INDIAN ECONOMY IN TRANSITION: CHALLANGES, REFORMS AND OPPORTUNITIES

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PREFACE

India today stands at a decisive moment in its developmental journey. Over the past three decades, the country has undergone a profound economic transformation shaped by liberalisation, technological change, urban expansion, and deeper integration with the global economy. Digital innovation, financial inclusion, expanding infrastructure, and entrepreneurial dynamism have strengthened India's position as one of the world's fastest-growing major economies. Yet, alongside this progress, persist enduring challenges—unemployment, agrarian distress, inequality, environmental degradation, regional imbalances, and unequal access to quality education and healthcare. As India moves towards the vision of *Viksit Bharat @2047*, the need for informed academic engagement and policy reflection has become more urgent than ever.

It is within this context that *Indian Economy in Transition: Challenges, Reforms, and Opportunities* has been conceived. The volume brings together diverse scholarly perspectives to examine the changing contours of the Indian economy and the complex realities accompanying its transformation. The contributors engage with themes that lie at the heart of contemporary development discourse: industrial restructuring, digitalisation, fiscal sustainability, healthcare, education, external sector dynamics, environmental concerns, decentralised governance, entrepreneurship, and social inclusion. Collectively, the chapters seek not merely to analyse economic change, but also to reflect upon the direction, character, and inclusiveness of India's development process.

A recurring concern across the volume is the tension between growth and equity, innovation and inclusion, centralisation and local empowerment. Several chapters explore how technological and institutional reforms are reshaping India's economy. Discussions on Industry 4.0, digital healthcare, and the digital transformation of education highlight both the transformative potential of technology and the structural inequalities that continue to limit its reach. The chapters on manufacturing policy, MSMEs, and Global Value Chains underline the importance of innovation, infrastructure, and institutional capacity in building a competitive and resilient economy.

Equally significant are the contributions that focus on questions of sustainability and social justice. The analyses of multidimensional poverty, environmental degradation, healthcare disparities, and decentralised governance remind us that economic progress cannot be measured solely through aggregate growth indicators. Development acquires meaning only when it enhances human capabilities,

strengthens democratic participation, and ensures ecological balance. The discussions on temples as economic institutions and on cooperative digital models further broaden conventional understandings of economic systems by drawing attention to community-based, culturally embedded forms of development.

The volume also reflects India's evolving position in the global economic order. Chapters examining deglobalisation, de-dollarisation, fiscal sustainability, and the changing external sector analyse the opportunities and uncertainties emerging from a rapidly shifting geopolitical and economic landscape. Together, these studies suggest that India's future trajectory will depend not only on sustaining growth, but also on building institutional resilience, strategic autonomy, and inclusive development frameworks.

While each chapter addresses a distinct theme, all are united by a common concern: understanding the possibilities and contradictions of an economy in transition. They do not claim to offer definitive answers; rather, they aim to encourage critical dialogue and deeper reflection on the pathways of India's development. We hope that this volume will serve as a meaningful resource for students, researchers, academicians, policymakers, and readers interested in the contemporary Indian economy.

As editors, we express our sincere gratitude to all contributors for their thoughtful scholarship and enthusiastic participation. We also acknowledge that economic transformation is an ongoing and evolving process. This book, therefore, should be viewed as part of a broader intellectual effort to engage with the changing realities of India's developmental journey and its aspirations for 2047.

Editors

ACKNOWLEDGEMENT

A book of this nature is never the work of its editors alone. It is, in the truest sense, a collective endeavour, and we owe a debt of gratitude to every person who gave their time, knowledge, and effort to bring it to life.

Our foremost thanks go to the contributing authors, professors, researchers, and scholars from across India, who responded to our call with enthusiasm and intellectual generosity. They worked diligently to craft chapters that are not only academically rigorous but also deeply relevant to the economic realities of our time. Their patience through the editorial process, their openness to feedback, and their commitment to producing original, plagiarism-free scholarship have made this volume what it is. We are truly grateful.

We extend our sincere appreciation to the double-blind peer reviewers who evaluated each submission with care and candour. Their anonymous yet invaluable observations sharpened the arguments, strengthened the evidence, and raised the overall quality of the volume.

We express our sincere gratitude to Anu Books International Publisher, New Delhi and Glasgow, UK, for the valuable institutional support received throughout this project. At a time when academic publishing faces increasing commercial pressures, its commitment to quality is commendable. We are especially thankful to the production team for their professionalism, careful attention to detail, and patient support during the editorial and publication process. Their guidance, from the first communication to the moment of final press, has been indispensable.

On a personal note, each of us has been sustained through this project by the quiet encouragement of family and close friends. Editing a multi-author volume while fulfilling teaching and administrative responsibilities is not a small undertaking, and the understanding shown by those closest to us has been a source of real strength. We acknowledge their support with warmth and affection.

Finally, we acknowledge the countless economists, policymakers, workers and citizens whose lives and livelihoods form the subject matter of this book. Scholarship on the Indian economy draws its meaning from its realities. It is ultimately to them that this work is dedicated.

Dr. Monica Awasthi
Prof. Manjula Upadhyay
Manish Kumar

CONTENTS

1

Trends in Health Infrastructure and Human Resources in Indian Hospitals: A Decadal Analysis (2013-2023)

K. Suganya
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Abstract: *This study examines the evolution of health infrastructure and human resources in Indian hospitals over the period 2013-2023, utilising secondary data from Rural Health Statistics, National Family Health Survey, and Health Management Information System databases. The research employs a longitudinal, descriptive-analytical approach to investigate patterns in hospital bed density, healthcare workforce availability, and regional disparities across Indian states. Key findings reveal that while hospital bed density increased from 0.9 to 1.4 per 1,000 population, significant rural-urban divides and inter-state inequities persist. Doctor availability reached WHO norms nationally at 1.2 per 1,000 population, yet nursing staff remained below recommended levels at 2.1 per 1,000. Southern states consistently outperformed national averages, whereas Bihar, Jharkhand, and Uttar Pradesh demonstrated persistent deficits. The COVID-19 pandemic catalysed infrastructure investments but exposed systemic vulnerabilities in intensive care capacity and workforce distribution. This analysis contributes to understanding India's healthcare transformation trajectory and identifies critical gaps requiring policy intervention for achieving Universal Health Coverage objectives under Sustainable Development Goal 3.*

Keywords: *Health infrastructure, human resources for health, hospital beds, healthcare workforce, rural-urban disparities, Universal Health Coverage*

1. Introduction

India's healthcare infrastructure operates within a distinctive framework characterized by extensive population coverage, pronounced regional heterogeneity, dual public-private provisioning mechanisms, and considerable variation in health outcomes. The fundamental components determining healthcare delivery effectiveness encompass physical infrastructure and human resource availability, which collectively constitute the foundational architecture of hospital systems

essential for ensuring accessible, affordable, and quality healthcare services to the population.

During the decade spanning 2013-2023, substantial reform initiatives have been implemented, including the National Health Mission and Ayushman Bharat Yojana, aimed at enhancing health infrastructure and expanding the healthcare professional workforce. Nevertheless, persistent challenges remain regarding geographical inequity, inadequate rural penetration, concentration in urban centers, qualified personnel shortages, and insufficient hospital capacity relative to demographic demands (Ministry of Health and Family Welfare, 2023).

The transformative decade witnessed pivotal policy interventions including the scaling of National Rural Health Mission into the comprehensive National Health Mission (2013-2015), expansion of medical and nursing educational institutions (2016-2018), implementation of Ayushman Bharat with dual focus on Health and Wellness Centres and Pradhan Mantri Jan Arogya Yojana (2018), COVID-19 pandemic response highlighting infrastructure gaps (2019-2021), and renewed emphasis on digital health and capacity building (2022-2023). These initiatives collectively aimed to address systemic deficiencies while promoting equitable healthcare access.

1.1 Research Gap and Justification

Existing scholarship predominantly focuses on cross-sectional assessments or scheme-specific evaluations of healthcare infrastructure and human resources. Limited research provides comprehensive longitudinal analysis examining state-level evolution of these critical parameters across an entire decade. While studies by Rao et al. (2011) examined rural health infrastructure, and Anand and Fan (2016) analyzed human resources for health globally, few investigations systematically track Indian hospital infrastructure trends over extended timeframes with granular state-level disaggregation.

Furthermore, despite substantial policy initiatives and budgetary allocations, systematic evaluation of infrastructure and workforce transformation outcomes remains inadequate. The pandemic period particularly necessitates assessment of resilience, adaptability, and systemic vulnerabilities. This research addresses these gaps by providing empirical evidence on decadal trends, comparative state performance, rural-urban differentials, and trajectory analysis toward achieving Universal Health Coverage benchmarks.

1.2 Research Objectives

The present investigation pursues the following specific objectives:

- To analyze temporal trends in hospital bed density across Indian states during 2013-2023

- To examine the evolution of healthcare workforce availability, specifically doctors and nursing personnel
- To assess rural-urban disparities in health infrastructure and human resource distribution
- To evaluate inter-state variations and identify high-performing and underperforming states
- To assess progress toward WHO benchmarks and Universal Health Coverage targets

2. Materials and Methods

2.1 Research Design

This investigation employs a longitudinal descriptive analytical design utilizing secondary quantitative data spanning the decade 2013-2023. The methodological framework integrates temporal trend analysis with comparative assessment across geographical and administrative dimensions. This approach facilitates systematic evaluation of infrastructure and human resource evolution while identifying patterns, disparities, and transformation trajectories.

2.2 Data Sources and Collection

Secondary data were systematically extracted from authenticated government databases and statistical repositories:

- Rural Health Statistics (RHS): Annual publications from 2013-2023 providing comprehensive data on hospital infrastructure, bed availability, and health facility distribution
- National Family Health Survey (NFHS): Rounds 4 and 5 (NFHS-4: 2015-16; NFHS-5: 2019-21) offering demographic and health indicator data
- Health Management Information System (HMIS): Monthly and annual reports documenting health facility performance, staffing patterns, and service utilization
- National Health Mission (NHM) Reports: Annual state and national reports detailing programmatic implementation and resource allocation
- Medical Council of India (MCI) and Indian Nursing Council (INC): Registration data for qualified medical and nursing professionals

2.3 Variables and Indicators

Key variables analyzed include:

- Hospital bed density (beds per 1,000 population)
- Doctor density (registered allopathic doctors per 1,000 population)

- Nursing personnel density (nurses and midwives per 1,000 population)
- Rural-urban distribution ratios of infrastructure and human resources
- State-wise comparative performance metrics

2.4 Analytical Framework

Data analysis incorporated descriptive statistical techniques including trend analysis, percentage change calculations, comparative ratios, and benchmarking against WHO standards. Temporal trends were visualized through line graphs and comparative tables. State-wise performance was categorized using quartile classification based on infrastructure and human resource indicators. Rural-urban differentials were assessed through ratio analysis comparing resource availability across geographical classifications.

The analytical framework compared observed values against WHO benchmarks (minimum 3 hospital beds per 1,000 population, 1 doctor per 1,000 population, 3 nurses per 1,000 population) and Sustainable Development Goal 3 targets for Universal Health Coverage. Data quality was ensured through triangulation across multiple sources and verification against published government reports.

2.5 Study Limitations

This investigation acknowledges certain methodological limitations. Reliance on secondary data constrains ability to verify primary source accuracy or completeness. Temporal gaps in reporting, particularly during the pandemic period, may affect trend continuity. State-level aggregation masks intra-state and district-level variations. The study focuses on quantitative indicators and does not assess qualitative dimensions such as infrastructure functionality, service quality, or healthcare workforce competency. Despite these limitations, the comprehensive scope and validated data sources provide robust foundations for meaningful analysis and policy recommendations.

3. Results and Discussion

3.1 Temporal Trends in Hospital Bed Density

Analysis reveals that national hospital bed density demonstrated progressive improvement from approximately 0.9 beds per 1,000 population in 2013 to 1.4 beds per 1,000 in 2023, representing a 55.6% increase over the decade. This growth trajectory, while encouraging, remains substantially below the WHO recommended minimum of 3 beds per 1,000 population. The compound annual growth rate of bed expansion approximated 4.5% annually, suggesting sustained but insufficient progress toward international benchmarks.

The pandemic period (2020-2021) witnessed accelerated infrastructure development, with bed capacity increasing by 18% compared to the pre-pandemic average annual growth of 3.8%. This surge primarily resulted from emergency infrastructure expansion, temporary hospital facilities, and COVID care center establishment. However, sustainability of these additions remains questionable, as many temporary facilities were subsequently decommissioned.

State-level analysis reveals pronounced heterogeneity. Kerala consistently maintained bed density exceeding 3 per 1,000 throughout the study period (ranging from 3.2 in 2013 to 3.8 in 2023), achieving WHO standards. Tamil Nadu, Karnataka, and Maharashtra demonstrated steady improvement, reaching densities between 2.1-2.6 beds per 1,000 by 2023. Conversely, Bihar, Jharkhand, and Uttar Pradesh persistently recorded densities below 0.7 per 1,000, indicating severe infrastructure deficits serving populations exceeding 300 million collectively.

3.2 Evolution of Healthcare Workforce Availability

Doctor availability nationally improved from 0.7 per 1,000 population in 2013 to 1.2 per 1,000 in 2023, achieving the WHO minimum threshold. This represents a 71.4% increase attributable to medical college expansion, increased admissions in existing institutions, and enhanced registration under the National Medical Commission. However, distribution remains highly skewed toward urban areas and southern states.

Nursing personnel density increased from 1.3 per 1,000 in 2013 to 2.1 per 1,000 in 2023, a 61.5% improvement yet remaining below the WHO recommendation of 3 per 1,000. The nurse-to-doctor ratio improved from 1.86:1 to 1.75:1, suggesting better balance compared to historical norms but still reflecting nursing shortages in absolute terms. Auxiliary Nurse Midwives (ANMs) and General Nursing and Midwifery (GNM) graduates constituted 67% of the nursing workforce, while Bachelor of Science in Nursing (BSc Nursing) and specialized nurses comprised 33%, indicating scope for skill enhancement.

Specialist doctor availability showed marginal improvement, with critical specialties including anesthesiology, pediatrics, and obstetrics continuing to experience acute shortages in rural and remote facilities. Public sector hospitals reported vacancy rates averaging 32% for specialist positions in 2023, down from 41% in 2013 but remaining problematically high. Retention challenges, particularly in rural postings, contribute substantially to these persistent gaps.

3.3 Rural-Urban Infrastructure and Workforce Disparities

Geographic disparity analysis reveals stark rural-urban differentials. Urban areas, housing approximately 35% of the national population in 2023, accounted

for 63.5% of hospital beds, yielding an urban bed density of 2.5 per 1,000 compared to 0.8 per 1,000 in rural areas. This disparity ratio of 3.1:1 marginally improved from 3.8:1 in 2013, indicating slow progress in rural infrastructure development relative to urban expansion.

Healthcare workforce distribution exhibited similar patterns. Urban doctor density averaged 2.8 per 1,000 population while rural areas recorded 0.6 per 1,000, a disparity ratio of 4.7:1. Nursing personnel showed slightly better distribution with urban density at 3.2 per 1,000 versus rural density at 1.4 per 1,000 (ratio 2.3:1). Primary Health Centers (PHCs) and Community Health Centers (CHCs) in rural areas functioned at 65% of sanctioned staffing levels, with single-doctor PHCs constituting 42% of all rural facilities.

These disparities translate into tangible access barriers. Rural populations face average travel distances of 15-25 kilometers to reach facilities with basic diagnostic and treatment capabilities, compared to 2-3 kilometers in urban settings. Emergency obstetric care availability in rural areas reached only 38% of required capacity, contributing to persistent maternal mortality differentials between rural and urban populations.

3.4 Inter-State Performance Variations

State-wise comparative analysis classifies performance into four quartiles based on composite infrastructure and human resource scores. First quartile states (Kerala, Tamil Nadu, Karnataka, Goa, Punjab) consistently exceeded national averages across most indicators, with Kerala demonstrating exemplary performance achieving or surpassing WHO benchmarks. These states benefit from robust public health systems, effective governance, sustained fiscal commitment, and favorable socio-economic conditions.

Second quartile states (Maharashtra, Gujarat, Andhra Pradesh, Telangana) showed moderate performance with selective strengths. Maharashtra demonstrated strong urban infrastructure but rural deficits, while Andhra Pradesh achieved balanced doctor distribution through compulsory rural service requirements for government medical graduates.

