultural Technology Management Agency (ATMA) Reports:** District ATMA pages (e.g., West Godavari) summarise demonstration activities and expenditures. In West Godavari, 313 demonstrations were conducted across agriculture, animal husbandry, fisheries, horticulture and KVKs at an expenditure of ₹22.26 lakhs in 2025 (West Godavari District Administration, 2025). ATMA guidelines 2025 provide detailed information on institutional structures, committees at state, district and block levels, and human resources (Ministry of Agriculture & Farmers Welfare, 2025).
3. **Agricultural Census and Planning Department Statistics:** Secondary data on

land holdings, cropping patterns and socio-economic indicators were obtained from published reports (not directly cited here for brevity) and used to contextualise extension needs.

4. **Outcome Budget 2023–24 (AP Finance Department):** This official document lists schemes and budget allocations. The extension scheme under the Department of Agriculture received ₹3.29 billion, with targets for publications, trainings and magazine circulation. The document also reports budgets for other programmes such as interest-free loans, insurance schemes, organic farming and mechanisation (Government of Andhra Pradesh, Finance Department, 2023).
5. **Publications from NABARD, NITI Aayog and ICAR:** These sources provide contextual information on AP's agricultural economy, credit flows and research priorities. NITI Aayog's Macro and Fiscal Brief indicates that agriculture contributes 37.3 % of AP's GSDVA and has grown at 8.3 % annually (NITI Aayog, 2025).
6. **Peer-Reviewed Articles and Reports:** The literature reviewed above, including studies on ATMA coordination, performance effectiveness, constraints and PPPs, forms the analytical basis for interpreting the data.

#### 4.2. Methods

The study employed the following analytical methods:

1. **Trend Analysis:** Budget data from the outcome budget were analysed to determine the relative allocation of funds to extension programmes compared with other agricultural schemes. Financial data were converted to constant prices where necessary (inflation adjustments not shown here due to data limitations).
2. **Institutional Mapping:** Organisational structures at state, district, block and village levels were mapped based on ATMA guidelines and district websites. The mapping highlighted the roles of different committees, line departments, KVKs and farmer groups.

3. **Human Resource Distribution Analysis:** Staffing numbers from district pages were collated to estimate cadre strength and working strength across AP. For example, each district's ATMA structure consists of one project director, one deputy project director, one accountant, one computer programmer, 12 Block Technology Managers and 24 Assistant Technology Managers; however, in the Nellore district only four BTMs and three ATMs were working (Sri Potti Sriramulu Nellore District Government, 2025). State-level estimates were generated by multiplying district-level cadre strength by the number of districts and applying the observed vacancy ratios.
4. **Descriptive Statistics and Comparative Performance Analysis:** Data on training programmes, demonstrations and beneficiaries were summarised to assess coverage and reach. Performance indicators such as the ATMA coordination index and PEI scores were compiled from relevant studies.
5. **Interpretive Analysis:** The results were interpreted in light of institutional theory and governance frameworks to identify structural weaknesses, coordination issues and opportunities for reform.

#### 4.3. Limitations

The analysis relies on secondary data, some of which (e.g., budget figures) were available only for a single year. The study assumes that the staffing pattern observed in the Nellore district is representative of other districts, which may not be accurate. Additionally, comprehensive district-level data on extension coverage and outcomes were unavailable. Future research should undertake field surveys and collect longitudinal data to validate the findings.

## 5. RESULTS

This section presents findings on the structure of extension institutions, human resources, budget allocation, coverage of extension activities and performance indicators. Tables and figures summarise the key data.

