A STUDY ON INTEGRATED STUDY OF AGRICULTURAL SUPPLY CHAIN AND LOGISTICS CHALLENGES, ICT IMPLEMENTATION, AND REGULATORY POLICIES SUPPORT" WITH SPECIAL REFERENCE TO TELANGANA STATE.

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ABSTRACT

Agricultural supply chains (ASCs) in emerging economies like India play a pivotal role in ensuring food security, rural development, and economic growth. Telangana, as a predominantly agrarian state, is confronted with structural inefficiencies across its agricultural supply chain and logistics (ASCL) networks. This study investigates the multidimensional challenges impacting the ASCL sector in Telangana, including infrastructural deficits, logistical bottlenecks, limited adoption of Information and Communication Technologies (ICT), and regulatory shortcomings. Despite numerous government interventions and schemes designed to modernize agricultural value chains, stakeholders continue to face hurdles in accessing timely logistics support, financial resources, and institutional guidance. Using a mixed-method approach, the study evaluates the effectiveness of policy frameworks, financial support systems from banks and institutions, and public-private initiatives aimed at improving supply chain performance. Particular attention is given to the implementation of ICT solutions, regulatory responsiveness, and environmental risks that threaten the long-term sustainability of agricultural logistics in the state. Statistical tools including regression analysis, t-tests, factor analysis, and chi-square tests are employed to examine correlations between policy effectiveness, infrastructural quality, supply chain competencies, and overall ASCL performance. Findings reveal a significant gap between policy intent and field-level implementation, exacerbated by inadequate infrastructure, fragmented supply chain planning, and limited digital penetration in rural logistics operations. Moreover, challenges related to environmental volatility, poor labor conditions, and lack of coordinated governance further reduce resilience and operational efficiency. The study underscores the urgent need for a strategic overhaul that combines infrastructure modernization, digital innovation, institutional accountability, and stakeholder capacity building.

This study contributes valuable insights to policymakers, agricultural cooperatives, financial institutions, and logistics planners by highlighting key areas for systemic reform. The findings advocate for integrated, technology-enabled, and policy-aligned solutions that can transform Telangana's agricultural supply chain into a resilient, transparent, and sustainable ecosystem, aligning with the state's long-term socio-economic and food security goals.

Key Words: *Agricultural Supply Chain (ASC), Logistics Management, Information and Communication Technology (ICT), Public–Private Partnerships (PPP).*

INTRODUCTION

Agriculture remains a cornerstone of India's economy, employing a significant share of the rural population and contributing to national food security. Within this sector, the Agricultural Supply Chain and Logistics (ASCL) system plays a pivotal role in ensuring the efficient

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movement of produce from farm to market. However, in states like Telangana, which is agriculturally diverse yet infrastructure-deficient, the supply chain is riddled with numerous challenges that limit its efficiency, inclusivity, and resilience. Despite various efforts by the government, the agricultural supply chain in Telangana faces enduring structural and operational constraints. These include inadequate cold storage infrastructure, poor road connectivity, inefficient warehousing, and fragmented logistics networks, all of which contribute to high post-harvest losses and limited market access for farmers. Compounding these issues is the underutilization of Information and Communication Technologies (ICT), which are crucial for real-time tracking, demand forecasting, and digital integration in modern supply chain systems. While some ICT-based solutions have been initiated, their implementation remains patchy, especially in rural areas due to gaps in digital literacy, connectivity, and institutional support.

Another significant layer of complexity is added by the regulatory and policy ecosystem governing agriculture logistics in the state. While Telangana has rolled out several schemes and financial interventions, such as subsidies for cold storage development, farmer-producer organizations (FPOs), and minimum support price (MSP) procurement mechanisms, their execution often suffers from bureaucratic inefficiencies, lack of stakeholder awareness, and inconsistent monitoring. Additionally, support from banks and financial institutions remains limited in scope and reach, particularly when it comes to enabling access to working capital and credit for smallholders and Agri-logistics entrepreneurs.