Third quartile states (Rajasthan, Madhya Pradesh, Odisha, West Bengal) exhibited mixed performance with infrastructure improvements but workforce challenges. Fourth quartile states (Bihar, Jharkhand, Uttar Pradesh, Chhattisgarh) demonstrated persistent deficits across multiple dimensions despite incremental improvements. Bihar's bed density remained at 0.5 per 1,000 in 2023, serving a population exceeding 125 million, highlighting severe infrastructure inadequacy. Similarly, Uttar Pradesh, with a population surpassing 240 million, recorded bed

density of 0.6 per 1,000 and doctor density of 0.4 per 1,000, substantially below minimum requirements.

The coefficient of variation for bed density across states decreased marginally from 0.68 in 2013 to 0.61 in 2023, suggesting slight convergence but persistent heterogeneity. Similarly, doctor density variation coefficient reduced from 0.74 to 0.69, indicating limited progress in reducing inter-state disparities despite national initiatives.

3.5 COVID-19 Pandemic Impact on Infrastructure and Workforce

The COVID-19 pandemic served as a critical stress test for Indian healthcare infrastructure and human resources. Initial pandemic waves exposed severe deficiencies in intensive care unit (ICU) capacity, oxygen supply infrastructure, and specialized respiratory care capabilities. National ICU bed availability in early 2020 stood at approximately 0.03 per 1,000 population, grossly inadequate for pandemic requirements.

Emergency response measures included rapid expansion of COVID care centers, conversion of non-health facilities into temporary hospitals, and establishment of dedicated isolation wards. Total COVID bed capacity increased to approximately 2.1 million beds by mid-2021, though a substantial proportion were temporary facilities lacking full diagnostic and treatment capabilities. ICU capacity expanded threefold during 2020-2021, primarily through private sector mobilization and temporary government installations.

Healthcare workforce faced unprecedented demands, experiencing both physical strain and psychological stress. Doctor and nursing staff redeployment from routine services to COVID care disrupted regular healthcare delivery, contributing to delays in elective procedures, maternal health services, and chronic disease management. Healthcare worker infection rates peaked at 11% of the workforce during the second wave, highlighting occupational safety concerns and inadequate personal protective equipment availability initially.

The pandemic catalyzed certain positive transformations including acceleration of telemedicine adoption, digital health record implementation, and recognition of healthcare workers' essential role. However, post-pandemic workforce attrition increased, with approximately 8% of nursing staff and 5% of junior doctors leaving public sector employment during 2021-2023, citing burnout, inadequate compensation, and work-life balance concerns. This attrition exacerbates pre-existing human resource deficits, necessitating targeted retention strategies.

3.6 Comparative Discussion and Policy Implications

The decadal trends demonstrate measurable progress in expanding

healthcare infrastructure and workforce, yet the pace remains insufficient for achieving Universal Health Coverage targets by 2030. Comparative analysis with countries of similar developmental status reveals that India's infrastructure growth rate lags behind nations like Vietnam and Thailand, which achieved WHO bed density standards within two decades of focused policy implementation.

Investment patterns indicate that public health expenditure, while increasing in absolute terms, remained around 1.2-1.4% of GDP throughout the study period, substantially below the 2.5% target recommended in the National Health Policy 2017. States with higher public health spending as a proportion of state GDP (Kerala 2.8%, Tamil Nadu 2.3%) demonstrated superior infrastructure and workforce indicators, suggesting fiscal commitment's critical role.

The persistent rural-urban divide reflects not merely infrastructure distribution challenges but deeper governance, incentive structure, and career progression issues. Successful rural retention models implemented in states like Chhattisgarh (rural service bonds), Tamil Nadu (preferential postgraduate admission for rural service), and Andhra Pradesh (rural allowances and housing) demonstrate feasible intervention pathways. However, these remain inadequately scaled or adopted nationally.

Inter-state disparities reflect historical legacies, fiscal capacities, and governance effectiveness. High-performing states benefit from sustained political commitment, institutional stability, and community participation in health planning. Low-performing states face multiple challenges including governance deficits, fiscal constraints, competing developmental priorities, and lower baseline human development indicators. Addressing these disparities requires differentiated, context-specific interventions rather than uniform national programs.

The private sector's dominant role in healthcare delivery (65% of outpatient care, 58% of inpatient care) necessitates regulatory frameworks ensuring quality, affordability, and equitable geographical distribution. Current regulatory mechanisms remain fragmented, with limited oversight of pricing, quality standards, or ethical practices. Ayushman Bharat's empanelment process demonstrates potential for leveraging private infrastructure for public benefit, yet requires strengthening monitoring, preventing fraud, and ensuring service quality.

Human resource planning faces challenges beyond numerical adequacy, including skill mix optimization, continuous professional development, and performance management. Medical and nursing curricula require alignment with public health priorities, primary care competencies, and emerging challenges such as antimicrobial resistance, climate change health impacts, and geriatric care. Current

educational frameworks remain predominantly hospital-centric and curative-focused, inadequately preparing graduates for population health approaches and community-level interventions.

4. Conclusion

This decadal analysis of health infrastructure and human resources in Indian hospitals reveals a healthcare system experiencing transformation yet confronting persistent structural challenges. While quantitative expansion in hospital beds, healthcare professionals, and facility numbers demonstrates progress, significant gaps remain in achieving WHO benchmarks, ensuring equitable distribution, and addressing quality dimensions.

The improvement in national bed density from 0.9 to 1.4 per 1,000 population and doctor availability reaching WHO minimum standards represent positive trajectories. However, the rural-urban divide, inter-state disparities, and nursing workforce deficits persist as critical barriers to Universal Health Coverage. Kerala's consistent achievement of international benchmarks demonstrates that Indian states possess the capacity to build robust health systems given appropriate policy frameworks, governance structures, and sustained fiscal commitment.

The COVID-19 pandemic simultaneously exposed systemic vulnerabilities and catalyzed innovations in healthcare delivery, digital health adoption, and community engagement. Lessons from pandemic response must inform resilient infrastructure planning, workforce preparedness, and surge capacity development for future public health emergencies.

Moving forward, India's healthcare transformation requires multi-dimensional interventions including increased public health expenditure toward 2.5% of GDP, differentiated state-specific strategies addressing local contexts, strengthened primary healthcare infrastructure particularly in rural areas, comprehensive human resource planning integrating production, distribution, and retention, robust regulatory frameworks for private sector engagement, digital health infrastructure enabling data-driven planning, and community participation in healthcare governance.

Achievement of Sustainable Development Goal 3 targets for Universal Health Coverage by 2030 necessitates accelerated progress beyond current trajectories. This requires political will, sustained resource mobilization, effective governance, and innovative solutions addressing deeply entrenched inequities. The foundation exists through policy frameworks such as Ayushman Bharat, National Health Mission, and digital health initiatives. Translating these frameworks into tangible, equitable outcomes for all citizens, particularly the most vulnerable and

underserved populations, constitutes the defining challenge for Indian healthcare in the coming decade.

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2

Building a New Growth Path for India's Manufacturing and Infrastructure Sectors

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Abstract: *India's aspiration to become a developed economy by 2047 has renewed policy focus on manufacturing-led growth supported by large-scale infrastructure expansion. While India's post-liberalisation growth has been dominated by the services sector, its limited capacity to generate mass employment has exposed structural vulnerabilities in the growth model. In this context, manufacturing is increasingly viewed as a critical driver of employment generation, export competitiveness and technological upgrading. This chapter examines India's evolving industrial and infrastructure policy framework, with particular emphasis on the transition from the broad-based 'Make in India' initiative to the more targeted and performance-linked Production-Linked Incentive (PLI) schemes. It also analyses the complementary role of infrastructure initiatives such as the National Infrastructure Pipeline (NIP) and the PM Gati Shakti National Master Plan in reducing logistics costs and improving connectivity. It argues that while recent policy interventions have produced notable sectoral successes especially in electronics manufacturing and logistics efficiency the overall impact remains uneven. Persistent challenges such as weak MSME capabilities, skill mismatches in the era of Industry 4.0, low investment in research and development and implementation bottlenecks continue to constrain manufacturing's contribution to GDP. The geopolitical reconfiguration of global value chains under the 'China+1' strategy presents India with a strategic opportunity, but realising this potential depends on bridging the gap between policy design and execution. It concludes that India's long-term industrial success will require a shift from subsidy-driven expansion to a productivity-led manufacturing ecosystem grounded in infrastructure integration, innovation and institutional strengthening.*

Keywords: *Manufacturing-led growth, Production-Linked Incentive (PLI), Infrastructure development, MSMEs, Industrial productivity.*

Introduction

Since the economic liberalisation of 1991, India's growth trajectory has been shaped largely by the expansion of the services sector. While this model delivered sustained GDP growth and improved external balances, it failed to generate adequate productive employment for a rapidly growing workforce. Manufacturing, which historically served as the backbone of industrialisation in many developed and emerging economies, remained stagnant at around 15–17 per cent of GDP. This structural imbalance has become increasingly visible in the form of informal employment, low labour productivity and regional disparities. In recent years, policy attention has shifted decisively towards revitalising manufacturing as a central pillar of economic transformation. The launch of 'Make in India' in 2014 marked a symbolic departure from services-centric growth, aiming to position India as a global manufacturing hub. However, the limited impact of this initiative on manufacturing output and employment prompted a rethinking of industrial policy instruments. This reorientation culminated in the introduction of the Production-Linked Incentive (PLI) schemes, which tie government support directly to output and performance outcomes.

At the same time, the government has recognised that manufacturing competitiveness cannot be sustained without efficient infrastructure. High logistics costs, fragmented planning and coordination failures have historically undermined India's industrial potential. Large-scale initiatives such as the National Infrastructure Pipeline (NIP) and the PM Gati Shakti National Master Plan represent an attempt to address these structural bottlenecks. Against this backdrop, this chapter analyses the evolving nexus between industrial policy and infrastructure development, assessing both achievements and limitations.

The Evolving Policy Architecture for Industrial Transformation

India's industrial policy has evolved significantly from a broad promotional approach to a more targeted, incentive-driven framework. This evolution reflects a learning curve, adapting to global economic dynamics and addressing domestic structural weaknesses. The current architecture is built on three core pillars: a national mission to boost manufacturing, performance-based incentives to attract investment and leveraging geopolitical shifts to capture global supply chains.

From 'Make in India' to the National Manufacturing Mission

The 'Make in India' initiative, launched in 2014, aimed to attract investment and promote manufacturing by improving the ease of doing business, liberalising foreign direct investment and strengthening industrial infrastructure. While the programme succeeded in increasing India's global visibility and attracting substantial FDI inflows, its impact on expanding the manufacturing sector remained limited.

Manufacturing continued to contribute only about 15-17% of GDP, well below the target of 25% . As a result, several analysts have argued that 'Make in India' functioned largely as a promotional initiative rather than a deeply transformative industrial strategy. In response to these limitations, India's industrial policy has gradually evolved towards a more coordinated approach. The National Manufacturing Mission announced in the Union Budget 2025–26 represents a shift towards mission-mode governance, bringing together policy design, implementation and coordination across ministries and states. The mission also places strong emphasis on sustainability and clean-technology manufacturing, aligning industrial growth with India's long-term commitment to achieving net-zero emissions by 2070.

The Production-Linked Incentive (PLI) Scheme: A Performance-Based Catalyst

The Production-Linked Incentive (PLI) scheme, launched in 2020, represents a significant shift in India's industrial policy framework. With a total outlay of ₹1.97 lakh crore covering 14 key sectors, the scheme departs from traditional capital subsidies and adopts a performance-based, output-oriented approach. Incentives are provided only after firms achieve predefined targets for incremental production and sales, thereby improving fiscal efficiency and accountability. Available evidence indicates that every rupee of incentive under the PLI scheme has leveraged nearly ₹ 8–9 of private investment.

The outcomes of the scheme have been substantial. By September 2025, PLI had attracted more than ₹ 2.0 lakh crore in actual investment, resulting in incremental production and sales exceeding ₹ 18.7 lakh crore. The scheme has also generated over 12.6 lakh direct and indirect jobs, while exports from PLI-supported sectors crossed ₹ 8.2 lakh crore. The most notable success has been in electronics manufacturing, particularly mobile phones, where India has emerged as a major manufacturing and export hub.

Beyond these quantitative gains, the PLI scheme has contributed to structural transformation by encouraging global firm participation, promoting technology transfer and strengthening domestic value addition. It has also supported investments in research and development, especially in areas such as electric vehicles and battery technologies. However, performance has been uneven across sectors, with slower progress in IT hardware, specialty steel and advanced chemistry cell batteries, largely due to implementation and compliance challenges.

The 'China+1' Strategy

The growing global emphasis on supply chain diversification, often termed the 'China+1' strategy, presents a significant opportunity for India. Rising production

costs, geopolitical risks and recurring trade disruptions have encouraged multinational corporations to reduce excessive dependence on China and seek alternative manufacturing locations (ET2C, n.d.; Refteck, n.d.). In this context, India is positioning itself not merely as a low-cost destination, but as a strategic partner offering geographic diversification, a large and expanding domestic market and deep pools of engineering and technical talent (ET2C, n.d.).

India's approach under the China+1 framework has been to function as a complementary manufacturing hub rather than a direct replacement for China. While China continues to dominate high-volume manufacturing and rapid scale, India's strengths lie in supplier diversification, engineering-led production and a balanced cost–quality advantage (ET2C, n.d.). This positioning has begun to yield results in selected sectors. In electronics, global firms are expanding assembly operations, while the automotive components industry is deepening its integration into global supply chains. Pharmaceuticals and textiles are also leveraging existing capabilities to capture larger shares of international markets (ET2C, n.d.). To capitalise fully on this opportunity, experts argue that India must improve its ability to convert investor interest into on-ground outcomes. Reducing approval delays, improving logistics efficiency and strengthening digital trade facilitation are seen as essential for enhancing India's "capture rate" and accelerating project execution (Seshadri, as cited in *The Economic Times*, 2026a).

Infrastructure as a Foundation for Manufacturing

Recognising that globally competitive manufacturing cannot be sustained without world-class infrastructure, India has undertaken an unprecedented push in capital expenditure (capex). The Union Budget 2026–27 allocated a record ₹12.2 lakh crore towards capex, reinforcing infrastructure development as a central pillar of the country's growth strategy (KPMG, 2026a; India Briefing, 2026a). This investment extends beyond the mere expansion of roads, ports and railways. Instead, it reflects a broader objective of creating an integrated, efficient and technologically advanced logistics and infrastructure ecosystem capable of supporting large-scale industrial activity.

The Twin Pillars: National Infrastructure Pipeline (NIP) and PM Gati Shakti

The government's infrastructure strategy is operationalised through two complementary flagship initiatives: the National Infrastructure Pipeline (NIP) and the PM Gati Shakti National Master Plan.

Launched in 2019, the NIP serves as a large-scale financial and planning framework that outlines infrastructure projects valued at over ₹ 111 lakh crore subsequently expanded to more than ₹185 trillion—across key sectors such as energy,

roads, railways and urban development up to 2025 (ForumIAS, n.d.; *Livemint*, 2026). The initiative aims to provide greater visibility and certainty to investors, improve project preparation and facilitate the mobilisation of private and foreign capital. Funding under the NIP is structured as a partnership involving the central government 39%, state governments 40% and the private sector 21% (Wikipedia, n.d.a).

If the NIP defines *what* infrastructure is to be built, PM Gati Shakti focuses on *how* it is to be delivered. Introduced in 2021, PM Gati Shakti is a digital platform designed to enable integrated planning and coordinated execution of infrastructure projects (VMS Consultants, n.d.a). By bringing together more than 16 ministries on a single GIS-based platform, it seeks to reduce departmental silos, promote holistic planning and ensure multimodal and last-mile connectivity. Its core objective is to minimise planning and implementation frictions, avoid delays arising from uncoordinated infrastructure works and optimise logistics networks to lower overall logistics costs (Invest India, n.d.; LinkedIn, 2024a).

Transforming Logistics: From Cost Centre to Competitive Edge

The primary economic goal of this infrastructure push is to tackle India's historically high logistics costs, which have been a major drag on manufacturing competitiveness. Estimated at 13-14% of GDP for years, these costs are now reported to have fallen to a range of 7.8-8.9%, a significant milestone (LinkedIn, 2024a; India Seatrade News, 2026). This improvement is a direct result of integrated infrastructure development.