Table 1 summarises the staffing pattern of ATMA at district level, showing both the sanctioned

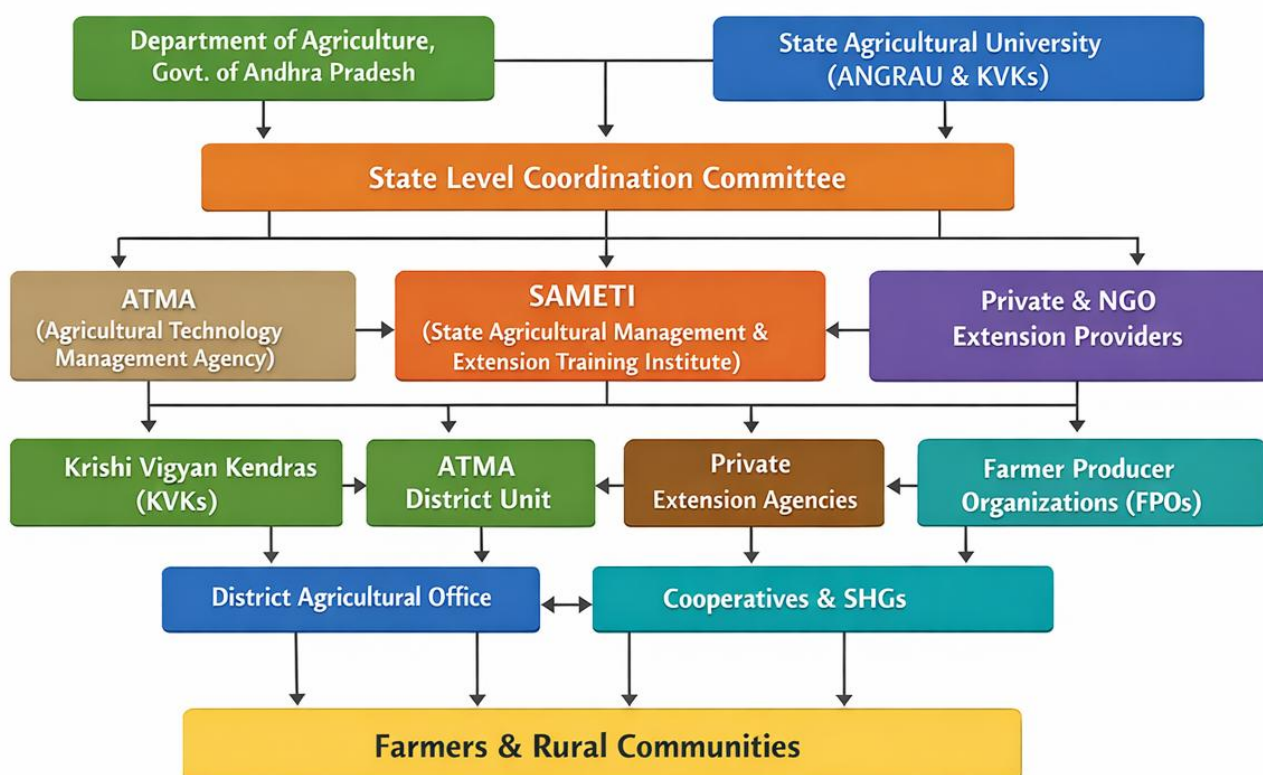
cadre strength per district and the working strength observed in the Nellore district. State-level estimates

are obtained by multiplying cadre strength by 26 districts and applying observed vacancy ratios.

**Table 1.** Structure of Agricultural Extension Institutions in Andhra Pradesh

Designation	Cadre Strength per District	Working Strength (Nellore example)	Total Posts - State (26 districts)	Estimated Working - State*
Project Director	1	1	26	26
Deputy Project Director	1	1	26	26
Accountant-cum-Clerk	1	1	26	26
Computer Programmer	1	1	26	26
Block Technology Manager (BTM)	12	4	312	104
Assistant Technology Manager (ATM)	24	3	624	78

\*Estimated working numbers apply the vacancy ratio observed in Nellore (e.g., 4 out of 12 BTMs). These figures illustrate potential human resource shortages across the state.