This study aims to undertake a comprehensive evaluation of these multifaceted challenges, with a focus on logistical bottlenecks, ICT integration gaps and financial and regulatory support mechanisms in Telangana's agricultural supply chain. By doing so, the study hopes to offer data-driven insights and policy-relevant recommendations to modernize and streamline the ASCL system in the state. Ultimately, strengthening Telangana's agricultural logistics through integrated governance, technological advancement, and institutional collaboration is crucial for enhancing productivity, reducing losses, and ensuring inclusive rural development.

STATEMENT OF THE PROBLEM

Despite various policy reforms and technological advancements at the national and state levels, Telangana's ASCL system continues to face significant structural, operational, financial, and institutional challenges. These persistent issues not only hinder the efficiency and transparency of agricultural supply chain and logistics but also contribute to post-harvest losses, price volatility, reduced farmer income, and market fragmentation.

One of the core problems lies in the inadequacy of physical infrastructure, such as rural roads, cold storage, warehousing, and transportation systems, which are either insufficient or unevenly distributed across the state. This limits the timely movement of produce and affects the overall reliability and reach of the supply chain. Simultaneously, Information and Communication Technologies (ICT) despite their potential to revolutionize agricultural logistics remain grossly underutilized due to connectivity gaps, lack of digital literacy, and minimal institutional support, particularly in underserved regions. Furthermore, the

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implementation of government regulatory policies and financial support mechanisms often fails to match ground-level requirements. While schemes and subsidies exist on paper, delays in disbursement, limited outreach, poor monitoring, and weak institutional accountability dilute their intended impact. Banks and financial institutions also fall short in supporting smallholder farmers, logistics operators, and Agri-entrepreneurs, primarily due to procedural complexities and risk aversion.

OBJECTIVES OF THE STUDY:

- ➢ To analyse the infrastructural and logistical challenges affecting the efficiency, accessibility, and reliability of agricultural supply chain and logistics (ASCL) operations in Telangana.
- ➢ To examine the adoption level and impact of Information and Communication Technologies (ICT) in enhancing transparency, traceability, and coordination within the agricultural logistics systems in Telangana.
- ➢ To evaluate the effectiveness of regulatory policies, government support mechanisms, and financial institutional interventions in addressing ASCL challenges and supporting sustainable agricultural value chains.
- ➢ To provide integrated, data-driven recommendations for strengthening infrastructure, policy implementation, digital integration, and institutional collaboration to transform Telangana's ASCL system.

REVIEW OF LITERATURE:

Mudda et al. (2017) a research work highlights chronic infrastructure limitations in India's agricultural logistics. Document pervasive shortcomings in cold storage, warehousing, and rural transport networks, leading to severe post-harvest losses and market inefficiencies. NITI Aayog and other sources emphasize the low mechanization in logistics, especially at farm gates, exacerbating cost inequities and bottlenecks across value chains and focused studying documenting chronic deficits in India's agricultural logistics specifically inadequate cold storage, underdeveloped warehousing capacity, and poor rural transport networks. These deficiencies contribute to significant crop spoilage and reduce farmers' access to higher-price market.

Kumar et al. (2020) research study underscore the potential of ICT for enhancing information flow, transparency, and performance in Agri-supply chains. Which demonstrate that ICT-enabled supplier coordination and logistics integration yield significant organizational performance benefits this study projected structural shortcomings across India's agricultural logistics network, notably limited cold storage capacity, fragmented warehousing, and inadequate rural transport infrastructure factors linked to elevated post-harvest losses and diminished market efficiency. **Kumar, Singh & Modgil (2020)** empirically demonstrate that ICT-enabled practices particularly logistics integration, supplier coordination, and information sharing positively influence organizational performance in Agri-food supply chains, using PLS-SEM analyses on executive-level survey data. Additional empirical assessments reveal

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that ICT systems reduce supply volatility and enhance responsiveness in the Indian agricultural context, but widespread adoption remains constrained by cost, fragmented collaboration, and low digital literacy in rural area.