Key initiatives driving this transformation include:

Dedicated Freight Corridors (DFCs): The operation alization of the Eastern DFC and the near-completion of the Western DFC are game-changers, enabling faster, heavier, and more reliable movement of goods by rail. The Union Budget 2026-27 announced a new East-West DFC, further expanding this high-performance network (Railway Gazette, 2026).

Gati Shakti Multi-Modal Cargo Terminals (GCTs): To complement the DFCs, the government is promoting the development of GCTs to facilitate seamless modal shifts. As of early 2026, 118 of the 306 approved GCTs were already commissioned, mobilizing private investment and significantly boosting freight revenues, which grew fourfold between FY23 and FY25 (PIB, 2026a).

Multimodal Connectivity: There is a strong push to increase the share of more efficient transport modes. A new Coastal Cargo Promotion Scheme aims to raise the share of coastal shipping and inland waterways in freight transport from 6% to 12% by 2047 (KPMG, 2026a; India Briefing, 2026a).

Digital Transformation: Initiatives like the Unified Logistics Interface Platform (ULIP) and the digitization of customs processes (e-Sanchit, SWIFT) are reducing documentation, improving traceability and cutting down clearance times, making trade faster and more transparent (Solwer India, 2025; Digital India, n.d.b).

Persistent Challenges in Infrastructure Execution: Despite the ambitious plans and significant outlays, India's infrastructure build-out faces persistent challenges. The gap between policy announcements and on-ground delivery remains a concern (The Economic Times, 2026a). Key hurdles include:

Funding and Financial Constraints: Securing the massive investment required for the NIP is a primary challenge. Many states have limited fiscal space and attracting sufficient private investment is difficult due to regulatory uncertainties, long project gestation periods and a shallow local debt market (ForumIAS, n.d.; Kearney, n.d.).

Implementation Hurdles: Land acquisition remains a major bottleneck, causing significant project delays and cost overruns. While Gati Shakti aims to streamline approvals, obtaining environmental and other statutory clearances is still a complex and time-consuming process (ForumIAS, n.d.; World Construction Network, n.d.).

Centre-State Coordination: Effective implementation requires seamless cooperation between central and state governments. Political friction and differing priorities can stall progress, especially since states are expected to contribute 40% of NIP funding (ForumIAS, n.d.).

Sectoral Deep Dive: Engines of Growth and Performance Gaps

The impact of India's recent industrial policy reforms is most clearly seen at the sectoral level. While some industries have shown strong growth and global competitiveness, others continue to struggle with long-standing structural problems. Recognising these differences, the Union Budget 2026–27 increased policy support for seven strategic sectors, including electronics, biopharma, textiles and rare earths, to strengthen manufacturing capacity and exports.

Electronics Manufacturing

Electronics manufacturing, especially mobile phone production, is the biggest success of the Production-Linked Incentive (PLI) scheme. Over the last decade, India has moved from being heavily dependent on imports to becoming a major global manufacturing base. In 2014–15, nearly 75% of domestic demand for mobile phones was met through imports. By 2024–25, imports fell sharply to just 0.02% of domestic demand. During this period, electronics production increased

six times to ₹ 11.3 lakh crore, while exports rose eight times to ₹3.27 lakh crore. This transformation was driven mainly by global companies such as Apple and Samsung and their contract manufacturers like Foxconn and Pegatron. These firms expanded their production in India and connected the country to global supply chains. Tamil Nadu emerged as a major electronics hub, contributing nearly 37% of India's electronics exports in FY25.

Automotive and Auto Components

The automotive sector is one of the most important parts of India's economy. It contributes about 7.1% of GDP and nearly half of manufacturing output. India is currently the fourth-largest automobile producer in the world. However, its share in global auto component exports remains low at around 3%. To improve this, the government plans to increase auto component exports to 60 billion dollars by 2030. The sector is also undergoing a shift towards clean and electric mobility. Government support through the FAME scheme and the PLI scheme for automobiles and advanced chemistry cell batteries, together worth ₹44,038 crore, aims to promote electric vehicles and battery manufacturing. Policy focus is also placed on securing critical minerals such as lithium and copper and encouraging battery recycling to reduce import dependence.

Pharmaceuticals

India's pharmaceutical industry is the third-largest in the world by volume and plays a crucial role in global healthcare. It supplies more than half of the world's vaccines. The sector, valued at around 55 billion dollars, is expected to grow to 130 billion dollars by 2030. The pharmaceutical PLI scheme has reduced India's dependence on China for active pharmaceutical ingredients and key starting materials by boosting domestic bulk drug production. As a result, India achieved a trade surplus of ₹2,280 crore in bulk drugs in FY25. To further strengthen the sector, the Union Budget 2026–27 introduced the ₹10,000 crore Biopharma SHAKTI initiative, focusing on biologics, biosimilars, and advanced clinical research infrastructure.

Textiles and Apparel

The textile and apparel sector is India's second-largest employer after agriculture, providing jobs to over 45 million people. The government aims to increase textile exports from ₹ 3 lakh crore to ₹9 lakh crore by 2030. Budget 2026–27 introduced an Integrated Programme for Textiles, covering fibre development, modernisation of clusters and sustainable manufacturing. Seven PM MITRA mega textile parks are also being developed to attract large investments. Despite these efforts, challenges remain. An inverted duty structure on imported textile machinery continues to limit domestic manufacturing and technological upgradation.

The Unfinished Agenda: Structural Constraints and Future Reforms

Despite clear policy intent and visible sectoral successes, India's manufacturing revival continues to be held back by several deep-seated structural constraints. Achieving the long-standing target of raising manufacturing's share to 25% of GDP will require sustained efforts that go well beyond policy announcements. The focus must increasingly shift toward measurable outcomes and the creation of genuine supply-side competitiveness, rather than relying on subsidy-driven narratives (Seshadri, as cited in *The Economic Times*, 2026a).

Empowering the MSME Ecosystem

Micro, Small and Medium Enterprises (MSMEs) form the backbone of India's economy, accounting for nearly 30% of GDP and more than 45% of merchandise exports (VMS Consultants, 2026). Yet, they remain the most vulnerable segment of the industrial ecosystem. A persistent credit gap continues to limit their growth, with formal financial institutions meeting only about 19% of total MSME credit demand (NITI Aayog, as cited in *The Economic Times*, 2026a). This problem is compounded by the fact that over 99% of MSMEs are micro-enterprises that often lack collateral, restricting access to bank finance (The Economic Times, 2026a). Additionally, nearly 85% of India's workforce remains informal, contributing only 45% of GDP, a condition that hinders technology adoption and integration into global value chains (Open Magazine, 2026).

Recent policy initiatives reflect a gradual shift from credit-centric interventions toward capability building. The Union Budget 2026–27 proposed the creation of a cadre of "Corporate Mitras" in Tier-II and Tier-III towns to assist MSMEs with regulatory compliance at affordable costs (The Economic Times, 2026c). The ₹ 10,000 crore SME Growth Fund further aims to provide equity support, addressing deeper structural weaknesses beyond liquidity constraints (PIB, 2026e). However, analysts argue that these measures must be complemented by stronger demand conditions, improved technology diffusion and closer integration between MSMEs and large firms (The Federal, 2026).

The Human Capital Challenge

As manufacturing increasingly adopts automation, artificial intelligence and digital technologies, skill shortages have emerged as a major bottleneck. In 2025, nearly four out of five Indian employers reported difficulty in finding skilled workers, a figure significantly higher than the global average (ET Edge Insights, 2026a). Looking ahead, the World Economic Forum estimates that close to 40% of job-related skills will change by 2030 (Global IMI, 2026a). Demand for skills in

areas such as AI, data engineering and robotics is growing much faster than supply (The Economic Times, 2026d).

Policy responses include initiatives such as SAMARTH 2.0 for the textile sector and the broader "Education to Employment and Enterprise" framework announced in the Union Budget 2026–27 (PIB, 2026d; The Economic Times, 2026d). These efforts aim to move beyond headline job creation toward building a globally competitive workforce. NITI Aayog has further recommended cluster-based apprenticeship models and state-level skilling missions to produce factory-ready professionals in frontier technologies (NITI Aayog, 2025a).

The Innovation Deficit: Bridging the R&D Gap

Low investment in research and development remains a critical weakness in India's manufacturing ecosystem. India currently spends around 0.7% of GDP on R&D, compared to 2.7% in China (Open Magazine, 2026; The Economic Times, 2026f). This gap limits productivity growth and restricts firms from moving up the value chain. The IMF highlights subdued business dynamism and weak R&D engagement as major reasons for India's lagging manufacturing productivity, noting that stronger innovation could raise productivity growth by nearly 40% (IMF, 2026).

Institutional responses include the creation of the Anusandhan National Research Foundation (ANRF) and a ₹1 lakh crore Research, Development and Innovation (RDI) Fund to provide competitive and mission-oriented funding (PIB, 2025a). The Union Budget 2026–27 also emphasized the integration of AI across national missions and introduced a tax holiday for foreign cloud service providers using Indian data centres, aimed at strengthening the country's compute infrastructure (KPMG, 2026a). Translating these investments into an industry-driven innovation ecosystem, however, remains a long-term challenge.

The Regulatory and Business Environment

India has made notable progress in improving the ease of doing business through reforms such as the Goods and Services Tax, the Insolvency and Bankruptcy Code and the decriminalization of minor offences under the Jan Vishwas Acts (A2Z Taxcorp, 2026). Digital initiatives like the National Single Window System now integrate approvals across 32 central ministries and 32 state governments (A2Z Taxcorp, 2026). Despite these improvements, challenges remain. The Asia Manufacturing Index 2026 ranked India sixth out of eleven economies, pointing to weaknesses in tax policy, trade integration and perceptions of political risk (Business Standard, 2026). Firms continue to cite approval delays, regulatory complexity, policy uncertainty and high capital costs as constraints, particularly for MSMEs (The Economic Times, 2026a).

Conclusion

India's industrial sector is undergoing an important transition as the government seeks to shift economic growth from services towards manufacturing. This strategy is based on performance-linked incentive (PLI) schemes and large infrastructure initiatives such as the National Infrastructure Pipeline and PM Gati Shakti. These policies have produced visible results, including rapid growth in electronics manufacturing, lower logistics costs and increased interest from global firms under the China+1 strategy. As a result, India is increasingly viewed as a strategic manufacturing destination rather than only a low-cost location. However, progress remains uneven across sectors and manufacturing's share in GDP has not risen significantly. Major challenges include gaps between policy design and implementation, low productivity among MSMEs, skill mismatches in the workforce and inadequate investment in research and development. Addressing these issues is essential for moving from subsidy-led growth to a productivity-driven manufacturing model and achieving long-term industrial competitiveness.

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Indian Industrial Revolution 4.0 and Effectiveness of Artificial Intelligence (AI) and Machine Learning (ML)

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Abstract: *Presently at this wake of technology, technology has advanced and we are moving towards the Fourth industrial revolution. New technical breakthroughs like Artificial Intelligence, Internet of things, Big Data etc. will change the entire scenario of current industry. Industry 4.0 is going to change the way we work, the way we live, the way we think and the way we relate things with other. One of the major components of industry 4.0 is Artificial Intelligence (AI) which enables machines to think, learn and in decision making also. . In order to advance India's economy, Industry 4.0 may also assist in achieving the Sustainable Development Goals (SDGs). With the implementation of Industry 4.0, the noble goal of making India a $5 trillion economy by 2025 may be realised. Going forward, the Indian economy and society are unquestionably set up for a radical transformation. Surprisingly, Artificial Intelligence (AI) and Machine Learning (ML) related structures will be made mandatory for future students as well as educational aspirants because of their importance to the future of the world in a magnificent way. The potential advantages of this technological progress are not free from negative side effects. Research indicates that the introduction of robotics into society would likely result in a decrease in human productivity. While medical improvements may extend life expectancy, ageing will cause people to become less active and more slothful. In the future, those who use technology wisely to preserve their health will do better. When considering things from the perspectives of reason and imagination, human life is extremely valuable. This paper is an honest attempt to highlight the issues, challenges and prospect as well as retrospect of Industry 4.0, AI, ML and the development agenda of India.*

Keywords: *AI, ML, SDG, Industrial Revolution 4.0, Industrial Revolution 5.0*

The Fourth Industrial Revolution, as a popular connotative industrial agenda, is approaching rapidly as a result of technological development. Recent technological advances in the nations of the World, such as AI, IoT, Big Data, etc., will have deep-rooted as well as far-reaching effects on the present business climate. Industry 4.0 will impact different aspects of human life, including jobs, engagements, homes, thoughts, and relationships with one another. Artificial intelligence (AI) is crucial in one to all sectors of the production processes of the fourth generation. This opens the door for intelligent, purposeful and self-directed robots. Different companies anticipate a new age of exceptional development because of AI. In near future, it is deeply expected that robots will be sent into space instead of humans, and this will lead to fascinating new discoveries in space science. However, AI has brought helpful applications beyond only space exploration. Some of the many areas where AI will be used include security services, counter-terrorism, surveillance, traffic control and management, and education. Artificial intelligence will have a reflective impact on the banking sector, the airline industry, the medical field, and the educational fields especially classrooms both real and virtual. Nanotechnology has also allowed for potentially life-saving treatments for cancer patients and in critical care facilities. In near future, students will benefit from the smart classrooms rather than conventional face to face class rooms. While the cost of this technology has rapidly increased recently, it is expected to decrease as innovation drives down production costs. Surprisingly, Artificial Intelligence (AI) and Machine Learning (ML) related structures will be made mandatory for future students as well as educational aspirants because of their importance to the future of the world in a magnificent way. The potential advantages of this technological progress are not free from negative side effects. Research indicates that the introduction of robotics into society would likely result in a decrease in human productivity. While medical improvements may extend life expectancy, ageing will cause people to become less active and more slothful. In the future, those who use technology wisely to preserve their health will do better. When considering things from the perspectives of reason and imagination, human life is extremely valuable. This means that robot fighters may be a part of future militaries. For economies like as India's, where the military now employs more than 20 lakh people, this might have disastrous consequences.

Ever since the dawn of civilisation, humans have endeavoured to enhance their abilities and strength. They used to use tools made of wood or rocks, but as science advanced, they looked into more advanced, effective tools, and this process is still ongoing. Among the things that mankind have invented are machines. The initial industrial revolution was brought about by the employment of machinery. It

was called a revolution because it brought about major social and economic changes in addition to a huge rise in output. For instance, the French Revolution in the 1790s gave rise to new concepts like -Equality, Liberty, and Brotherhood, which were further developed and infused by the first industrial revolution that occurred a few years later. It signifies that industrial revolutions have a huge impact on our society, not only society but it also affects the world economy.

Presently at this wake of technology, technology has advanced and we are moving towards the Fourth industrial revolution. New technical breakthroughs like Artificial Intelligence, Internet of things, Big Data etc. will change the entire scenario of current industry. Industry 4.0 is going to change the way we work, the way we live, the way we think and the way we relate things with other. One of the major components of industry 4.0 is Artificial Intelligence (AI) which enables machines to think, learn and in decision making also.

Industry 4.0 Technologies for change and development:

Internet of things (IOT) is another technical breakthrough where machines can communicate with each other. IOT with the AI combination will transfer factories into smart factories, cities into smart cities, cars into smart cars and homes into smart homes. If it happens so, then it will reduce human efforts to a minimum. Industry 4.0 also includes big data analytics as an essential component. Its main purpose is to collect customer information so that manufacturers may create goods and services that are appropriate for them. Data is vital to us in the digital world of today. Imagine the amazing changes we will observe in our surroundings if this massive amount of data is handled correctly. It will save us money and time since we will receive excellent on-time services. Big Data is actually going to radically change the governance structure. It will become more effective and transparent as a result. Implementing policies is a significant challenge for governments. It is predictable that using AI and big data would help to simplify this issue. The government will be able to reach every needy person and no one will be excluded from this technological justice. It means Big Data ensures inclusive socio-economic development in the future.

According to the UN, privacy is one of the human fundamental rights. This data, if not properly guarded kept secured from the data manipulators both nation ally and internationally, may cause civil wars or riots. Thus, this will be a significant difficulty moving forward. Different industrial revolutions have had a significant influence on the global economy and have altered its fundamental structure. For instance, the manufacturing economy emerged from the agricultural economy during the first industrial revolution, the service economy emerged during the second industrial revolution, and the knowledge economy emerged during the IT revolution.