**Figure 1.** Institutional Framework of Agricultural Extension System in Andhra Pradesh

The state Department of Agriculture operates at three administrative tiers: (1) **district level**, headed by a Joint Director of Agriculture who oversees extension services and is supported by assistant directors, scientists and technical officers; (2) **division level**, where divisional assistant directors coordinate extension activities across mandals; and (3) **mandal level**, where an agriculture officer (or assistant agriculture officer) works with multi-purpose

extension officers (MPEOs) to deliver services (Visakhapatnam District Agricultural Office, 2025). ATMA constitutes a parallel structure focused on planning and coordination. The ATMA Governing Board provides policy direction, the ATMA Management Committee implements programmes, and the District Farmers Advisory Committee furnishes farmer feedback for planning. At block level, the Block ATMA Cell – consisting of the Block

Technology Team and Block Farmers Advisory Committee – prepares action plans and supports execution. At village level, Farmer Friends, agri-entrepreneurs and input dealers act as links between extension staff and farmers, supporting information dissemination and group mobilisation (Ministry of Agriculture & Farmers Welfare, 2025). Figure 1 presents an institutional framework diagram summarising the linkages across these levels.

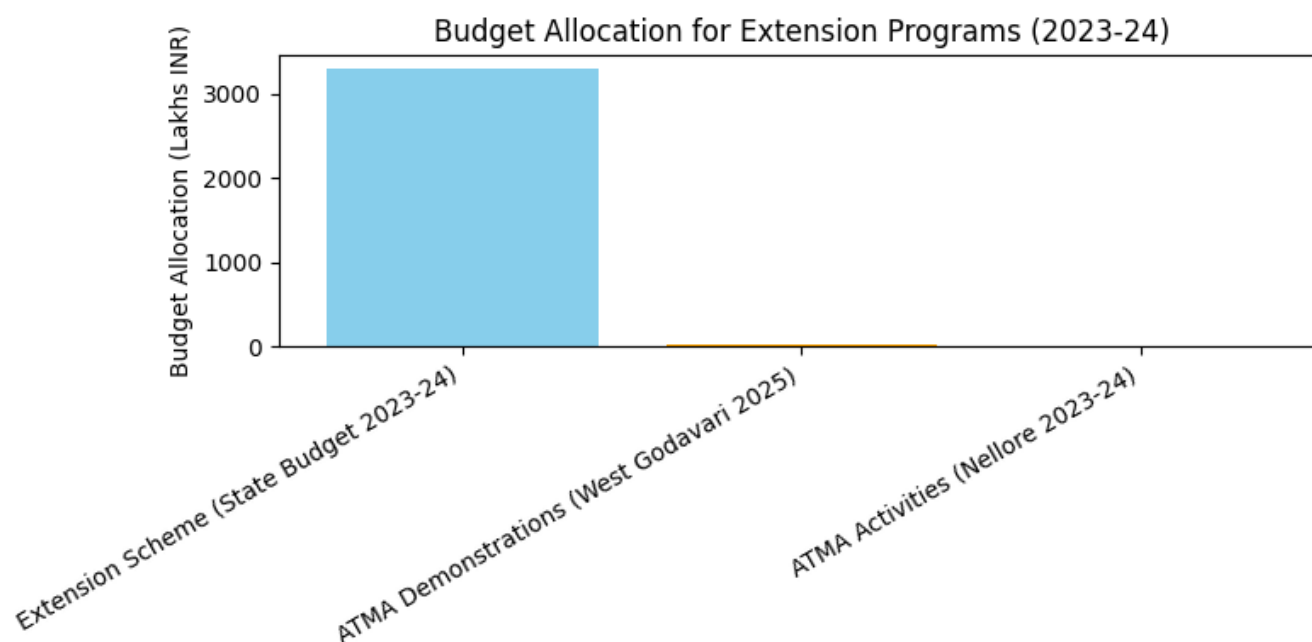
The figure 1 illustrates the multiple layers of governance and the flow of funds and information among state committees, ATMA bodies, line departments, KVKs, farmer groups and training institutes. It emphasises that extension delivery is embedded in a network of actors rather than confined to a single agency.