Shukla et al. (2023) show that IT systems reduce supply volatility and improve responsiveness in the agricultural sector. However, barriers such as cost, distrust, low literacy, and fragmented collaboration impede widespread ICT adoption in rural contexts. The study investigates how Information Technology (IT) and enhanced supply chain collaboration (SCC) work together to mitigate volume uncertainty a key risk in agriculture and improve supply chain performance (SCP). They conducted a study with 121 senior executives from Agri-tech firms across India using structural equation modelling (SEM). Their findings indicate: Volume uncertainty significantly increases risk but can be effectively managed through the strategic use of IT and collaboration among stakeholders. IT adoption has a positive and significant effect on SCP, mediated by stronger collaboration (SCC).

Thakur et al. (2024) "Agricultural Produce Supply Chain Network of Capsicum: Empirical Evidence from India" Provides empirical insights into logistics constraints and market inefficiencies relevant to Indian horticultural supply chains on supply chains offers valuable insights into environmental risks and logistics constraints in horticultural contexts. In Himachal Pradesh a region with agricultural and structural similarities to Telangana the study emphasizes the adverse effects of inadequate road infrastructure, fragmented market access, and intermediary dominance on both livelihoods and sustainability the study highlights on the need for climate-adaptive and inclusive supply chain interventions.

Srai et al. (2022) "Interplay between Competing and Coexisting Policy Regimens within Supply Chain Configurations", Analyses how multiple regulatory regimes coexist and drive operational implications in Indian agricultural logistics. Also, explores how conflicting or overlapping policy frameworks such as those at the state versus federal level impact agricultural supply chain configurations, especially in the Indian context. The study also demonstrates that policy misalignment, through coexisting regimes with inconsistent incentives or standards, Argues that these dynamics result in netting and inventory pooling effects, including changes in material, information, and financial flows that undermine transparency, equity, and welfare outcomes within fragmented agrifood networks. Highlights relevance to Telangana's context, where multiple interventions (e.g., MSP, eNAM, APMC reforms) often lack alignment, leading to governance gaps and uneven stakeholder impact.

METHODOLOGY OF THE STUDY:

This study adopts a robust mixed-method research design grounded primarily in quantitative methodology, with embedded qualitative elements, to comprehensively explore the challenges in agricultural supply chain and logistics management (ASCLM) in Telangana and evaluate the effectiveness of institutional support mechanisms. Given the multifaceted nature of the research objectives, the methodology integrates structured empirical analysis and thematic interpretation to generate actionable insights. The research follows an exploratory and

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explanatory research design. The exploratory phase uncovers prevalent challenges through expert's feedback, while the explanatory component statistically examines the relationships between logistical drivers, supply chain practices, regulatory frameworks, and performance metrics. The population for this study includes a wide range of expert's directly or indirectly involved in the agricultural supply chain ecosystem in Telangana. This includes: Farmers (small, marginal, and large-scale), Logistics service providers, Agricultural traders and commission agents, Government officials from agricultural and rural development departments, Representatives from banks, financial institutions, and cooperative societies, ICT providers and Agri-tech entrepreneurs. A stratified purposive sampling method was adopted to ensure representation across different zones of Telangana and expert's groups.