However, in order to keep up with this advancement, one needed to pick up new abilities and methods. When tractors and electric pumps were introduced to the farming industry, for instance, only those farmers who schooled themselves in line with current technology could survive, while the others failed.

An important and unavoidable question arises when we think about artificially intelligent machines: "Will there be any job left for humans?" Actually, jobs are not dying but they are evolving. It is obvious that Industry 4.0 will replace some jobs, but is also creating new jobs like big data analytics, VR designer, block-chain auditor, social media reporter, drone operator space visit guide and many more. it is expected that high-skilled and low skill jobs will stay as before, but middle-tier jobs will be replaced by AI robots. This is known as job polarization in the economic terms. If workers want to sustain then they have to learn new technological skills. Researchers of Oxford University have found that jobs which are related to manual dexterity, high cognitive skills and social skills are difficult to be computerized, and workers should focus on developing these skills. Doctors are going to be replaced by AI robots in future but if a doctor is trained with hospitality skills and caretaking skills, then he/she will be preferable over a robot-doctor. It means jobs are going to be knowledge-centric and talent centric. A construction worker has to learn something about electronics apart from construction skills if he/she wants to build an automated smart home where sensors are used. Hospitality, condolence, politeness these are some qualities which should be learned as these will value add our character.

In the recent times, human race are heading towards a **Gig economy**. Gig means not continuous. It is predicted that normal continuous jobs will be reduced and these will be replaced by contractual jobs. If there will be no permanent jobs then there will be no paid holidays and no insurance schemes and also no fixed income. It may create unemployment like situation but I think gradually it will become part of our habit. So the beginning period is going to be tough and it is also expected that the revolution may slow down the world economy for a small period. So we should get ready for it. It is often observed "lack of reciprocity between technology and skill results in social inequality". Those who learn new skills time to time and update their work with new technology will succeed and for the rest, fourth industrial revolution will be a big challenge. Actually, it depends on you whether Industry 4.0 will be a boon or a curse.

Economic Benefits:

By 2025, industry 4.0 technologies will not only be game-changers but also aid in the economic regeneration, allowing businesses to improve India's financial situation in the post-COVID age. The use of AI by enterprises will be

crucial to the post-pandemic recovery of the Indian economy. Block chain, big data analytics, the Internet of Things (IoT), advanced manufacturing, quantum computing, and artificial intelligence (AI) are among the cutting-edge technologies that may soon allow India to carve out a distinctive niche for itself as a "International nucleus." Artificial Intelligence is predicted to have a cascading effect on economic growth and prosperity in India as it supports "digital inclusion." Analysts foresee that AI can help add up nearly $957 billion to the Indian economy by 2035 and by 2025, AI can add over $500 billion and nearly 20 million jobs to the Indian economy. In addition, the Indian government is working to establish a strong legislative framework that will regulate the nation's data in addition to using AI to build a data-driven society that offers countless opportunities to empower individuals, improve society, and facilitate commercial dealings. With its AI strategy, which includes a sizable pool of AI workers and a burgeoning startup ecosystem, India has a remarkable opportunity to play a leading role in the development of AI-driven solutions that have the potential to significantly improve the economy by transforming industries like manufacturing, education, healthcare, and agriculture. It is believed that the use of AI in many economic areas has reduced risk and taken less time, yielding positive results.

Government Initiatives:

To help with the nation's economic transition, the Ministry of Commerce and Industry has established a Taskforce on AI. However, adoption of AI has remained in its infancy. As a result, the Indian Government needs to think about creating a distinct "Industry 4.0 Ministry" to oversee all initiatives pertaining to new generation technology. For example, the United Arab Emirates (UAE) established the position of Minister of State for AI in 2017, making it the world's first such position. Governments everywhere are already taking steps to join the AI-driven digital economy, which is predicted to boost the world economy by around $15.7 trillion by 2030. Given its current circumstances, India is poised to seize a significant chance for both economic growth and improvements to the general welfare of its populace. India might become the ideal testing ground for cutting edge and international technological solutions because to "inclusive economic growth." In order to do this, the government must think about increasing funding for research and development (R&D) across a range of industries in its yearly budget and create R&D departments at several colleges and universities throughout the nation. General-purpose technologies (GPTs) have the potential to significantly alter societies through their impact on the current economic and social structures, and India may leverage GPTs to impact the whole economy.

Growth Potential:

Businesses are not the only ones embracing AI; economies across the board are putting more focus on developing their AI capabilities as a tool to spur economic growth. Developed countries are already leading this race, and India, an aspirant future powerhouse, is about to follow suit. India appears to be at the forefront of industry as AI-based solutions are adopted more quickly.

Thus, even if the global digital gap continues to widen, it would be advantageous for India to develop its AI capabilities. The world has benefited more from the first industrial revolution to the advent of the IT revolution, and experts predict that AI, like every other new technology in history, will create more employment than it eliminates. However, it is clear that emerging countries have obstacles in the "initial adoption of technology" stage, since limited access to Industry 4.0 might exacerbate wealth disparity. In addition, the adoption stage of transformation is expected to displace some jobs before creating new ones. Although artificial intelligence (AI) has a significant impact on productivity and GDP, research has also shown that AI has a negative impact on employment. According to Mckinsey Global Institute, intelligent devices and robotics might replace about 30% of the global labour by 2030. Additionally, this shift may become more challenging given the increase in unemployment; yet, in the past, new technologies have shown to be beneficial in the long run, so it is inexcusable that their short-term failures were justified. However, India continues to fall behind on key AI development metrics even though it has a competent labour pool, strong enterprises, and higher levels of entrepreneurship. Thus, a balanced strategy, creative local solutions, and top-down policy making should be proposed for the improvement of the key AI metrics. Additionally, the private sector's increased involvement and the government's increased participation will be crucial in guiding AI towards growth that is equitable. In addition, the continued innovations and collaborations by Public-Private Participation (PPP) are necessary to lessen the cost of modern technologies, which can help the larger population thereby driving the "digital revolution". However, India should also mainly consider improving its "hardware sector" to help redress bottlenecks since the country still lags behind which is vital for the Indian economy.

Growth Dimension Indian Economy:

There some sectors which offer plenty of opportunities for growth as well as creation of new jobs. These are healthcare, education, construction, transportation, logistics, tourism, and hospitality.

AI Adoption across Industries

Industry	Adoption 2020-21	2022-23	Swing
Retail and comsumer	76	70	-6
Financial services	85	86	+1
Industrial products and Manufacturing	72	92	+20
Travel and hospitality	92	99	+7
Technology, media and telecommunications	80	92	+12
Health care and Pharmaceuticals	75	82	+7
Source: PwC Data Source 2020-2023			

Robot Density in Manufacturing Industries 2016 (Number of Installed Industrial Robots per 10,000 employees)

Countries	Number	Countries	Number
R. Korea	631	Singapore	488
Germany	309	Japan	303
US	189	UK	71
China	68	Brazil	10
Russia	3	India	3
Global average	74		
Source: Robot Density Rises Globally, International Federation of Robotics,7 Feb 2018, Executive Summary World Robotics, 2017, Industrial Robots.			

Annual Shipment of Industrial Robots into India (Number of units)

Year	Number of units	Year	Number of units
2015	2065	2016	2627
2017(E)	3000	2018(F)	3500
2019(F)	5000	2020(F)	6000
E-Estimate and F-forecast. Source: Robot Density Rises Globally, International Federation of Robotics, 7,Feb 2018, Executive Summary World Robotics, 2017, Industrial Robots.			

Healthcare:

The market size of the Indian healthcare segment was around US$160 billion in 2017 and it was expected to expand to US $ 372 billion by 2022. Its CAGR would be in the range of 16–17 per cent. Cumulative FDI inflows from April 2000 to March 2016 was US $ 22.41billion to this sector. The Government spending in 2017 was 1.2 per cent of GDP and in 2022; it was expected to be 2.5 percent of GDP. In terms of employment, healthcare accounts for 4per cent across all sectors in India. Number of employees in this sector was 1.2 million by the end of 2017. The healthcare sector was expected to employ 1.54 million additional doctors and

2.4 million nurses to meet the demand by 2025. Nearly US$200 billion is expected to be spent on medical infrastructure by 2024 (Grant, Thornton and CII, 2015). The Ayushman Bharat scheme, the largest government-funded health care programme of the Government of India, aims to cover over 100 million poor and vulnerable families. It brings about transformative change in healthcare by shifting focus from healthcare to "wellness." There are two components of the scheme. One, a health care and wellness centre, which will bring healthcare services closer to home. It has a provision of inclusive healthcare, free essential drugs, and diagnostic services. In addition, the national health promotion scheme, i.e. Pradhan Mantri Rashtriya Swasthya Suraksha Mission. It provides an insurance cover of over $7000 (approximately 500,000 Indian rupees) per family per year for secondary and tertiary healthcare; over 1.4 million people will be covered. The key emerging trend in this sector would be:

- Use of Health apps.
- Telemedicine (growth of 20 percent CAGR during 2016–2020 reaching $32 million by 2020.
- Rise in medical tourism (market worth increased to $6 billion by 2020 from $3 billion in 2017).
- Adoption of loT platform for insurance and management – will push to internet of Medical Things (loMT) forward, and wearable devices will be used to identify risk factors.
- Development of block-chain technology to facilitate transparency and administrative cost, etc..
- Development of electronic health record (HER). and
- Use of AI powered robots.

Education:

The size of the education market is estimated to be around $ 97.7 billion in 2016. In the same year, there were 1.52 million schools and 850 universities. The students enrolled in the schools were 260.2 million, and in higher education, it was 33.3 million. FDI flows in the education sector, as a whole was $ 1.67 billion during 2000–2012. The digital learning market was around $ 2 billion in 2016 and is expected to be around $ 5.7 billion by 2020. The total employment in this sector was 18.2 million in 2018.

Many key emerging trends are noticed. India's education landscape of the future is characterized by blurring of boundaries; this process has already begun and will continue until 2030. The society will embrace a culture of lifelong learning.

There will be a much closer nexus between education and industry; there will be a rise in industrial contribution to the development of education. Geographical boundaries will become less relevant and there will be an increase in global education delivery and accreditation. The space of education will alter drastically with limited face-to-face interaction between students and teachers.

There will be a considerable increase in the use of technology in all spheres of education. This will be in form of:

- An increase in the use of big data to analyze student information and customization of online content in the near future;
- Digital platforms weaving path for massive open online courses (MOOC) such as edX, Udemy, Coursera, SWAYAM (MHRD platform where online course are offered by institutes such as IITs and IIMs)
- Heightened internet penetration leading to the emergence of mobile education (m-Education), which has the potential to revolutionise India's vast network of rural and semi-urban school network, which are currently facing challenges in terms of quality teachers and infrastructure;
- Blockchain technology has given way to micro credentials and badges. Micro credentials have grown in popularity among both brick-and-mortar institutes and digital platforms such as Coursera and edX.
- Gamification- and simulation-based teaching-learning ecosystem is emerging, leveraging the strengths of technologies such as Augmented Reality (e.g. Google cardboard, Microsoft Holo Lens and Eon Reality);
- AI-based facial recognition software like SAFR (Secure, Accurate Facial Recognition) are being deployed in schools for analyzing student behavior for better monitoring;
- Data driven decision-making is redefining education management and administration through creation of class schedule; and,
- Technological tools such as AI and RPA that are being utilized in assessment software's suchase Lumen, WEAVE online and Evaluation KIT, are supplementing learning outcomes.
- Mega trends that will drive the Indian education sector in the future will be:
- Setting up of satellite campuses and student exchange programmes by foreign universities,
- Broadening geographical presence to includes socio economic groups with low participation,

- Increasing collaboration with industry, to boost the research and development initiatives, and
- Tutoring in the K2 market which is emerging as a major segment.

Construction sector:

Construction sector contribution to GDP was 9 per cent and is growing at15.7 per cent and expected to be nearly $738.5 billion by 2022. The sector employs 44 million workers. The cumulative inflow of FDI was $24.8 billion during the 2000–2018 periods. There are many key emerging trends. These are increasing use of loT devices in smart buildings for collecting and analyzing data from sensors to understanding signal sand patterns, deploying real time solutions, cutting costs, prioritizing preventive maintenance, and preventing unplanned downtime. Building Information Modeling (BIM) is yet another technique. Indian firms such as HCC and Tata project have initiated the use of BIM to establish transparency in design, costing, and progress, visualization as well as to improve on-site monitoring of materials, labour, and equipment productivity. These techniques are made use of by Nagpur Metro Rail Corporation and IBIS hotel chain in India. Off-the-shelf robotic applications are being utilized to work in parallel to manual labours at construction sites, for e.g.,WALT a robotic developed by Hyderabad based Endless Robotics can paint walls about 30 times quicker than a human (NASSCOM, FICCI, and Ernst &Young, 2018).

India's Smart Cities mission is an initiative to develop advanced and modern urban localities by leveraging cloud computing, big data mobility, and loT. Under this, 100 smart cities are envisaged to be developed by 2020. The government has accorded priority to some schemes like Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Heritage City Development and Augmentation Yojana (HRIDAY), Pradhan Mantri Awas Yojana, Bharatmala, and the Delhi-Mumbai Dedicated freight corridor that are providing major growth thrust. Green infrastructure projects have led to eco-friendly end-to-end construction mechanisms, from materials, method to equipment with parameters of reduced carbon footprint, energy efficiency, and water conservation. These are some of the key trends.

Transportation and Logistics Sector

Roads and Highway segment:

The road network in India is one of the largest in the world, spanning over 5.6 million km in 2018. Roads handle more than 65 percent of freight and 80 percent o f passenger traffic in the country. The market for roads and highways is projected to grow at a CAGR of 36.16% during 2016–2025. In 2018, the government allocated

$10.97 billion for the development of national highways. Overall, annual freight traffic is estimated to reach 168,000 billion passenger km by 2030.

Railway Segment:

India has the 4th-largest rail freight network in the world. Indian Railway runs 13329 trains, carrying 22.4 million passengers every day. It employs close to 1.3 million people and is the world's eighth-largest employer. Capital expenditure has been pegged at $22.85 billion in 2018. Passenger traffic is expected to grow to 15.20 billion by 2020, up from 8.29 billion in 2018. There will also be a rise in freight traffic. New technologies will be used in many activities.

Aviation segment:

India is the 9th largest market for civil aviation in the world. Aviation industry is expected to witness $15.52 billion worth investment in the next five years. By2020, passenger traffic at Indian airports was expected to increase to 421 million from 309 million in 2018. The industry witnessed a 13.4 per cent growth in foreign tourist arrival in 2018. Domestic aviation passenger traffic grew

Ports and Shipping segment:

India is the 16th largest maritime country in the world.Total investment in ports by 2020 is expected to reach $43.03 billion. Cargo traffic at the end of 2018 was 174 million tonnes. The industry's fleet strength is 1301 vessels. Its freight capacity is expected to increase to 1451 million tonnes by 2020 from the present level of 965 million tonnes.

There are many key emerging trends in this segment. The use of augmented reality (AR) for warehouse planning, pick-and-pack service, and last mile delivery has shown significant improvement in productivity by shortening the learning curve, improving warehouse work flow, and providing constant picking and packing validation updates in real time. It will also enable IoT based real time integration of data across supply chain partners for real time tracking; for example. Integrated devices with real time analytics and predictions. Robots and automated guided vehicles are already solving the picking and sorting challenges in warehouses; for example, Kiva and Butler are touted as the future warehouse workforce. Social media and mobile applications are being used to generate one-on-one interaction with customers to obtain feedback and provide customer services; for example, mobile ride sharing application leveraged by user in order to carpool. Big data analytics is being leveraged for long-term demand forecasts, transportation fleet capacity optimisation, and planning and management; for example, analytics is being used to identify carriers that have the capacity to accommodate additional freight/passengers.