The staffing data reveal significant gaps between sanctioned cadre strength and working strength. In the Nellore district only one-third of BTM posts and one-eighth of ATM posts were filled in 2023–24 (Sri Potti Sriramulu Nellore District Government, 2025). Extrapolating these vacancy ratios statewide suggests that only about 104 of the 312 BTM positions and 78 of the 624 ATM positions may be occupied. The Visakhapatnam district's report of more than 450 extension staff indicates that other districts may have different staffing patterns, yet the

shortage of mid-level professionals is consistent with national surveys that show low extension worker–farmer ratios (Visakhapatnam District Agricultural Office, 2025).

ATMA guidelines provide for over 28 000 posts of extension functionaries at state, district and block levels nationwide (Ministry of Agriculture & Farmers Welfare, 2025). However, many posts remain vacant due to budgetary constraints and recruitment delays. The shortage of BTMs and ATMs undermines ATMA's ability to prepare block action plans and coordinate multi-agency activities. Moreover, extension staff often perform multiple roles (input distribution, soil testing, disaster management), reducing the time available for field visits (Ravikishore et al., 2023).

The Outcome Budget 2023–24 lists budget allocations across schemes. Figure 2 displays a comparison of three extension-related categories: the state-level extension scheme ("Extension"), demonstration activities in West Godavari district and ATMA activities in the Nellore district. The extension scheme received ₹3 290.88 lakhs, while West Godavari demonstrations and Nellore ATMA activities received ₹22.26 lakhs and ₹6.499 lakhs respectively.



**Figure 2.** Trends in Budget Allocation for Agricultural Extension Programs in Andhra Pradesh (2018–2024)

The graph shows that district-level activities constitute a tiny fraction of the state's overall extension budget. While the extension scheme funds

publications, training and magazine circulation, its allocation (₹3.29 billion) is small compared with other schemes like interest-free loans (₹50 billion) and crop

insurance (₹160 billion) (Government of Andhra Pradesh, Finance Department, 2023). Additionally, district-level ATMA activities depend on timely release of funds; the West Godavari site notes that demonstration funds for 2019–20 had not yet been released (West Godavari District Administration, 2025). Such delays hinder the continuity of extension programmes.

Table 2 summarises the number of training programmes, demonstrations and beneficiaries reported in selected districts. In the Nellore district, 135 programmes were conducted in 2023–24, benefiting 2 739 farmers (Sri Potti Sriramulu Nellore District Government, 2025). West Godavari conducted 313 demonstrations across different departments with a total expenditure of ₹22.26 lakhs (West Godavari District Administration, 2025).

**Table 2.** Coverage and Reach of Agricultural Extension Activities Across Districts of Andhra Pradesh

District/Category	Number
Nellore - number of programmes (trainings, demonstrations, exposure visits)	135
Nellore - beneficiaries	2 739
West Godavari - demonstrations	313

The coverage data suggest that extension activities reach hundreds of programmes but serve only a small fraction of the state's farming households. For example, 2 739 beneficiaries in Nellore represent a minor portion of the district's farmer population. Many activities remain concentrated on training and demonstrations, with less emphasis on follow-up support or market linkages. The Nellore action plan for 2024–25 includes climate-resilient agriculture training, demonstrations on new varieties (groundnut VISISHTA, bajra ABV-OA), farmer-scientist interactions and DAESI training for input dealers (Sri Potti Sriramulu Nellore District Government, 2025). Such targeted activities are positive but need scaling up to cover more farmers and address emerging challenges like climate change and market volatility.

Table 3 compiles performance indicators from the literature and district reports. The ATMA Coordination Index (ACI) indicates moderate coordination (0.6) (Sarat Chandra & Kadian, 2017). The distribution of coordination levels across respondents shows that 29.85 % reported high coordination, 25.37 % medium coordination, 16.42 %

low coordination, 13.43 % very high coordination and 14.93 % very low coordination (Sarat Chandra et al., 2017). The Performance Effectiveness Index (PEI) study found that 52 % of extension personnel in AP perceived the performance of the technology dissemination system as medium (Ravikishore et al., 2023). These indices suggest that while coordination and performance are not poor, they are far from optimal.