RESEARCH DESIGN, DATA COLLECTION METHODS AND DATA ANALYSIS PROCEDURES:

The study collected data from 600 experts and experts across 33 districts of Telangana. The stratification ensured balanced participation from both rural and semi-urban clusters, and across functional roles within the supply chain. The research follows an exploratory and explanatory research design. The exploratory phase uncovers prevalent challenges through expert's feedback, while the explanatory component statistically examines the relationships between logistical drivers, supply chain practices, regulatory frameworks, and performance metrics. The primary data collection process involved a combination of Structured Questionnaires. Quantitative instrument comprising Likert-scale questions designed to capture respondents' perception of infrastructural adequacy, ICT utilization, logistics practices, financial inclusion, regulatory responsiveness, environmental risk, and socio-economic sustainability, Semi-Structured Interviews were conducted with selected officials, policymakers, and logistics experts aimed at providing context and interpretive depth to the quantitative findings. Secondary Data adopted form Annual reports from the Telangana Agriculture Department, Ministry of Food Processing, and NITI Aayog, Academic journals, white papers, and policy briefs eNAM and Rythu Bandhu scheme reports. The analysis was conducted using both quantitative statistical tools and qualitative thematic techniques, Descriptive Statistics: Frequencies, means, and standard deviations to summarize responses. Inferential Statistics like Regression Analysis, T-Tests, Factor Analysis and Chi-Square Tests were examined. Qualitative Analysis like Thematic Coding: Applied to interview transcripts to extract emergent themes. Informed consent was obtained from all participants and Ethical clearance was obtained from the Institutional Research Ethics Committee. This methodology provides a comprehensive and contextually grounded approach to evaluate the multidimensional challenges and institutional dynamics shaping Telangana's agricultural supply chain and logistics landscape.

EMPIRICAL FINDINGS:

Objective 1: Data Analysis using Descriptive statistics measures like mean, standard deviation, and variance to summarize Agriculture supply chain and Logistics challenges and issue indicators related to internal and external factors.

ASSESS THE AGRICULTURE SUPPLY CHAIN AND LOGISTICS CHALLENGES AND ISSUES IN TELANGANA STATE.	N	Range	Mean	Std. Deviation	Variance
Storage facilities are stable to maintain the stock	600	4	2.63	1.224	1.499
Temperature Management in Storage facilities is significantly decreased	600	4	2.86	1.261	1.591
Collaboration and Information sharing between Supply Chain Partners are facing difficulties in the Telangana state	600	4	2.71	1.331	1.771
Supply and Demand Uncertainty in Agriculture supply and Logistics have increased	600	4	2.7	1.234	1.523
Supplier Relationship in ASCLM (Agriculture Supply Chain and Logistics) has been decreased	600	4	2.30	1.214	1.474
Financial Constraints like providing loans for agriculture supply chain and Logistics has been affected	600	4	2.78	1.275	1.626
Supply Chain Visibility has increased in ASCLM (Agriculture Supply Chain and Logistics of Telangana state)	600	4	2.87	1.261	1.591
Transportation or Logistic Facilities declined	600	4	2.58	1.262	1.592
Transportation Infrastructure improved in ASCLM (Agriculture Supply Chain and Logistics of Telangana state)	600	4	2.59	1.232	1.518
Significantly impacted distribution quality of the agriculture products in the Telangana state	600	4	2.33	1.121	1.258
Handling Facilities at the Farm and Marketplace successfully managed to meet the Agriculture supply chain and Logistics requirement	600	4	2.61	1.273	1.621
Operational Capabilities in Agriculture supply chain have significantly impacted in the state.	600	4	2.91	1.319	1.741
Investments in Training and Skill Enhancement in Agriculture supply chain and Logistics of the state and slowed down.	600	4	2.54	1.284	1.648
Received sufficient support in in implementing Modern Harvesting Techniques in Agriculture Supply chain of Telangana State	600	4	2.57	1.21	1.464
The financial Support have been effective in agriculture supply chain and logistics of the Telangana state	600	4	2.85	1.206	1.453
Valid N (list wise)	600				