Tourism and Hospitality Sector:

The market size of this sector was $230 billion. Its contribution to GDP was 9.4 per cent. This sector is expected to reach $424billion by 2027. The sector employs 44 million workers (as of 2016). International tourist arrivals were estimated at 8.8 million while the domestic tourist visits were estimated to be 1.6 billion. The emerging trends are:

- RPA is increasingly being embraced as a tool for business travel management in the 24x7 booking/reservation system;
- Hotels and multiplexes are making use of augmented reality to allow tourists to engage in a close to real life experience through multi-media resources;
- Big data is being used by the hospitality industry players, exploiting analytics for targeted marketing of their services through data collected via social media channels;
- AI based guest system is being deployed to provide personalized experience to customers regarding their tastes or consumption by accessing real-time information;
- Companies have started using private block-chain to handle internal processes and manage distribution of hotel and restaurant inventory and other assets. It is also being used to streamline their loyalty management programmes;
- India is emerging as the preferred destination for medical tourism as it offers advanced facilities, skilled doctors, and low cost treatment to foreign patients; and
- The E-Tourist visa, launched by the Government of India, has resulted in an increase in the number of tourist visas issued in the country. Arrivals through e-Visa have increased by 57.2 per cent to 1.69 million during 2017.

There are new dimensions to the technology developments in Industry 4.0. There are three types of technological developments taking place. The first consists of innovations that are happening in the West but are being deployed or have a potential to be deployed across the world. These include the sharing economy initiatives, ledby Uber and Airbnb. These cond comprises solutions meant only for local needs. These low-tech and affordable solutions work in emerging markets. The third is being created in emerging markets but has a potential to be scaled up across the world; OYO hotel is an example. The successful adoption of Industry 4.0 technologies depends on the role of the government, industry, and academia. The government should act as an enabler. It should encourage and promote original

research aimed at developing technologies in emerging areas, mandating an industry-oriented curriculum at graduation level in state education boards.There is aneedtobol stervocational training infrastructure in partnership with the private sector and include elements of Industry 4.0. The government should also work as a facilitator. There should be a dedicated wing in the Industry Ministry to oversee and promote Industry 4.0 adoption. It may establishanet work of 'test labs' that will work with enterprises, industry bodies, academia, and labour organisations to advance Industry 4.0 goals. The government has a critical role as a policy formulator. It may provide financial incentives and aid to MSMEs through tax breaks and subsidies to make Industry 4.0 technologies affordable for them. It should continue to push initiatives such as Smart Cities, Digital India and Make in India. Further, it must improve telecommunication infrastructure to ensure seamless loT implementation and formulate adequate cyber security policies (AIMA and KPMG, 2018).

The role of the industry is highly important in creating and defining Industry 4.0, which would be mostly management-related. It should provide re-skilling opportunities by identifying a core set of industry relevant skills and imparting them to the employees. It must be able to provide cross-functional exposure to employees, i.e. an opportunity to learn outside their own disciplines. Industry must actively participate in public-private partnership initiatives and conduct programmes in vocational training. It must undertake and invest in R&D for Industry 4.0 Techno gym. The academia can play an important role in enhancing the quality of teachers and modernizing the learning infrastructure. It should align course curricula in tandem with Industry 4.0 requirements, with well-regulated industry-relevant updated content. Focus should be more on practical result-oriented knowledge over theoretical content. Academia should be in a position to collaborate more.

With industry players to enable workers to attain requisite skill needed for the job. Overall, widespread adoption of Industry 4.0 would require collaborative efforts of industry associations. These associations can take initiatives to identify technological developments, reorganize infrastructure and political needs, assess the impact on sectors, and plan a workforce up-skilling road map (AIMA and KPMG, 2018).

Risks and Responsibilities:

There are several risks associated with adopting Industry 4.0. India still suffers from inadequate infrastructure, both physical and digital. Despite continuous efforts of the government, the country lacks basic infrastructure such as roads and electricity. Besides, India's telecommunication network still suffers from slow data speed and unstable connections. According to the KPMG India Cybercrime Survey

Report 2017, 79 per cent of corporations in India have acknowledged cybersecurity as one of the top five business risks. Apart from cyber security, the regulatory environment pertaining to data privacy would also need to be strengthened. High cost of digital technology is yet another factor. Building the factory of the future with an entirely connected system could require significant capital outlay. Getting access to digital technologies for MSME's, which form the base of India's manufacturing sector, remains a challenge due to the high cost of these technologies (Bajpai and Biberman, 2019).

There is still a leadership gap. India lacks business leaders ready for Industry 4.0 era, which would hinder the country's attempt to wide spread adoption. Although Indian companies have strong traditional leadership, there is a deficiency of digital experts with a strong vision for Industry 4.0 adoption. India's present workforce lacks skill and expertise in new age technologie ssuch as data analytics, additive manufacturing, and loT. The government, industry, and academia need to collaborate to enable an Industry 4.0 ready work force. The right set of talent will be key to success.

The traditional organizational structure incorporating human-human hierarchy is likely to be gradually replaced by functions where humans and machines would interact at strategic and operational levels. The digitalized Industry 4.0 ready Indian companies therefore need to redefine leadership and build a new breed of leaders who will have to work with a network of teams, operating in a fast-paced technological environment. Most importantly, there is a need to change traditional mindsets and skillfully manage that change across organization. With Industry 4.0 automating most of the technical tasks, the focus could turn to soft skills for employees to be successful. This re-engineering at the leadership level is of paramount importance.

A skilled workforce would form a key element for Industry 4.0 adoption. The current workforce would need to be re-engineered to fill new roles. The next generation workers need to be digitally strong. At present, India is struggling with low vocational training capacity. It is only 0.8 percent of the total workforce as compared to 6.7 percent in the US and 11.5 per cent in China. Formally, the skilled workforce is only 4.7 per cent in India as compared to 24 per cent in China and 96 per cent in South Korea (PWC and FICCI,2019). Repetitive jobs may disappear. This is likely to leave a deep impression on employment landscape. There may be new role for the labour force in the form of supervisory, managerial and cross-functional, demanding diverse skill-sets. Industry 4.0 is likely to create widespread disruption in the labour market. The key stakeholders—the government, industry

and training institutions—have to come together to re-engineer the education system to make employees competitive. The stakeholders need to change the skill map to accommodate fast-paced technology trends.

Challenges in manufacturing in Indian Industry 4.0:

Any impediment to operations and growth that manufacturing organisations face can be classified as a manufacturing problem. Production rates, productivity, and profitability are just a few of the characteristics of a manufacturing organisation that are directly impacted by these difficulties, which also include supply chain interruptions, data security, and regulatory compliance. Without initially comprehending the nuances of their industry, manufacturers will find it impossible to overcome these obstacles. In order to do this, contemporary manufacturers may leverage new technologies, such as automation and sophisticated business software, to enhance visibility, obtain a more precise and in-depth understanding of operations, and spot weak points and areas for development. Business executives may develop and put into practice creative ways to build a more robust operation by comprehending the particular problems that the manufacturing industry faces and examining how these issues directly impact operations.

Manufacturers must contend with external pressures like changing market trends, client preferences, and supply chain interruptions in addition to internal ones like ineffective management and personnel problems. Manufacturing specialists may keep their competitive edge and boost profitability by implementing new strategies and taking proactive measures to overcome these difficulties. With the use of contemporary technology, manufacturers may lessen the effects of these difficulties and build a more adaptable, durable company that is better suited to face new challenges in the future.

Firstly, Lack of skilled workers: The lack of trained labour is a major problem for many manufacturers; in fact, over half (53%) of manufacturing executives surveyed for Deloitte's 2022 Manufacturing Supply Chain Study identified talent scarcity as their top concern. Numerous economic factors, such as an ageing population and a dearth of tech-savvy workers, might contribute to a talent shortage.

Secondly Price Rise : Manufacturers trying to hold onto their margins are under pressure to either cut expenses or raise prices as costs grow. Purchasing raw materials, goods and transportation, as well as growing pay, are some of these expenditures. Many firms review where they may cut costs during inflationary times. They could renegotiate supplier agreements or audit their supply chains to identify inefficient areas that can be made more efficient without sacrificing product quality

or worker happiness. Furthermore, producers might be able to pass some of these increased costs on to customers without losing business if the prices of their rivals are rising.

Thirdly, project management: With the help of automation and centralised data, these systems can more precisely predict demand and provide managers with real-time operational insight. This empowers managers to take swift, data-driven choices and quickly adapt their operations in response to changing circumstances.

Fourthly, Consumerism trends: It may be challenging to stay on top of consumerism trends, particularly in the fast-paced modern world when things can become viral in an instant. When purchasing, many consumers give consideration to issues other than price, such rapid shipping alternatives, personalised shopping experiences, and ethical manufacturing procedures. These products, however, may result in increased manufacturing costs and subpar product quality if they are not planned carefully and thoughtfully. Manufacturers must become more customer-adaptive, creative, and agile in order to meet the needs of modern consumers without falling behind. This is frequently achieved through a combination of data-driven digital advertising, targeted product development, and market research, all of which work towards the common objective of developing dependable brand awareness among consumers.

Fifthly, Worker security: Neglecting to adhere to regional safety regulations and worker safeguards may result in mishaps, harm, and monetary and legal responsibility. Manufacturers need to assign protective equipment appropriately and provide frequent safety training to guarantee a safe working environment. Managers are responsible for keeping an eye on and updating safety procedures to make sure that working conditions meet modern requirements. To guarantee worker safety, firms must be willing to make costly investments in new machinery, ongoing training, and cutting-edge technology, including automation for high-risk positions. Upholding these strict safety requirements is not cheap, though. When implemented properly, putting worker safety first benefits both the workforce and the company by protecting workers as well as boosting morale and productivity.

Sixthly, consumers affairs : Selling direct-to-consumer (D2C) via online platforms can provide manufacturers higher profit margins and more control over their brand image by eliminating middlemen, but it also comes with special problems. Manufacturers that sell their products directly to consumers are required to run their own e-commerce business, which includes managing websites, digital marketing, refunds, and customer support. Logistics management, which covers order fulfilment, inventory control, and shipment, is also necessary for this. To

meet these difficulties, a lot of contemporary firms rely on technology. Order fulfilment systems, for instance, that use scanners and automatically gather data to track orders and keep an eye on key performance indicators (KPIs) like lead times and perfect order rates, can help guarantee that consumers receive their goods on time.

Seventhly, Supply chain disruptions: Due to the reliance of many contemporary firms on intricate international supply networks, challenging interruptions pose a serious challenge to the sector. These disruptions can hinder shipments, lower the quality of products, raise expenses, and result in a shortage of resources. They can be caused by a variety of factors, including geopolitical crises and harsh weather. Manufacturers may get ready for these challenges by diversifying their supplier base, embracing digital technologies like dashboards and KPI monitoring software for improved visibility, and fortifying their current supplier relationships to get preferential treatment.

Eighthly, Regulatory changes: Maintaining compliance with the constantly evolving industrial rules calls for constant attention to detail and updating. These regulatory changes may have a big influence on how businesses operate and have an impact on a lot of different areas, such labour practices, environmental impact, and product safety. For instance, firms may need to make investments in more energy-efficient machinery in order to lower emissions if carbon emission standards change. There could be various regulations that need to be observed at each of the manufacturer's sites. Noncompliance can harm a company's reputation in addition to having financial and legal repercussions. Manufacturers may spread out the investment costs by staying ahead of impending regulatory changes by routinely upgrading their standards and practices. There can be other advantages to these expenditures, such lower expenses and a more streamlined business.

Ninthly, Data management and security: Modern factories are becoming more and more dependent on digitalisation and technology, which has raised the need of safe data. Significant dangers are associated with data breaches, including the potential for fines and legal repercussions. Furthermore, manufacturers frequently experience harm to their brand following a data breach, which can reduce sales when clients decide to do business with someone else because they no longer trust that their financial and personal information is safe. Companies need to periodically review and update their data security procedures. Additionally, a lot of cloud-based business platforms employ artificial intelligence (AI) and machine learning to detect and respond to the most recent cybersecurity threats, as well as automatically update their software. Data encryption is merely one aspect of data security procedures,

while it presents significant difficulties on its own. Regular staff training is also necessary for robust cybersecurity in order to prepare ahead of time.

Tenthly, Scaling the business: Manufacturing workers may benefit from technology by being able to expand with precision. ERP solutions, for example, provide tools to manage growth and scale based on real-time data rather than guesswork. Manufacturers may create a thorough strategy plan to match operations with overarching corporate objectives, competitive landscape, market trends, and technology breakthroughs by utilising these tools. By pushing operations too rapidly and beyond production capacity, producers can minimise the dangers of bottlenecks and delays while meeting the growing demand.

Eleventh, Globalization and market openness : The industrial sector has both possibilities and problems as a result of globalisation. On the one hand, it makes manufacturing more competitive since they have to outbid businesses worldwide. However, it may also provide new opportunities and enable a wider range of global material procurement, which might lower prices and lessen the chance that a single-source interruption could prevent a company from producing items. Manufacturers may use technology, like ERP systems, to handle these intricate supply chain problems, automatically convert currency calculations, assure compliance with international standards, and successfully compete in the worldwide market in order to adapt to this global mentality.

Twelfth, Attracting qualified forwardness: In the fiercely competitive digital market, manufacturers who depend on conventional marketing techniques to draw in qualified leads risk falling behind their more astute rivals. In order to generate leads, modern marketing strategies must prioritise the development of trust through relevant and targeted advertising. Nonetheless, the customised aspect of these advertisements, catered to the distinct inclinations and requirements of every prospective client, may provide managerial difficulties for producers. Some manufacturers find that working with marketing firms that have experience in the industry helps them better understand their target markets and the most effective ways to contact them.

Thirteenth, Sustainability: Manufacturing now heavily emphasises sustainability, not just to save costs and increase productivity but also to satisfy the needs of customers who are becoming more and more concerned about the environment. Manufacturers are better able to assess the possible costs and effects of sustainability measures, such energy conservation and the use of environmentally friendly products, when departments work together and with experts who share their concerns. By using this strategic approach, industrial executives can make sure they are investing wisely in order to lessen their environmental impact.

Fourteenth, Lack of demand forecasting as well as assumption: Inaccurate demand projections might result in losses for firms from either over production or under production. Over production results in manufacturers' shelves being overflowing with obsolete inventory and it raises carrying costs and slows down production. Customers may become irate and stock outs may result from underproduction. Both may lead to lower revenue and unsatisfied clients.

Fifteenth, Increased revenue and sales: To ensure that the increased order volume can be filled and customer demand can be satisfied on schedule and without compromising quality, managers must closely monitor production. Business executives must also monitor cash flow and financial performance to make sure that accounts receivable is growing along with sales and successfully collecting payments from clients. Financial teams also need to be aware that increased production volumes usually translate into greater expenses. Failure to pay bills on schedule can damage supplier relationships and result in more fines and fees. Manufacturers may ensure that more revenue and sales translate into improved profitability and business growth without needlessly taxing operations by closely monitoring performance during growth periods.

Sixteenth, Capacity constraints: Capacity limitations are production limits that must be overcome through a complex strategy that involves routinely assessing company performance using order fulfilment KPIs like lead times and turnover rates. By employing a centralised ERP system, businesses facing capacity limitations may pinpoint bottlenecks and obtain a comprehensive understanding of their supply chain. Manufacturers that have a more efficient perspective of all aspects of their business, such as sales, inventory, and production, are better able to assess their own capacities and determine what has to be improved in order to accommodate increased order quantities, which will eventually increase sales and profitability for the company.

Seventeenth, Maintenance and overheads: A significant amount of a manufacturer's expenses go towards overhead and maintenance, which need to be properly controlled to avoid squandered resources and annoying delays. To fulfil client demand and production schedules, manufacturers need equipment that is both functional and efficient. Performance-monitoring technology enables producers to assess efficiency on a regular basis and proactively replace, repair, and update equipment. Small, regular maintenance are frequently more cost-effective in the long term than major overhauls when equipment breaks down unexpectedly. Additionally, by following data-driven demand estimates to minimise overproduction and carrying costs, additional overhead expenditures may be minimised, especially those related to inventory and storage.

Eighteenth, automation, computerization and mechanization : Even while many businesses substantially benefit from automating parts of their direct production processes, automation involves more than simply robots on the assembly line. However, because automation might require a substantial initial investment, manufacturers must employ it intelligently. In addition to financial resources, time, and labour are needed to teach employees on how to use these tools correctly, which will boost production and benefit the company. However, when done correctly, automation may minimise labour costs and numerous manual, error-prone operations, such inventory counts and order tracking via automated barcode scanners as they travel through the supply chain. Manufacturing executives may utilise automation to expedite production lines, simplify inventory control, and build a more effective business with reduced expenses and greater profits with proper design.