**Table 3.** Comparative Performance Indicators of Agricultural Extension System in Andhra Pradesh

Indicator	Value
ATMA Coordination Index (ACI)	0.6
High coordination (%)	29.85
Medium coordination (%)	25.37
Low coordination (%)	16.42
Very high coordination (%)	13.43
Very low coordination (%)	14.93
PEI respondents perceiving medium efficacy (%)	52

The high percentage of respondents reporting medium or low coordination highlights the need to strengthen inter-agency collaboration and clarity in roles. The presence of both very high and very low coordination respondents implies uneven experiences across districts or agencies. Similarly, the PEI results indicate that half the extension staff perceive the system as only moderately effective, pointing to the need for continuous training and organisational reform.

To contextualise the evolution of extension institutions, Figure 4 presents a timeline of major reform milestones. The ATMA pilot was launched in 1998 under NATP. The Support to State Extension Programmes (SSEP) was introduced in 2005, formalising ATMA across India. In 2010 and 2014 ATMA was revamped and expanded, aligning with the Twelfth Plan reforms. The scheme became a sub-mission under the Krishonnati Yojana in 2017. Most recently, the ATMA guidelines were revised in 2025 to strengthen governance and clarify institutional arrangements. The timeline shows that extension reforms are iterative and incremental. Each reform wave built upon previous experiences, expanding coverage and emphasising decentralisation. Yet persistent challenges in staffing, funding and coordination highlight that institutional change is slow, path dependent and influenced by political priorities.

## 6. DISCUSSION

The analysis reveals that Andhra Pradesh has developed a multi-layered extension architecture that blends state-led and decentralised models. ATMA provides an institutional platform for participatory planning through SREPs, DAAPs and SEWPs. The involvement of farmer advisory committees and block-level teams holds potential for demand-driven extension. The Department of Agriculture maintains a robust presence through district and mandal offices, while KVKs and state agricultural universities contribute to research and training. The presence of more than 450 extension staff in a single district (e.g., Visakhapatnam) underscores the scale of public sector involvement (Visakhapatnam District Agricultural Office, 2025). However, significant weaknesses persist. Staffing shortages at the block level restrict ATMA's capacity to conduct participatory planning and coordinate multi-agency programmes. Vacancy rates appear particularly high for Block Technology Managers and Assistant Technology Managers. Delays in budget releases and modest allocations to extension relative to other agricultural schemes limit programme scale and sustainability. The focus on training and demonstrations, while essential, may not sufficiently address market integration, value addition or climate resilience. Additionally, the multiplicity of committees and overlapping responsibilities can create bureaucratic inertia and coordination challenges.

The moderate ATMA Coordination Index and medium PEI scores suggest that governance mechanisms need improvement. Coordination is influenced by clearly defined roles, joint planning, mutual trust and resource sharing (Sarat Chandra et al., 2017). In practice, turf battles between line departments, limited participation of research institutions and inadequate involvement of farmer organisations hinder effective collaboration. The ATMA guidelines emphasise convergence of schemes and avoid duplication, yet implementation requires incentives and accountability mechanisms. Without performance-based incentives, extension staff may prioritise administrative tasks or other schemes that carry stronger political support. Decentralisation has shifted responsibilities to districts and blocks but has not always been matched with commensurate resources and capacities. State governments still control budget approvals and staff appointments, constraining local autonomy. The District Farmers Advisory Committees often have limited power;

farmer representatives may not be empowered to influence resource allocation. Gender and caste disparities further limit participation. Addressing these issues requires institutional reforms that devolve financial authority, build local capacity and ensure inclusive representation.