The above table show the statistical findings from a survey of 600 respondents in Telangana State, focused on evaluating key logistical, infrastructural, financial, and operational issues affecting the Agriculture Supply Chain and Logistics Management (ASCLM). The mean score for "Storage facilities are stable to maintain the stock" is 2.63 (SD = 1.224), indicating a general perception of inadequate or moderately stable storage infrastructure. Temperature management within storage facilities shows a mean score of 2.86 (SD = 1.261), suggesting challenges in maintaining optimal storage conditions for perishable goods, especially in rural areas. Collaboration and information-sharing difficulties among supply chain partners are reflected by a mean of 2.71 (SD = 1.331), signifying notable coordination issues. Respondents also report increased supply and demand uncertainty (Mean = 2.70, SD = 1.234), reinforcing the perception of instability in market forecasting and logistics planning. A low mean of 2.30 (SD = 1.214) for supplier relationships indicates deterioration in upstream connectivity within the agricultural value chain. Financial constraints, particularly access to agricultural logistics loans, are significant (Mean = 2.78, SD = 1.275), highlighting persistent institutional bottlenecks. Supply chain visibility scores relatively better (Mean = 2.87, SD = 1.261), potentially due to digital interventions and e-governance tools in select clusters. Despite some progress, transportation and logistics facilities have declined (Mean = 2.58, SD = 1.262), and improvement in transport infrastructure remains modest (Mean = 2.59, SD = 1.232). The distribution quality of agricultural products is perceived to have been significantly impacted (Mean = 2.33, SD = 1.121), reflecting deficiencies in post-harvest handling and end-to-end distribution systems, Operational capabilities have also been negatively affected (Mean = 2.91, SD = 1.319), indicating limited capacity to adapt to logistical volatility. Investments in training and skill development have slowed down (Mean = 2.54, SD = 1.284), affecting long-term sustainability and productivity, Implementation of modern harvesting techniques has not received sufficient support (Mean = 2.57, SD = 1.210), underscoring a gap in technology transfer mechanisms and Effectiveness of financial support mechanisms shows moderate affirmation (Mean = 2.85, SD = 1.206), though variance suggests uneven reach and limited inclusivity. The overall descriptive findings indicate systemic challenges in Telangana's agricultural supply chain, particularly in areas of infrastructure, institutional coordination, and capacity building. While some digital integration and visibility improvements are noted, broader gaps in physical logistics and financial access persist. The analysis reinforces the need for holistic interventions combining infrastructure investment, digital enablement, regulatory streamlining, and capacity enhancement.

Objective 2: To examine the challenges faced by the agriculture supply chain and logistics sector in Telangana State with respect to the use of Information and Communication Technologies (ICT) and the implementation of standard government   policies   and   support   mechanisms

Identifying Core Challenge Dimensions in Agricultural Supply Chains Using Factor Analysis.

KMO and Bartlett's Test	
Kaiser-Meyer-Olkin Measure of Sampling	.511

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Adequacy.		
Bartlett's Test of Sphericity	Approx. Chi-Square	390.225
	df	105
	Sig.	.000

Communalities

	Initial	Extraction
Challenges1	1.000	.540
Challenges2	1.000	.657
Challenges3	1.000	.638
Challenges4	1.000	.722
Challenges5	1.000	.767
Challenges6	1.000	.737
Challenges7	1.000	.670
Challenges8	1.000	.469
Challenges9	1.000	.602
Challenges10	1.000	.730
Challenges11	1.000	.720
Challenges12	1.000	.783
Challenges13	1.000	.805
Challenges14	1.000	.650
Challenges15	1.000	.638
Extraction Method: Principal Component Analysis.		

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	%of Variance	Cumulative %	Total	%of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.148	14.321	14.321	2.148	14.321	14.321	1.562	10.414	10.414
2	1.808	12.052	26.373	1.808	12.052	26.373	1.551	10.339	20.754
3	1.643	10.954	37.327	1.643	10.954	37.327	1.485	9.903	30.656
4	1.391	9.274	46.601	1.391	9.274	46.601	1.457	9.715	40.371

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5	1.112	7.414	54.015	1.112	7.414	54.015	1.444	9.626	49.998
6	1.021	6.809	60.823	1.021	6.809	60.823	1.347	8.980	58.977
7	1.003	6.685	67.508	1.003	6.685	67.508	1.280	8.530	67.508
8	.883	5.885	73.393						
9	.782	5.213	78.605						
10	.751	5.008	83.613						
11	.629	4.191	87.805						
12	.545	3.633	91.438						
13	.513	3.421	94.859						
14	.454	3.029	97.888						
15	.317	2.112	100.000						
Extraction Method: Principal Component Analysis.									

Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
Challenges1							
Challenges2							
Challenges3	.563						
Challenges4		.502					
Challenges5	.589						
Challenges6							
Challenges7				.644			
Challenges8	.545						
Challenges9			.542				
Challenges10							
Challenges11				.622			
Challenges12	.596						
Challenges13					.688		
Challenges14		.524					
Challenges15		.637					
Extraction Method: Principal Component Analysis.							
a. 7 components extracted.							

Rotated Component Matrix[a]

	Component						
	1	2	3	4	5	6	7
Challenges1							

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Challenges2				.760		
Challenges3	.737					
Challenges4		.715				
Challenges5		.827				
Challenges6					.535	
Challenges7					.759	
Challenges8						
Challenges9			.641			
Challenges10			.849			
Challenges11					.642	
Challenges12	.749					
Challenges13						.883
Challenges14				.785		
Challenges15				.749		

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 17 iterations.

Component Transformation Matrix							
Component	1	2	3	4	5	6	7
1	.567	.552	.207	.412	-.006	.124	.381
2	-.303	.414	-.508	.226	.646	.004	-.107
3	-.417	-.261	.559	.541	.255	-.231	.188
4	.066	-.211	.247	-.052	.349	.863	-.145
5	-.055	-.082	-.012	-.516	.328	-.045	.783
6	.439	.015	.349	-.298	.512	-.421	-.397
7	-.461	.636	.452	-.359	-.164	.086	-.122

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

The factor analysis conducted to identify and analyze the Factor Analysis conducted to assess the core challenges in the Agricultural Supply Chain and Logistics Management (ASCLM) sector in Telangana. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy is 0.511, which, although slightly lower than the generally recommended threshold of 0.6, is still acceptable for factor analysis. The Bartlett's Test of Sphericity, with a chi-square value of 390.225 and a significance level of 0.000, confirms that the variables are sufficiently correlated to proceed with the analysis.

Communalities: The communalities, which represent the amount of variance in each variable that can be explained by the extracted factors, are generally high. Values range

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from 0.469 (Challenges8) to 0.805 (Challenges13), indicating that the majority of the variance in these challenges is well accounted for by the identified factors.

Total Variance Explained: 7 components were extracted, which together explain 67.508% of the total variance. This cumulative variance indicates that these components capture a significant portion of the operational challenges faced by Supply chain and logistics operations in Telangana. The first component accounts for 14.321% of the variance, followed by the second component with 12.052%, and so on, demonstrating a balanced distribution of explanatory power across the components.

Rotated Component Matrix: The rotated component matrix, which provides a clearer interpretation of the factor loadings after Varimax rotation, reveals the specific challenges associated with each component:
Component 1 has a high correlation with rotated **components 1 and 2** (0.567, 0.552), indicating a shared contribution from two rotated axes. This might reflect overlapping ICT and policy factors. **Component 2** loads most strongly on Rotated **Component 5 (0.646)**, suggesting a clean rotation that possibly isolates financial or infrastructural themes. **Component 3** loads most on Rotated **Component 3 and 4 (0.559 and 0.541),** reflecting interrelated themes, such as digital adoption and technical skill gaps. **Component 4** has a dominant loading on Rotated **Component 6 (0.863)** strongly suggesting an isolated latent factor, possibly related to regulatory or institutional support. **Component 5** is heavily transformed into Rotated **Component 7 (0.783)**, likely reflecting themes like PPP involvement or operational efficiency. **Component 6 and 7** are more distributed, loading across multiple rotated components, indicating complex interplay among residual or multi-thematic variables.