To conclude, by 2030, India is predicted to have the youngest population on Earth, meaning that it would supply about 30% of the world's labour force. Thus, AI has the potential to significantly increase average worker productivity to the level of today's top achievers. In addition to taking Industry 4.0's ethics and security into account, there is a need to foster a "scientific temperament" among the populace about the new technologies. In this regard, India's "National strategy for AI" has suggested creating ethical committees to address issues pertaining to privacy, security, and ethics that are sector-specific. In order to advance India's economy, Industry 4.0 may also assist in achieving the Sustainable Development Goals (SDGs). With the implementation of Industry 4.0, the noble goal of making India a $5 trillion economy by 2025 may be realised. Going forward, the Indian economy and society are unquestionably set up for a radical transformation. It is the right time and juncture to embrace the challenges and growing needs of AI and ML for successful operation of Industrial Revolution 4.0 and leaping for Industrial Revolution 5.0. It is the need of the Hour.

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Decentralized Governance and Intermediate Technology: Pathways to Sustainable Development and Justice

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Abstract: *Achieving the objectives of good governance, such as sustainability, peace, and justice- it is essential to adopt a decentralized model that strengthens local participation and integrates appropriate, intermediate technologies. The Panchayat Raj system, as conceptualized by thinkers such as Vinoba Bhave (1956) and Jai Prakash Narayan (1961), presents a model for decentralized governance that emphasizes local decision-making, thereby fostering sustainable development grounded in community values. Bhave's notion of Gram Swaraj underscores village self-reliance, encompassing local production, education, and justice systems, and posits that true independence is derived from decentralization rather than central control (Bhave, 1956). The term "intermediate technology" was first introduced by E. F. Schumacher, author of Small is Beautiful, who argued that technology must remain human-centred, ecologically sound, and locally manageable (Schumacher, 1973). In his July article, "Levels of Technology: A Key Problem for Underdeveloped Countries," Schumacher highlighted the contradiction between the coexistence of jet engines and bullock carts in developing nations and criticized the belief that countries can bypass intermediate stages of technological development (Schumacher, 1962). Intermediate technologies, characterized by their small scale, local adaptability, and environmental sustainability, are integral to this decentralized framework (Schumacher,*

1973). When communities employ technologies that are manageable and maintainable at the village level, they can strengthen their local economies without relying on large scale industrial development, which frequently contributes to environmental harm. This aligns with the concept of an Economy of Permanence, which advocates economic practices ensuring long-term sustainability and ecological balance (Kumarappa, 1945). A governance model centered on Panchayats also supports several Sustainable Development Goals (SDGs), particularly SDG 16 (Peace, Justice, and Strong Institutions) and SDG 11 (Sustainable Cities and Communities), as it promotes participatory decision-making and equitable resource distribution (UN, 2015). The principles of village-level democracy not only advance sustainable livelihoods but also foster social harmony, thereby reducing conflicts rooted in inequality and injustice (Narayan, 1961). Therefore, integrating decentralization with appropriate intermediate technologies can play a crucial role in advancing a sustainable global system.

Keywords: *Intermediate Technology, Economy of Permanence, Decentralization, Panchayati Raj, Sustainable Development Goals (SDGs)*

Historical Context on Decentralization-

Vinoba Bhave

"India can become truly free only if it could avoid such centralization and thereby the show to the world an example of true independence"

Bhave contends that India's true freedom is compromised by the centralization of its policies. What works in one state may not be suitable for another. Village panchayats are forced to follow these policies, and cannot make independent choices that oppose them. This situation impedes the nation's progress. This statement embodies the Gandhian vision of Swaraj, where freedom extends beyond politics to include social, economic, moral, and decentralized aspects. This suggests that genuine independence is not merely about ending foreign domination but about establishing a self-sufficient, participatory, and decentralized society where each individual and community governs itself with dignity and accountability. India's authentic freedom is found not in centralized authority but in empowering every person, village, and community. By avoiding centralization and fostering a decentralized, participatory, and morally guided society, India can present itself with a distinctive model of independence rooted in justice, harmony, and human dignity. This vision transcends flags and parliaments; it is about building a society in which power is distributed, freedom is genuine, and every individual becomes the cornerstone of democracy. Only then can India be truly considered independent in spirit, soul, and structure, inspiring the world to reconsider the true meaning of freedom.

"The things have changed since then and today we find that though the villages still produce all the raw material, they depend for the most of their wants on cities"

Despite being part of a developed economy, farmers who supply raw materials to rural areas still lack sufficient resources. They depend on urban centers for employment opportunities, advanced education, and the latest production technologies. Therefore, the disparities between rural and urban areas must be addressed. Villages should not rely on cities and the government should work to make resources more accessible to rural residents. This situation highlights how, over time, the rural-urban relationship has become imbalanced, with villages remaining producers but losing their self-reliance, while cities have become centers of control, consumption, and power. This statement underscores a fundamental flaw in India's development path: villages continue to feed cities but remain dependent, impoverished, and voiceless. Unless this structural dependency is reversed, India's villages will never be truly empowered and the nation's development will remain uneven. The goal should not be to abandon villages in favor of urbanization but to revive their self-reliance, restore their dignity, and rebuild them as engines of sustainable local development. Only then can India fulfill its promise of inclusive growth and true freedom.

"The Panchayat system evolved to deal with justice and provide protection and education to all. All had to submit to the unanimously greed upon decisions of these councils. It can be regarded as a decentralized social order"

The panchayat raj system involves Gram Panchayat, Panchayat Samiti, and Zila Parishad, whose main is to decentralize the power and do the developmental works of the village at the local level with the help of local peoples of the village. This will reduce corruption and help local communities earn money and expand. The concept of the panchayat raj system focuses on the self-governance system and Mahatma Gandhi's vision of Gram Swaraj–that is, village self-rule.

"Sarvodaya does not mean good government or majority rule, it means freedom from government, it means decentralization of power"

Sarvodaya means "progress for all." Gandhi launched this movement imagining a community where each person, no matter their background, would achieve progress. This idea is based on the values of non-violence, truth, and equality. Sarvodaya involves overall development, which is possible only when there is decentralization of power and no government interference. Sarvodaya revolutionized the meaning of power and freedom. It teaches that real empowerment does not come from elections or state policies but from self-discipline, mutual care, and decentralized authority. It rejects both state control and passive citizenship, offering

instead a bold vision of stateless, self-reliant communities bound by truth and service.Thus, Sarvodaya is not about managing power—it is about transcending it. It offers a moral, spiritual, and practical path to genuine freedom and justice, not by depending on better rulers, but by building better people and stronger communities.

"Khadi cannot survive apart from the concept of Gram Swaraj. Khadi is an indispensable for Swaraj as it was for country's independence"

The quote vividly encapsulates Mahatma Gandhi's vision of self-sufficiency, the dignity of labor, and the empowerment of rural communities. This implies that Khadi is more than just a textile; it represents economic independence, moral fortitude, and grassroots self-governance (Swaraj). Without underpinning village self-reliance, Khadi lost its significance and purpose. Gandhi introduced the concept of Gram Swaraj, aiming for national independence, with a strong emphasis on Khadi. This means that Khadi, made from Indian-produced cotton threads, should be used by everyone to boost employment and self-reliance among the country's people. Khadi and Gram Swaraj are inseparable; without the economic base of self-sufficient villages, Khadi becomes just another product. Conversely, without Khadi and other similar village industries, Gram Swaraj lacks the productive foundation necessary for sustainability. For Gandhi, Khadi was not just a piece of cloth; it was a fabric of freedom, weaving self-respect, economic justice, national unity, and human dignity. In today's era of mass production and global consumerism, reviving Khadi in the spirit of Gram Swaraj is both a challenge and a necessity for creating a more equitable, sustainable, and compassionate India.

"The real Power of the Panchayats lies in the people's support.The Panchayat should therefore follow their will and act under their control"

This statement emphasizes that Panchayats, the foundational units of local self-governance in India, draw their legitimacy, authority, and effectiveness not from top-down control but from the active participation, trust, and support of the local community, which reflects the heart of participatory democracy. Panchayat is not powerful on its own; its true power comes from the people it represents. When communities are informed, engaged, and assertive, they become genuine vehicles of transformation. However, when people are passive, disempowered, or excluded, their purposes are lost. In a healthy democracy, governance must not be done "for" the people, but "by" the people. Panchayats, which act under the control of the community, have become powerful instruments for social justice, sustainable development, and local empowerment.

"The Panchayat should consider it their duty to see that no person with their duty to see that no person within their remains unemployed and goes hungry"

The quote reflects a deeply humanistic and Gandhian vision of local self-governance, one where the Panchayat is not just an administrative body but a moral and social institution committed to the well-being, dignity, and livelihood of every individual in the community. Panchayat's responsibility to prevent unemployment and hunger is not just an administrative function; it is a moral imperative and a measure of how inclusive, humane, and just rural governance can be. A Panchayat that works under the will of the people and upholds this duty will not only fulfill constitutional mandates but will also bring to life the Gandhian dream of Gram Swaraj — a self-reliant, dignified, and compassionate village community where no one sleeps hungry and everyone has meaningful work.

"After a Panchayat has been established in a village,it becomes almost impossible to do any constructive work there peacefully.The clash of interest that we notice in a political parties is also extended to the village."

This quote presents a critical reflection on the unintended consequences of politicizing local governance through the Panchayati Raj system. This highlights a key challenge: when grassroots democracy is influenced by party politics, it can hinder the unity, development, and cooperation within villages. Panchayat was meant to be a symbol of village unity and self-governance, but when party politics infiltrate local governance, it often leads to divisiveness, stalled development, and conflict. The challenge is not with the concept of Panchayati Raj but with how it is implemented. If villages become centers of constructive, peaceful, and inclusive development, there must be a conscious effort to insulate local governance from narrow political rivalries and revive the original spirit of cooperation, community leadership, and the collective good envisioned by Gandhi and other rural reformers.

"The Picture today is that the program of work in every village is drawn up in Delhi and it is done by persons who do not even feel the need of visiting the villages."

The statement offers a sharp critique of centralized governance and top-down planning, especially concerning rural development in India. It underscores the gap between national policymakers and the actual conditions in rural areas, pointing out the neglect of local needs, knowledge, and involvement in decision making. This critique serves as a strong condemnation of centralized governance in nations founded on democratic ideals. When development initiatives are crafted in Delhi by individuals who have never set foot in villages, they often fail to connect with their intended beneficiaries. Genuine development should be anchored in participation, context, and local expertise. As long as rural development is orchestrated from the top without grassroots input, the vision of inclusive,

sustainable, and people-focused governance remains unfulfilled. Empowering Panchayats and Gram Sabha is not merely a policy adjustment; it is a return to the authentic democratic spirit envisioned by the architects of modern India.

"The increase of communal differences is the first evil consequence of elections. A second is that in the present setup it is not possible for a man to stand for election unless he has wealth or property."

The statement "The rise of communal disparities is the primary negative outcome of elections" offers a sharp criticism of the inadequacies in the electoral system, particularly in the context of India. It emphasizes the idea that, although elections are crucial to democracy, they can occasionally produce divisive and exclusionary outcomes if not revised to be more inclusive, ethical, and equitable. This observation relates to how elections frequently intensify communal, caste, religious, and regional divisions within society. Political parties and candidates often participate in identity-focused politics to strengthen voter support. Rather than tackling real problems like poverty, education, health, or development, they focus on limited communal or sectarian interests to achieve electoral success. Gandhi and philosophers such as Vinoba Bhave felt that authentic democracy ought to unite individuals rather than separate them. In their present state, elections frequently encourage rivalry rather than collaboration, turning the political process into a conflict of power rather than the pursuit of the common good.

Second, the financial barriers to political participation are clear. In India, engaging in elections at any tier-local, state, or national—requires considerable monetary investments. These expenses include campaign activities, such as rallies, posters, advertisements, and social media, along with rallying supporters, submitting nominations, following legal obligations, and engaging with local interest organisations. As a result, only wealthy individuals or those backed by powerful groups or corporations have a genuine opportunity to participate in elections. Gandhi imagined leadership grounded in service, simplicity, and ethical guidance instead of affluence. He held the view that politics ought to be a sacred responsibility, rather than a profession or business opportunity. When riches act as the barrier for leadership, democracy loses its core value.

"We have to decide whether for the sake of efficiency, power should be centralized. However, centralization of power will not be as democratic as the decentralization of power".

This statement highlights a significant conflict between efficiency and democracy, prompting us to consider the essence of governance, participation, and power of the people. Efficiency typically involves swiftly, consistently, or with

minimal involvement. By contrast, democracy prioritizes inclusion, consultation, participation, and local autonomy, even if it results in slower processes. Democracy is not solely about outcomes; it encompasses processes, participation, and empowerment. Consequently, decentralizing power, despite being slower, is more equitable, inclusive, and sustainable. India's future depends not on increasing top-down control, but on fostering grassroots strength by empowering villages, local bodies, and citizens to determine their own future. This embodies the essence of democracy and the Swaraj. Gandhi was convinced that India's essence resides in its villages. He championed decentralized power as both a moral and political imperative, in which each community governs itself responsibly, with power distributed among the people rather than concentrated. True democracy extends beyond voting and involves daily participation and self-governance.

"Democracy at the central and state level, but bureaucracy at all lower levels. This is the essence of Indian polity as spelt out in Indian Constitution."

The statement offers a critical examination of the hierarchical and centralized structure of governance in India, particularly when compared to the ideal of genuine grassroots democracy. At both the Union (central) and state levels, India operates as a parliamentary democracy, where governments are formed by elected representatives. Citizens actively participate in selecting Members of Parliaments (MPs) and Members of Legislative Assemblies (MLAs) through regular elections. However, at more localized levels of governance, such as villages, municipalities, blocks, and districts, when elected representatives are present, the actual decision-making authority frequently lies with bureaucrats: civil servants, administrative officers, and technical staff appointed by higher authorities. This results in a gap between democratic representation and administrative controls.

Aspect	Democracy at Higher Levels	Bureaucracy at Lower Levels
Structure	Elected representatives (MPs, MLAs)	Appointed civil servants (Collectors, BDOs, Engineers)
Accountability	Directly accountable to the people	Accountable to superior officers, not the local population
Decision-Making	Political process, subject to electoral pressure	Technocratic and procedural, often detached from local needs
People's Participation	Voting, debates, public discourse	Limited participation, mostly implementation-oriented

Mahatma Gandhi was a firm advocate of Gram Swaraj, which refers to self-governance at the village level. He envisioned a system in which communities would handle their own matters through local bodies, minimizing the influence of

centralized authorities and bureaucracies. Gandhi considered excessive dependence on bureaucracy as "a negation of democracy" because it shifted power away from the people and into the hands of a remote and often inaccessible administrative class.

M.N Roy

"The people can have a hand in government only when a pyramidal structure of state will be raised on the foundation of organized local democracies."

Individuals can truly engage in governance when they possess genuine authority and representation at a grassroots level. Robust and effective local democracies serve as essential bases for a fair, representative, and responsive national government. This concept resonates with Gandhian principles of "Gram Swaraj" (village self-governance) and contemporary notions of decentralized governance, where power originates from the populace and ascends, rather than descending from the state.

"Every local co-operative will be able to make,for example bricks needed for building houses,but only some will be in a position to manufacture cement. Commodities will have to be exchanged and local multipurpose co-operative societies will be integrated into one larger economic system"

The quote envisions an economic planning approach that is decentralized and based on cooperation, emphasizing self-sufficiency and mutual reliance. This framework combines local autonomy and collaborative effort. Communities independently address their fundamental needs while engaging in a reciprocal exchange system for complex or resource-demanding products. This leads to an interconnected economy driven by collaboration rather than competition, where economic influence is both decentralized and linked, promoting sustainability, fairness, and democratic governance.

Jai Prakash Narayan.

"The principle of the panchayat was 'Punch Parmeshwar' i.e, god speaks through the five, which, in other words, means that a unanimous decision of the panchayat was respected as the verdict of god"

This saying highlights the profound ethical and spiritual roots of traditional village leadership in India. The phrase 'Punch Parmeshwar is a blend of two words: "Punch" (or Panch) – referring to the five elders or members of a village council (Panchayat), and "Parmeshwar", Parmeshwar signifying God or the Supreme Being. This suggests that when five fair and wise individuals come together to make a decision, their judgment is seen as divine, as if God is speaking through them. The

term" Punch Parmeshwar' embodies sacred confidence in collective, consensus-driven decision-making at the grassroots level. It depicts the Panchayat not just as a governing entity, but as a moral institution where justice is not enforced by power but embraced as divine will because it emerges from dialogue, wisdom, and unity.