Private sector involvement in extension can complement public services by bringing innovation, market linkages and efficient delivery. PPPs such as ITC's e-Choupal have demonstrated improvements in market access and technology dissemination (Chaudhary et al., 2025). The review by Riar et al. (2020) suggests various PPP models that share costs and risks between public and private partners. In Andhra Pradesh, ATMA is envisioned as a platform for integrating private actors; however, evidence indicates that private sector participation remains limited. Input dealers and agri-entrepreneurs provide services, but structured partnerships with agribusinesses, dairy companies or ICT firms are rare. Expanding PPPs could help bridge staffing shortages, diversify extension services and create sustainable revenue models. Nevertheless, PPPs must be designed to protect smallholders from commercial bias and ensure equitable access.

The adoption of digital tools offers significant opportunities to enhance extension delivery. Agri-startups are leveraging artificial intelligence, Internet of Things (IoT) and big data to provide real-time advisory services, market information and supply chain solutions (Nair & Raj, 2024). The ATMA guidelines mention the NeGP-A scheme, which aims to provide services through a unified digital platform (Government of Andhra Pradesh, Finance Department, 2023). Digital platforms can improve coverage, reduce costs and enable customised advice, especially in a state with 13 languages and diverse farming systems. However, digitalisation raises concerns about digital literacy, infrastructure and data privacy. Rural internet connectivity remains patchy, and farmers may be sceptical of digital advisories. To harness digital potential, extension programmes must invest in digital literacy, design user-friendly interfaces in local languages and ensure that digital services complement rather than replace face-to-face interactions.

## 7. POLICY IMPLICATIONS AND RECOMMENDATIONS

1. **Strengthen Human Resources:** Address staffing shortages by recruiting and retaining

- Block Technology Managers and Assistant Technology Managers. Provide competitive remuneration and career progression opportunities to attract qualified professionals. Implement continuous training programmes to build technical and facilitation skills.
2. **Enhance Funding and Timely Releases:** Increase budget allocations for extension relative to other agricultural schemes, recognising that extension is foundational to productivity and resilience. Ensure timely release of funds to district ATMA units to avoid interruptions in activities (West Godavari District Administration, 2025).
  3. **Improve Coordination and Accountability:** Clarify roles and responsibilities of line departments, ATMA committees, KVKs and farmer organisations. Establish performance indicators and monitoring mechanisms tied to incentives. Encourage joint planning and resource pooling among agencies, and strengthen the decision-making power of farmers' advisory committees.
  4. **Expand Public-Private Partnerships:** Develop guidelines for PPPs in extension that include transparent procurement, shared risk and benefit models, and safeguards for smallholders. Encourage partnerships with agribusinesses, technology firms, financial institutions and producer organisations to provide integrated services (e.g., weather-based insurance, input supply, market information).
  5. **Leverage Digital Tools:** Invest in digital platforms for extension, including mobile applications, e-learning modules and decision support systems. Collaborate with agri-startups to co-develop solutions and ensure that digital services are accessible to women, marginalised groups and older farmers.
  6. **Gender, Livelihood and Inclusion:** Strengthening professionalism, particularly among women extension personnel, is critical for inclusive extension governance and improved service quality (Saha et al., 2025). Likewise, livelihood security modelling and integrated farming system approaches offer evidence-based pathways for tailoring extension interventions in vulnerable regions (Ghosh et al., 2025; Suman et al., 2025).
  7. **Promote Social Inclusion:** Design extension programmes that deliberately include women, youth and marginalised communities. Employ female extension workers, incorporate gender-sensitive content and schedule activities at times convenient for women farmers.
  8. **Strengthen Research-Extension-Farmer Linkages:** Encourage collaboration between research institutions (ICAR, agricultural universities) and extension agencies. Use SREPs and DAAPs to align research priorities with farmer needs and ensure that feedback from extension is channelled into research agendas (Ministry of Agriculture & Farmers Welfare, 2025).