Overall Interpretation: The factor analysis has successfully distilled the operational challenges into seven distinct components, each capturing different aspects of the difficulties experienced by supply chain and Logistics operations in agriculture sector of Telangana. The high communalities and the significant variance explained by these factors underscore the multidimensional nature of the challenges. These insights can inform targeted strategies to address the specific areas of CT infrastructure and adoption gaps, High cost and low availability of technical expertise, Policy implementation inefficiencies, Network and connectivity issues, Operational limitations and skill shortages, Public-private collaboration weaknesses and Market linkage and support system gaps

RECOMMENDATIONS FOR THE STUDY

This study identifies critical reform areas in Telangana's agricultural supply chain and logistics (ASCL) ecosystem and proposes a series of actionable recommendations. First, to bridge digital disparities, it is essential to expand rural ICT infrastructure, enhance network connectivity, and invest in digital literacy through mobile-accessible platforms. Strengthening logistics capacity requires strategic investments in decentralized cold storage, warehousing, and rural transport infrastructure. Policy reforms must prioritize coordination

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between state and central frameworks while establishing a dedicated ASCL governance body for monitoring and accountability. Financial accessibility should be enhanced through inclusive credit schemes, simplified loan procedures, and increased institutional outreach especially targeting smallholder farmers and Agri-logistics startups. Capacity building efforts should focus on dedicated training centers for logistics and ICT, supported by academic and institutional collaborations. To catalyze innovation and infrastructure development, Public–Private Partnerships (PPPs) must be incentivized, particularly in storage, processing, and market linkages. Lastly, the resilience and sustainability of Telangana's ASCL systems can be improved through climate-adaptive logistics practices, enhanced traceability, and the development of localized processing hubs that connect farmers to formal markets more efficiently.

CONCLUSION

This study set out to investigate the multifaceted challenges plaguing the Agricultural Supply Chain and Logistics Management (ASCLM) in Telangana State, with particular emphasis on infrastructure, ICT integration, institutional effectiveness, and policy implementation. Drawing on the insights from 600 expert respondents, as well as secondary data and statistical tools such as factor analysis, the research presents a comprehensive understanding of the systemic barriers that continue to hinder the efficiency, inclusivity, and sustainability of agricultural logistics in the region.

The findings underscore that while the agricultural sector remains a backbone of Telangana's economy, its supply chain suffers from structural deficiencies. Key issues include inadequate and poorly maintained storage facilities, limited temperature-controlled infrastructure, substandard rural transportation networks, and inconsistent market access. These infrastructural challenges result in high post-harvest losses, inefficient inventory turnover, and substantial financial strain on small and marginal farmers.

In terms of digital advancement, the underutilization of Information and Communication Technologies (ICT) emerged as a critical bottleneck. Despite the demonstrated potential of ICT tools in improving supply chain visibility, demand forecasting, and coordination, the study reveals that adoption levels remain low due to high costs, poor connectivity in rural areas, and lack of adequate technical expertise and support systems. Additionally, many stakeholders expressed uncertainty or skepticism about the benefits of digital tools, highlighting a pressing need for digital training, awareness, and infrastructure expansion.

The regulatory and policy landscape also presents a complex and fragmented picture. While government initiatives such as Minimum Support Price (MSP), eNAM, and Rythu Bandhu exist to support farmers and streamline logistics, their implementation remains inconsistent and often lacks alignment between central and state-level mandates. The study reveals widespread perceptions of bureaucratic delays, poor monitoring, inadequate stakeholder engagement, and weak financial access mechanisms—especially for smallholders and agri-logistics startups. These gaps erode trust in institutions and reduce the effectiveness of

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public schemes.