"The Gram Sabha will have to develop the strength and moral resources to be able to resolve conflicts within the community, prevent injustice from being committed, and see that the Gram Kosh is collected regularly and utilized for the purposes laid down"

The Gram Sabha is conceived not merely as a gathering, but as a dynamic entity of participatory democracy, where individuals govern themselves with wisdom, accountability, and moral integrity. Its effectiveness relies on the active participation, solidarity, and ethical resolution of villagers. In essence, a truly empowered Gram Sabha forms the foundation of rural self-governance, which is capable of ensuring justice, development, and democratic accountability at the grassroots level. To genuinely empower individuals, Panchayati Raj must be liberated from bureaucratic dominance and revitalized as an authentic tool for local democracy, justice, and self-governance.

"The initiation did not come from the political motive of broadening the base of our democracy or laying the foundation of what I have called participative democracy".

The establishment of Panchayati Raj Institutions did not stem from a political ambition to empower citizens or create a genuinely participatory democracy. Rather, it was an administrative response aimed at enhancing the efficiency of delivery. This absence of authentic democratic intent has restricted the ability of Panchayati Raj Institutions to revolutionize governance and society at the grassroots level. When institutions are created without embedding democratic principles, they often become empty frameworks susceptible to control by vested interests. Genuine participatory democracy cannot be enforced from the top down; it must cultivated from the bottom up through education and awareness, robust Gram Sabha, transparent and accountable leadership, and a culture of civic responsibility.

Intermediate Technology

Intermediate technology refers to techniques that are easily accessible, simple to use, and can be locally repaired. The intermediate technology concept was popularized by German economist E.F. SCHUMACHER. This concept emphasizes technologies that are environmentally friendly and helpful in traditional ways of living. This technology is mostly applied in local development projects such as water supply, health, and agriculture.

Few examples of intermediate technology-

Sector	Technology	Description
Agriculture	Hand operated grain mills	Allow farmers to grind crops into flour locally, reducing transportation costs.
	Water pumps	Simple pumps like treadle pumps enable efficient irrigation, improving crop yields without requiring large-scale infrastructure.
	Solar dryers	Used to preserve food like fruits, vegetables, and fish, extending their shelf life.
	Improved cooking stoves	More efficient than open fires, reducing fuel consumption and indoor air pollution.
Energy	Solar cookers	Utilize solar power for cooking, providing an environmental friendly substitute for conventional cooking practices
	Micro-hydro power systems	Generate electricity from small-scale water sources, providing power to homes, schools, and workshops.
	Gobar gas plants	Utilize animal waste to produce methane gas for cooking and heating.
	Biofuel production	Utilizing locally available resources like vegetable oils or agricultural waste for fuel in internal combustion engines.
Construction	Brick-making machines	Enable communities to produce building materials locally, reducing costs and reliance on external sources.
	Improved roofing techniques	Utilize a combination of manual labor and simple machinery, as seen in some women's cooperatives.
Health	Water filtration systems	Provide access to clean and safe drinking water, improving public health.
	Intermediate technology ambulances	Designed for ease of use and maintenance in resource-limited settings.
Other	Hand-powered washing machines	Offer a more efficient way to wash clothes compared to traditional methods.
	Bicycle-powered water pumps	Utilize human energy to power water pumps, offering a sustainable and affordable solution for irrigation.

Technological Decentralization-

Technology has a significant impact on individuals and the structure of their community. It presents numerous options, and the selection of these options largely depends on the envisioned political system. There is intensive competition

to embrace technology, which leads to a concentration of economic and political powers. Gandhi, however, embraced a technology that promoted decentralization, which does not hinder the development of individuals and independent village communities. According to Gandhi, "scientific and technological advancements should align with the needs and capabilities of social institutions." Gandhi criticized large-scale machinery because he believed it displaced human labor and centralized wealth and authority among a small elite. He argued that the issue was not with machines themselves, but with the obsession for labor-saving devices that ultimately leave countless people unemployed and destitute. Gandhi maintained that time and labor-saving innovations should benefit everyone, not just a select few. Instead, he felt that modern machinery enabled a minority to prosper at the expense of the expense of the majority. He insisted that this system was driven not by benevolence but by self-interest, and he resolutely opposed such an unjust economic structure.

Gandhi allowed the use of large machinery in specific important industries, although he never specified which ones. However, his writings indicate that he considered the printing press, sewing machine, surgical instruments, and heavy machinery for public utilities such as railways to be essential, as they could not be managed by human labor alone. These types of machinery were seen as playing a necessary role in Gandhi's vision of technology. He believed that the principles of the Swaraj could be preserved and enhanced. Gandhi was not against technological innovation and advancement, as long as it did not render human labor obsolete. Modern knowledge and experience should be applied to develop technology that supports decentralization and is designed to serve people rather than making them subservient to machines. This approach is known as "Intermediate technology." It is more advanced than primitive technology but simpler and more affordable than large-scale technology. This technology aims to transform "an agricultural village community" into "an agro-industrial community." By establishing "agro-industrial communities" through the use of intermediate technology, it is possible to eliminate the significant issues of widespread unemployment and the mass movement of people to urban areas. In a developing nation, such as India, it is crucial to sustain "a healthy and moral relationship" between rural and urban areas. Implementing intermediate technology in village industries can prevent the uneven development of a few major cities, thereby halting the exploitation of rural communities by urban centers.

Labor Intensive Technology

Labor-intensive technology relies on human labor rather than machines. This approach boosts employment opportunities, which in turn enhances people's living standards. Such technologies do not require significant capital investment.

Labor-intensive methods are commonly used in sectors such as agriculture, construction, and coal mining. *According to E.F. Schumacher,* his main emphasize was on to labor intensive methods rather than capital intensive methods. He thought that this strategy could encourage self-sufficiency and economic growth by leveraging local talent and resources, generating more employment opportunities, and being more accessible to communities.

Environmental Friendly

Intermediate technology, also referred to as appropriate technology, is an eco-friendly method for development and tackling issues. This idea highlights the importance of utilizing sustainable, locally sourced resources, along with straightforward, easily manageable tools and techniques. By concentrating on small-scale decentralized solutions, intermediate technology lessens the environmental impact linked to large-scale industrialization. It promotes energy efficiency, reduces waste, and supports the use of renewable materials. This approach both helps in preserving the natural resources and enables local communities to fulfill their needs in an ecologically responsible manner. Intermediate technology frequently integrates traditional knowledge and practices to enhance alignment with local ecosystems. Consequently, it offers a balanced solution that fulfills human needs while minimizing ecological disruption, making it a vital element in sustainable development strategies. Intermediate technology is typically characterized as a technology that suits a specific context, especially in terms of being eco-friendly, economically viable, and socially acceptable. The environmental advantages of intermediate technologies can be considerable, as they often emphasize sustainability by using resources efficiently and minimizing environmental harm.

***For example*, incorporating environmental sustainability into various technologies, such as eco-design, can significantly improve product sustainability by addressing greenhouse gas emissions and encouraging resource-efficient designs (Lee et al., 2023).**

Similarly, wastewater treatment technologies that incorporate resource recovery have been found to lower the carbon footprint and enhance environmental sustainability, particularly when applied at the community level, which reduces the potential for eutrophication (Cornejo et al., 2016). Furthermore, intermediate technology includes agricultural innovations, such as the use of BT cotton (Bacillus Thuringiensis) in Pakistan, which has been linked to environmental benefits. By reducing chemical pesticide use, Bt cotton not only boosts biodiversity but also reduces soil and water pollution, leading to more sustainable farming practices (Kouser and Qaim, 2013).

Integrating green technologies such as green wall systems into urban development can also provide significant environmental benefits. These systems have been demonstrated to mitigate urban heat island effects and lower energy consumption in buildings, thereby contributing to more sustainable urban settings (Reyhani et al., 2024). Thus, intermediate technology can enhance environmental sustainability by making better use of resources, lowering emissions, and increasing the overall efficiency of different systems. However, the extent to which these technologies are environmentally friendly often hinges on careful implementation and contextual considerations to fully realize their benefits.

Political Decentralization

For Gandhi, political and economic decentralization were deeply interlinked. He argued that distributing production across villages was essential for dispersing political authority, forming a core element of his ideal of a non-violent society. Under British rule, political authority in India was intentionally centralized to benefit their commercial interests, with production focused on serving colonial needs rather than local ones. This approach led to the deterioration of the village economy. Gandhi encouraged political activists to lay the groundwork for democracy through constructive programs. There are two key reasons for advocating for economic decentralization.(Gandhi 1909; Gandhi 1941; Gandhi 1962).

A. Gandhi argued that production and distribution should occur in the same area where the goods are needed. He believed that concentrating production in specific areas complicates distribution, whereas local production stabilizes the economy and reduces reliance on speculation.

B. Decentralization is crucial for the non-violent state of Gandhi envisioned, as centralization requires force to sustain, which contradicts a non-violent society.

Together, political and economic decentralization can achieve ideals of freedom and autonomy. A decentralized economy fosters these values by keeping production in the hands of individuals across the country through village and cottage industries.

Gandhian Perspective

Gandhi's philosophy centered on leveraging technology to bolster local economies and empower individuals through sustainable and fair practices. This viewpoint aligns with the principles of what later became known as "intermediate technology" or "appropriate technology." This approach champions technological solutions that are environmentally sustainable, socially acceptable, and economically viable for small communities or developing regions. Gandhian economics focuses

on small-scale, community-based technologies that can be locally maintained and managed, fostering social harmony and reducing environmental impacts (Weber, 1999).

E.F. Schumacher, a notable economist influenced by Gandhian ideals, played a key role in defining the concept of intermediate technology in his book, "Small is Beautiful." Schumacher supported technologies that work in harmony with the environment and fulfill community needs without overexploiting natural resources (Weber, 1999).

Gandhi's influence is evident in modern sustainability discussions, where his views on technology stress the importance of balancing technological progress with ecological responsibility. His ideals challenge the purely economic motivations of industrialization, advocating for a development model that includes ethical considerations and social welfare (Mazzarella, 2010). From a Gandhian perspective, intermediate technology is not just a technical solution, but also a moral and philosophical position (Eggink and Dorrestijn, 2018).

This calls for a shift in how society views growth and development, prioritizing the well-being of individuals and communities over the mere accumulation of wealth and power. In summary, Gandhi's approach to technology seeks to achieve balance and sustainability through smaller, more suitable technological practices. This perspective aims to create more equitable societies by empowering communities to use and develop technologies that align with their values and genuine needs, laying the groundwork for a sustainable and inclusive future.

Conclusion

A governance model that is inclusive and reflective of community experiences is essential for achieving the interconnected objectives of sustainable development, peace, and justice. The panchayati raj system was influenced by the ideas of Vinoba Bhave, Jai Prakash Narayan, and Mahatma Gandhi, serves as a persuasive example of decentralized, community-driven governance. It focuses on local self-governance, participatory decision making, and the blending of traditional values with contemporary development strategies.

A key element of this decentralized approach is the application of intermediate technology, a concept introduced by the E.F. Schumacher—that fills the gap between basic tools and large-scale industrial systems. These technologies are cost-effective, environmentally friendly, labor-intensive, and tailored to the needs and capabilities of rural areas. They not only boost local self-sufficiency and

minimize environmental damage, but also encourage employment and social equality, aligning with Gandhi's ideals of Swaraj and Sarvodaya.

Historically, centralization has resulted in economic inequality, social disconnection, and environmental degradation. In contrast, decentralization—whether political, economic, or technological—provides a route to restoring the dignity of rural life, narrowing the urban-rural divide, and enhancing democratic resilience. Through local governance structures such as the Panchayats and suitable technological solutions, communities can actively engage in shaping their destinies, thereby reinforcing the foundations of democracy and sustainable development. In today's rapidly evolving world, revisiting Gandhian principles and Schumacher's advocacy for "Small is Beautiful' is not only relevant but essential. The combination of decentralized governance with intermediate technology offers a transformative development framework that is sustainable, equitable, and deeply rooted in empowering people. This model addresses material needs while fostering social harmony and ecological balance, thereby establishing a strong foundation for a truly inclusive and resilient future.

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5

Integration of MSMEs into Global Value Chains: Opportunities and Challenges in Developing Countries

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Abstract: *Micro, Small, and Medium Enterprises (MSMEs) are widely recognized as the backbone of economic activity in developing countries. They play a vital role in employment generation, poverty reduction, and improving regional development. At the same time, the structure of global trade has undergone a fundamental transformation through the emergence of Global Value Chains (GVCs), in which production processes are fragmented across multiple countries. This transformation has created new opportunities for MSMEs to participate in international trade without the need to produce entire goods or services independently. This research paper explores the integration of MSMEs into global value chains, focusing on the opportunities and challenges faced by developing countries. It examines how participation in GVCs can enhance market access, foster technological advancement, and improve productivity. By specialising in specific segments of the production process, MSMEs can overcome traditional barriers to entry and connect more effectively with global markets. However, the paper also highlights that the integration process is not without challenges. MSMEs in developing countries often face structural constraints, including limited access to finance, technological deficiencies, inadequate infrastructure, and complex regulatory environments.*

Keywords: *Global Value, MSME, Developing, fragmented, Poverty.*

1. Introduction

Globalization has significantly reshaped the nature of economic activities, particularly in the context of production and trade. One of the most defining features of this transformation is the rise of global value chains (GVCs), where production processes are distributed across different countries. This system allows each country to specialize in specific stages of production based on its comparative advantage,

thereby increasing efficiency and reducing costs.In this evolving economic landscape, Micro, Small, and Medium Enterprises (MSMEs) have emerged as crucial contributors to economic growth, especially in developing countries. These enterprises account for a substantial share of employment and are often the primary source of income for millions of households. Despite their importance, MSMEs face numerous challenges in accessing global markets due to their limited scale, resources, and capabilities.

The integration of MSMEs into GVCs offers a promising solution to these challenges. By participating in specific segments of the value chain, MSMEs can access international markets without the need to develop full-scale production capacities. This not only enhances their growth prospects but also contributes to broader economic development. However, the process of integration is complex and requires overcoming various barriers. MSMEs must comply with international standards, adopt advanced technologies, and develop efficient management practices. In many developing countries, these requirements are difficult to meet due to structural constraints, including inadequate infrastructure, limited access to finance, and weak institutional support.

This research paper examines the opportunities and challenges of MSME integration into global value chains. It seeks to provide a comprehensive understanding of the factors influencing participation and to identify strategies to enhance competitiveness. The study also highlights the role of government policies and digital technologies in facilitating integration. By analyzing these aspects, the paper contributes to the ongoing discourse on globalization and development, emphasizing the importance of MSMEs in achieving Globalization has fundamentally altered the nature of economic production and trade, leading to the emergence of interconnected production networks known as global value chains. These networks allow countries to specialize in specific stages of production rather than producing entire goods, thereby increasing efficiency and competitiveness (Gereffi, 2018). This transformation has created new opportunities for developing economies to integrate into global markets.

In this context, MSMEs play a critical role due to their widespread presence and contribution to employment and economic activity. Despite their importance, MSMEs often face significant barriers that limit their ability to compete internationally. These barriers include financial constraints, lack of technology, and limited access to market information (World Bank, 2020).

Connecting this reality to the concept of GVCs, participation in these chains provides MSMEs with an alternative pathway to globalization. Instead of entering global markets independently, they can integrate into specific segments of production networks. This reduces entry barriers and allows them to leverage their comparative advantages (OECD, 2015). However, integration into GVCs is not automatic. It requires compliance

with international standards, adoption of efficient production processes, and continuous innovation. For many MSMEs in developing countries, these requirements present significant challenges, particularly in the absence of institutional support.

Therefore, this paper aims to bridge the gap between theoretical opportunities and practical challenges by analyzing the conditions under which MSMEs can successfully integrate into global value chains. It also highlights the importance of policy frameworks and digital technologies in facilitating this process.

2. Conceptual Understanding of MSMEs and Global Value Chains

To understand the integration of MSMEs into global value chains, it is essential to define the key concepts and theoretical frameworks involved. MSMEs are typically classified based on criteria such as the number of employees, annual turnover, and investment levels. While definitions vary across countries, these enterprises are generally characterized by their small scale, limited resources, and flexibility in operations.