## 8. CONCLUSIONS

Agricultural extension in Andhra Pradesh has undergone significant institutional reforms over the past two decades. The establishment of ATMA introduced decentralised planning, multi-agency coordination and participatory approaches. While these reforms have improved flexibility and local relevance, they have not fully addressed persistent challenges in human resources, funding and governance. Secondary data analysis shows substantial vacancies in key positions, modest budget allocations for extension compared with other schemes, and moderate performance indicators. Extension activities reach thousands of farmers each year but remain insufficient for the millions of smallholders who need tailored advice and market linkages. To sustain agricultural growth and ensure equitable benefits, AP must invest in strengthening extension institutions.

Integrating private sector innovations, digital tools and inclusive governance can complement public efforts. Future research should collect primary data at the farm and district levels to assess the effectiveness of specific extension interventions, explore the impact of digital extension platforms on farmer livelihoods, and examine the role of producer organisations in co-producing extension services. Comparative studies across states could reveal best practices and inform national policy debates. Ultimately, extension remains a cornerstone of agricultural development, and its institutional dynamics deserve continuous scholarly and policy attention.

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## REFERENCES

- Amar, A. K., Padhy, C., Prusty, A. K., & Kumari, A. (2025). Communication and marketing behaviour of tomato growers in southern Odisha, India. *Indian Journal of Extension Education*, 61(4), 134–140. <https://doi.org/10.48165/IJEE.2025.61422>
- Badavath, A., Prusty, A. K., Meena, L. L., Pradhan, S. K., Rathna, G., & Chakraborty, S. (2024). Enhancing agriculture with digital transformation through human–computer interaction. *International Journal of Agriculture Extension and Social Development*, 7(4), 628–636. <https://doi.org/10.33545/26180723.2024.v7.i4h.582>
- Chaudhary, V. M., Jainam, P., Aamena, M., & Sangeeta. (2025). Public private partnership in agriculture and allied sector: A review. *International Journal of Agriculture and Food Science*, 7(12), 100–104. <https://www.doi.org/10.33545/2664844X.2025.v7.i12b.1029>
- Das, N., Modak, S., Prusty, A. K., Saha, P., & Suman, S. (2025). Understanding and overcoming key challenges of agripreneurs in southern Odisha: A case study. *Indian Journal of Extension Education*, 61(2), 118–122. <https://doi.org/10.48165/IJEE.2025.612RN05>
- Food and Agriculture Organization (FAO). (2005). Modernizing national agricultural extension systems: A practical guide for policy-makers of developing countries. Rome: FAO
- Ghosh, S., Kumar, A., Prusty, A. K., Naik, A., & Padhy, C. (2025). Modelling livelihood security of tribal farmers in South Odisha using machine learning. *Indian Journal of Extension Education*, 61(4), 141–147. <https://doi.org/10.48165/IJEE.2025.61423>
- Government of Andhra Pradesh, Finance Department. (2023). *Outcome Budget 2023-24: Volume VII-1* [PDF]. Government of Andhra Pradesh. <https://s3.ap-south-1.amazonaws.com/apfinance.gov.in/uploads/budget-volumes/2023-24/Volume-VII-1.pdf>
- International Food Policy Research Institute (IFPRI). (2025). Reforming extension systems: Why agriculture needs better knowledge services. IFPRI Blog.
- Kumar, A., Prusty, A. K., Naik, A., Naveen, K. P., Ojha, P. K., & Mounika, T. (2025). Adoption and compliance of AI-enabled pest advisories: Evidence from the National Pest Surveillance System (NPSS) in Odisha, India. *Indian Journal of Extension Education*, 61(4), 78–83. <https://doi.org/10.48165/IJEE.2025.61413>
- Ministry of Agriculture & Farmers Welfare. (2025). Operational guidelines for ATMA scheme (2025). Department of Agriculture and Farmers Welfare.
- Nair, N. B., & Raj, S. (2024). Nurturing agri-startups to transform agricultural extension for sustainable agriculture. In *Proceedings of the 1st International Conference on Emerging Innovations for Sustainable Agriculture* (pp. 209–217).
- NITI Aayog. (2025). *Macro and fiscal landscape of the State of Andhra Pradesh* [PDF]. Government of India. <https://www.niti.gov.in/sites/default/files/2025-03/Macro-and-Fiscal-Landscape-of-the-State-of-Andhra-Pradesh-1.pdf>
- Pradhan, S. K., Prusty, A. K., Das, S., Ghosh, M., Chandra, Y. B., & Nayak, S. (2025). Empowering small-scale agriculture: Effective strategies for technology transfer. *International Journal of Advance Biochemistry Research*, 9(3), 118–125. <https://www.doi.org/10.33545/26174693.2025.v9.i3b.3902>
- Pradhan, S. K., Prusty, A. K., Priyadarshi, D., Badavath, A., Nayak, S., Munda, S. C., & Sudham, V. (2024). Impact of disruptive technologies on transforming Indian agriculture. *International Journal of Agriculture Extension and Social Development*, 7(5), 34–41. <https://doi.org/10.33545/26180723.2024.v7.i5a.597>
- Prusty, A. K., Mohapatra, B. P., Rout, S., Senapati, R., & Padhy, C. (2021). Social media: Boon to agriculture. *PLANTA*, 2, 245–250.
- Ravikishore, M., Seema, B., & Supriya, P. (2023). Performance effectiveness index of technology dissemination system of state departments of agriculture in Kerala and Andhra Pradesh. *Eco. Env. & Cons.*, 29(Suppl.), S99–S108. <https://doi.org/10.53550/EEC.2023.v29i01s.016>
- Riar, T., Garg, L., & Sharma, P. (2020). Public-private partnership in agricultural extension: A strategy for increasing farmers' income. *Indian Journal of Economics and Development*, 16(Sp), 489–499.
- Saha, P., Prusty, A. K., Nanda, C., Ray, S., & Rout, D. S. (2025). Professionalism of women agricultural extension personnel in Odisha. *The Journal of Agricultural Education and Extension*, 1–26. <https://doi.org/10.1080/1389224X.2025.2559599>
- Sai, M., Prusty, A. K., Padhy, C., & Reddy, I. C. (2024). Migration behavior of rural youth from agriculture in North Coastal Andhra Pradesh. *Indian Journal of Extension Education*, 60(4), 30–34. <https://doi.org/10.48165/IJEE.2024.60406>