Factor analysis further distilled these challenges into seven core components, reflecting underlying themes such as infrastructure gaps, ICT and digital divide, policy misalignment, operational inefficiencies, skill shortages, and weak public-private coordination. These components collectively explained over 67% of the total variance, reinforcing the multidimensional and interconnected nature of ASCLM challenges in Telangana.

In conclusion, the study highlights an urgent need for a systemic and coordinated response. Addressing these challenges demands integrated policy frameworks, targeted investments in infrastructure and digital capacity, enhanced financial inclusion, and stronger institutional governance. Furthermore, fostering collaboration through Public–Private Partnerships (PPPs), localized skill development, and climate-adaptive supply chain practices will be crucial to transforming Telangana's agricultural logistics into a resilient, transparent, and future-ready system. Only through such comprehensive and inclusive strategies can the state fulfill its broader goals of rural development, food security, and sustainable agricultural growth.

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Table 4.30A-IV: Component Matrix[a]						
	Component					
	1	2	3	4	5	6
Challenges1						.509
Challenges2			.648			
Challenges3						
Challenges4						
Challenges5	.627					
Challenges6				.538		
Challenges7				.650		
Challenges8	.521					
Challenges9						
Challenges10			.503			
Challenges11					.652	
Challenges12	.572					
Challenges13					-.613	
Challenges14		-.508				
Challenges15		-.626				
Extraction Method: Principal Component Analysis.						
a. 6 components extracted.						

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Table 4.30A-V: Rotated Component Matrix[a]						
	Component					
	1	2	3	4	5	6
Challenges1				.606		
Challenges2						
Challenges3	.707					
Challenges4		-.605				
Challenges5						
Challenges6					.694	
Challenges7					.694	
Challenges8				.614		
Challenges9		.668				
Challenges10		.710				
Challenges11						.758
Challenges12	.804					
Challenges13						-.568
Challenges14			.792			
Challenges15			.801			
Extraction Method: Principal Component Analysis.						
Rotation Method: Varimax with Kaiser Normalization.						
a. Rotation converged in 12 iterations.						

Table 4.30A-VI: Component Transformation Matrix						
Component	1	2	3	4	5	6
1	.722	.008	.338	.568	.187	.076
2	.428	.574	-.649	-.214	.142	.010
3	-.388	.765	.246	.407	-.183	-.075
4	-.171	.180	.329	-.285	.846	.186
5	-.159	-.055	-.229	.234	-.057	.928
6	-.300	-.224	-.494	.575	.439	-.304
Extraction Method: Principal Component Analysis.						
Rotation Method: Varimax with Kaiser Normalization.						

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However, the results suggest that the pandemic has posed significant challenges to the banks, particularly in revenue generation, liquidity maintenance, and loan disbursement, with mean values of 2.80, 2.78, and 2.74, respectively. The increase in non-performing assets (NPAs) (mean = 2.80, SD =1.235) and the negative impact on profit margins (mean = 2.32, SD = 1.223) further underscore the difficulties faced by these institutions. The pandemic has also led to an increase in the cost of operations (mean = 2.85,SD = 1.246) and a decline in customer deposits (mean = 2.70, SD = 1.295), reflecting the broader economic downturn. Interestingly, digital banking services have contributed to improving financial performance to some extent (mean = 2.64, SD = 1.285), although this has not been enough to offset the overall negative impact of COVID-19 on interest income (mean = 2.32, SD = 1.143) and investment portfolios (mean = 2.96, SD = 1.309). Despite the challenges, the banks have managed to meet their financial obligations (mean = 2.66, SD = 1.278) and have received some government support (mean = 2.59, SD = 1.204). The effectiveness of the financial strategies implemented during the pandemic is reflected in a mean score of 2.95 with a standard deviation of 1.210, indicating a moderate level of success in navigating the crisis. Overall, while cooperative banks have faced substantial financial challenges during the pandemic, they have shown resilience in certain areas, particularly through digital banking and strategic management.