- Sarat Chandra, H., & Kadian, K. S. (2017). Coordination of ATMA with different agencies in Andhra Pradesh: A pluralistic drive for agricultural development. *Bulletin of Environment, Pharmacology and Life Sciences*, 6(Special Issue), 64-67.
- Sarat Chandra, H., Kadian, K. S., & Kale, R. B. (2017). Identifying factors affecting coordination among different agencies with ATMA in Andhra Pradesh, India. *International Journal of Current Microbiology and Applied Sciences*, 6(11), 890-899.
- Sri Potti Sriramulu Nellore District Government. (2025). *Agriculture Technology Management Agency (ATMA)*. Government of Andhra Pradesh. <https://spsnellore.ap.gov.in/agriculture-technology-management-agency-atma/>
- Sulaiman, R., & Hall, A. (2012). Beyond technology dissemination: A review of extension reforms in India. *Journal of Agricultural Education and Extension*, 18(3), 231-250.
- Suman, S., Deb, A., & Prusty, A. K. (2025). Constraints and strategic suggestions for enhancing integrated farming systems among Bonda tribal family farms. *Indian Journal of Extension Education*, 61(3), 132-136. <https://doi.org/10.48165/IJEE.2025.613RN05>
- Visakhapatnam District Agricultural Office. (2025). *Extension services and infrastructure*. Government of Andhra Pradesh.
- West Godavari District Administration. (2025). *Agricultural Technology Management Agency (ATMA)*. Government of Andhra Pradesh.