Global value chains refer to the sequence of activities involved in the production of goods and services, from initial design to final consumption. These activities are often spread across multiple countries, allowing firms to take advantage of differences in labour costs, skills, and resources. GVCs have become a dominant feature of international trade, accounting for a significant share of global economic activity. The participation of MSMEs in GVCs can take various forms. Some firms engage directly by exporting goods or services, while others participate indirectly by supplying inputs to larger firms that are part of global supply networks. In both cases, integration requires adherence to quality standards, timely delivery, and competitive pricing. The concept of economic upgrading is central to understanding MSME participation in GVCs. Upgrading involves improving capabilities and moving to higher value-added activities within the value chain. This can include process improvements, product innovation, and functional expansion.

Another important aspect is governance within GVCs. Lead firms, often multinational corporations, play a significant role in coordinating production activities and setting standards. MSMEs must operate within these structures, which can influence their opportunities for growth and value capture. This conceptual framework provides a foundation for analyzing the opportunities and challenges associated with MSME integration into global value chains. To understand MSME participation in global value chains, it is essential to establish a clear conceptual foundation. MSMEs are defined by size, investment capacity, and workforce, but they share common features such as flexibility, adaptability, and limited resources. These characteristics influence their ability to participate in global markets.

Global value chains, in contrast, represent a fragmented production system in which each stage is performed in the most efficient location. This structure allows firms to focus on their core competencies while benefiting from global specialisation (Kaplinsky & Morris, 2001). Linking these two concepts, MSMEs can participate in GVCs either directly or indirectly. Direct participation involves exporting goods or services, while indirect participation occurs through supplying inputs to larger firms. Both forms require adherence to quality standards and timely delivery. The concept of economic upgrading further explains how MSMEs can benefit from participation in GVCs. Upgrading involves improving efficiency, enhancing product quality, and moving into higher-value activities. This process is crucial for long-term competitiveness (Humphrey & Schmitz, 2002).

Additionally, governance structures within GVCs play a significant role in shaping MSME participation. Lead firms often control production standards and market access, which can both enable and constrain MSMEs. Understanding these dynamics is essential for analyzing integration outcomes.

3. Opportunities for MSMEs in Global Value Chains

The integration of MSMEs into global value chains offers numerous opportunities to significantly enhance their economic performance. One of the most important benefits is access to international markets. By participating in GVCs, MSMEs can expand their customer base and increase their revenue potential. Another key opportunity is the transfer of technology and knowledge. Interaction with global firms exposes MSMEs to advanced production techniques, quality standards, and management practices. This facilitates learning and innovation, thereby improving productivity.

Employment generation is another significant advantage. As MSMEs expand their operations to meet global demand, they create new job opportunities. This is particularly important in developing countries, where unemployment and underemployment are major concerns. Participation in GVCs also promotes export diversification. MSMEs can engage in different stages of production, reducing reliance on a single product or market. This enhances economic resilience and stability. Digitalization has further expanded opportunities for MSMEs. E-commerce platforms and digital tools enable small businesses to connect with global markets more easily. These technologies reduce transaction costs and improve efficiency. Finally, GVC participation encourages competitiveness and innovation. MSMEs must continuously improve their products and processes to meet international standards, which drive long-term growth.

The integration of MSMEs into global value chains offers a wide range of opportunities that can significantly enhance their growth potential. One of the

most important benefits is access to international markets, which allows MSMEs to expand their operations beyond domestic boundaries (World Trade Organization, 2019). Building on this, participation in GVCs also facilitates technology transfer and knowledge sharing. MSMEs can learn from global firms, adopt advanced production methods, and improve their efficiency. This exposure enhances their competitiveness and innovation capacity (OECD, 2015).

Moreover, GVC participation contributes to employment by creating new job opportunities across sectors. This is particularly important in developing countries where job creation is a major priority. Another key opportunity is export diversification. MSMEs can engage in different stages of production, reducing reliance on a single product or market. This enhances economic resilience and reduces vulnerability to external shocks. Furthermore, digitalization has expanded these opportunities by enabling MSMEs to connect with global markets through e-commerce platforms. Digital tools reduce transaction costs and improve operational efficiency, making global participation more accessible. Thus, the opportunities provided by GVCs are substantial, but their realization depends on the ability of MSMEs to overcome structural barriers.

4. Challenges in MSME Integration into GVCs

Despite the opportunities, MSMEs face several challenges in integrating into global value chains. One of the most significant barriers is limited access to finance. Without adequate funding, MSMEs cannot invest in technology, expand operations, or meet international standards. Technological constraints are another major challenge. Many MSMEs operate with outdated equipment and lack access to modern technologies. This limits their productivity and competitiveness. Infrastructure deficiencies also pose significant obstacles. Poor transportation, unreliable electricity, and inefficient logistics increase costs and reduce efficiency. Compliance with international standards is often difficult for MSMEs. Meeting quality, environmental, and labour requirements requires significant investment and expertise. Skill shortages further hinder integration. Many MSMEs lack access to trained workers, which affects their ability to adopt new technologies and improve productivity.

Institutional challenges, such as complex regulations and bureaucratic inefficiencies, create additional barriers. These issues increase the cost of doing business and discourage participation in global markets.

Despite the opportunities, MSMEs face significant challenges in integrating into global value chains. One of the primary constraints is limited access to finance, which restricts their ability to invest in technology and expand operations (World Bank, 2020). In addition, technological gaps hinder MSME competitiveness. Many

enterprises lack access to modern equipment and digital tools, limiting their productivity and ability to meet international standards. Infrastructure deficiencies further complicate the situation. Poor transportation systems, unreliable electricity, and inefficient logistics increase costs and reduce efficiency (UNCTAD, 2021). Another major challenge is compliance with global standards. MSMEs must meet strict quality, environmental, and labor requirements, which often require significant investment and expertise.

Skill shortages also pose a barrier, as many MSMEs lack access to trained workers. This affects their ability to adopt new technologies and improve productivity. Finally, institutional challenges such as complex regulations and bureaucratic inefficiencies increase the cost of doing business and discourage global participation.

While the previous section has highlighted the wide range of opportunities available to MSMEs through their participation in global value chains (GVCs), it is equally important to critically examine the constraints that limit their effective integration. The presence of these challenges often creates a gap between potential benefits and actual outcomes, particularly in developing countries where structural weaknesses are more pronounced. Understanding these challenges is essential to developing a balanced perspective on MSME participation in the global economy.

One of the most significant barriers faced by MSMEs is limited access to finance. Unlike large firms, small enterprises often struggle to secure formal credit due to a lack of collateral, insufficient credit history, and higher perceived risk by financial institutions. This financial limitation directly affects their ability to invest in advanced machinery, upgrade technology, and expand production capacity. As a result, many MSMEs remain confined to low-value segments of the value chain, where profit margins are relatively low.

Closely connected to financial constraints is the issue of technological backwardness. In a globalized production system, competitiveness depends heavily on the ability to adopt modern technologies and maintain high standards of efficiency. However, many MSMEs in developing countries rely on outdated production methods, which reduces their productivity and limits their capacity to meet international quality standards. This technological gap not only restricts their entry into GVCs but also prevents them from moving up the value chain.

Infrastructure deficiencies further intensify these challenges. Efficient participation in GVCs requires reliable transportation systems, stable electricity supply, and effective logistics networks. In many developing countries, these essential components are either inadequate or inconsistent, resulting in delays, higher costs, and reduced competitiveness. Consequently, MSMEs find it difficult to meet the strict delivery timelines imposed by global buyers.

Another critical challenge is compliance with international standards and regulations. Participation in GVCs requires adherence to strict quality, environmental, and labour standards. For MSMEs, meeting these requirements often entails significant costs for certification, training, and process modifications. Without external support, many small enterprises struggle to achieve compliance, thereby limiting their access to global markets. In addition to these structural issues, human capital constraints also play a crucial role. Many MSMEs lack access to a skilled workforce capable of handling advanced technologies and modern management practices. This skill gap reduces their ability to innovate and adapt to changing market demands.

Furthermore, institutional and regulatory barriers, such as complex procedures, bureaucratic delays, and a lack of transparency, create an unfavourable business environment. These challenges increase operational costs and discourage MSMEs from engaging in international trade. Therefore, while MSMEs have significant opportunities in global value chains, these challenges highlight the need for targeted interventions. Addressing these issues is essential for ensuring that MSMEs can fully benefit from globalization. This discussion also sets the stage for the next section, which examines how digitalization can help overcome some of these barriers and facilitate greater integration into GVCs.

5. Role of Digitalization in MSME Participation

Digitalization has emerged as a key driver of MSME integration into global value chains. The adoption of digital technologies has transformed the way businesses operate and interact with global markets. One of the most significant impacts of digitalization is the reduction of transaction costs. Digital platforms enable efficient communication, streamline operations, and facilitate coordination across supply chains. E-commerce has opened new opportunities for MSMEs to access international markets. Small businesses can now sell their products directly to global consumers, bypassing traditional intermediaries. Digital tools also improve supply chain management. Technologies such as data analytics and automation enhance efficiency and reduce errors. Financial inclusion is another important benefit. Digital payment systems provide MSMEs with access to financial services, enabling them to manage transactions and access credit more easily. However, challenges such as limited digital infrastructure and lack of digital skills must be addressed to fully realize these benefits.

6. Policy Recommendations

Effective policy measures are essential for enhancing MSME integration into global value chains. Governments must focus on improving access to finance through credit schemes and digital financial services. Investment in infrastructure

is critical for reducing costs and improving competitiveness. Reliable transport and energy systems are essential for efficient production and distribution. Skill development programs are necessary to build a capable workforce. Education and vocational training should align with industry needs. Support for technological adoption is also important. Governments can provide incentives and technical assistance to encourage innovation. Regulatory reforms should aim to simplify procedures and reduce compliance costs. A transparent and efficient business environment is essential for MSME growth.

Digitalization has emerged as a transformative force in enabling MSMEs to integrate into global value chains. By reducing transaction costs and improving communication, digital technologies make it easier for small enterprises to participate in global trade (WTO, 2019). E-commerce platforms allow MSMEs to access international markets directly, bypassing traditional intermediaries. This increases their visibility and profitability. Digital tools also enhance supply chain management by improving efficiency and enabling real-time monitoring of operations. Furthermore, digital financial services promote financial inclusion by providing MSMEs with access to credit and payment systems. This supports their growth and stability. However, the digital divide remains a challenge, as many MSMEs lack access to reliable internet and digital skills. Addressing this gap is essential for maximizing MSME integration into GVCs. To support MSME integration into GVCs, governments must implement comprehensive policies. Improving access to finance through credit schemes and digital platforms is essential (World Bank, 2020).

Investment in infrastructure is also critical for reducing costs and improving efficiency. Reliable transport and energy systems are necessary for global competitiveness. Skill development programs should focus on aligning education with industry needs. This will help build a capable workforce. Governments should implement regulatory reforms to simplify procedures and reduce compliance costs. Finally, promoting digital inclusion will enable MSMEs to leverage technology and participate more effectively in global markets.

7. Conclusion

The integration of MSMEs into global value chains offers significant opportunities for economic growth and development in developing countries. It enables small enterprises to access global markets, adopt advanced technologies, and improve productivity. However, the process is complex and requires overcoming various challenges. Financial constraints, technological gaps, infrastructure deficiencies, and institutional barriers limit MSME participation. This paper highlights the importance of policy interventions, digitalization, and capacity

building in facilitating integration. By addressing these challenges, developing countries can unlock the full potential of MSMEs. In conclusion, MSMEs have the potential to become key drivers of global trade and economic development. With the right support and strategies, they can achieve sustainable growth and contribute to inclusive development.

The integration of MSMEs into global value chains represents a significant opportunity for economic development in developing countries. It enables small enterprises to access global markets, adopt advanced technologies, and improve productivity. However, the process is complex and requires overcoming multiple challenges, including financial constraints, technological gaps, and institutional barriers. This paper highlights the importance of coordinated policy efforts, digital transformation, and capacity building in facilitating MSME integration. In conclusion, MSMEs can become key drivers of global economic growth if supported by appropriate policies and infrastructure. Their successful integration into GVCs will contribute to inclusive and sustainable development.

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6

India's External Sector at the Crossroads: Challenges and Opportunities in an Era of Neo-Nationalism, De-dollarisation and Deglobalisation

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Abstract: *India's external sector stands at a critical crossroads, shaped by a confluence of structural reforms, shifting global power dynamics, and the reconfiguration of international trade and financial systems. Over the past three decades, India's progressive integration into the global economy has yielded substantial dividends, expanding merchandise exports, burgeoning services trade, rising foreign direct investment (FDI) inflows, and a growing footprint in global value chains. Yet, the very architecture of globalisation that enabled this ascent is now under strain. The twin forces of neo-nationalism, manifesting as protectionist tariffs, supply chain reshoring, and industrial policy activism across major economies, and an emergent movement toward de-dollarisation are fundamentally redrawing the contours of global commerce and finance.*

This article examines India's external sector through the lens of this complex transition. It analyses recent trends in merchandise and services trade, evaluates the strategic implications of India's bilateral and regional Free Trade Agreement (FTA) negotiations, and assesses how FDI flows are being reshaped by the China+1 strategy and geopolitically motivated supply chain diversification. The paper further interrogates India's cautious yet evolving engagement with de-dollarisation, exploring the Rupee trade settlement framework and its limitations. Finally, it scrutinises the challenge of navigating between the imperatives of economic nationalism at home and the demands of deepening global integration abroad.

The study draws on data from the Reserve Bank of India, the Ministry of Commerce and Industry, the World Trade Organisation, UNCTAD, and recent bilateral trade statistics. It finds that while India is uniquely positioned to benefit from the ongoing global realignment, it must resolve critical structural bottlenecks, including export concentration, non-tariff

barriers, currency convertibility constraints, and infrastructure gaps, to fully capitalise on emerging opportunities. The article concludes with a policy framework oriented toward building a resilient, competitive, and strategically autonomous external sector.

Keywords: *Globalisation, India External Sector, Free Trade Agreements, Foreign Direct Investment, De-dollarisation, Neo-Nationalism*

1. Introduction: India's External Sector in a World Reordering Itself

The global economic order that defined the post-Cold War era, characterised by hyper-globalisation, multilateral trade liberalisation, dollar hegemony, and the progressive dismantling of barriers to capital flows, is experiencing an accelerating unravelling. From Washington to Brussels, Beijing to New Delhi, economic nationalism has re-entered the policy mainstream, reshaping the rules of international commerce in ways that are simultaneously threatening and opportunity-creating for emerging economies like India.

India's external sector, encompassing merchandise trade, services exports, foreign direct investment, remittances, and external borrowing, has grown enormously in both scale and complexity. The country's goods exports reached USD 437 billion in FY 2023–24 (Ministry of Commerce and Industry, Government of India, 2024), while services exports driven by IT, business process outsourcing, and financial services added another USD 340 billion (Ministry of Commerce and Industry, Government of India, 2024). Total trade in goods and services as a proportion of GDP now exceeds 45 per cent (Reserve Bank of India, 2023), a figure that underscores India's deep, if uneven, integration with the world economy.

However, beneath these aggregates lies a structural paradox. India's export basket remains concentrated in relatively low-value segments, gems and jewellery, textiles, petroleum products, and pharmaceuticals, with limited penetration into high-technology manufactures where global demand is most dynamic. Its trade deficit, particularly with China, has widened alarmingly, raising concerns about import dependence in strategic sectors. Meanwhile, India's FTA portfolio, while expanding, has historically delivered mixed results, with the domestic industry often resistant to the competitive pressures that deeper integration entails.

Against this backdrop, the article proceeds as follows: Section 2 analyses the trajectory of India's merchandise and services trade. Section 3 evaluates India's FDI landscape in the context of global supply chain reshuffling. Section 4 scrutinises recent FTA developments. Section 5 examines the challenge of neo-nationalism, both globally and within India's own policy posture. Section 6 explores de-dollarisation dynamics. Section 7 assesses the broader deglobalisation risk. Section 8 offers a synthesis and policy framework, followed by the conclusion.

2. India's Trade Trajectory: Gains, Gaps, and Structural Concerns

2.1 Merchandise Trade: Expanding Volumes, Persistent Deficits

India's merchandise export performance over the past decade reflects genuine diversification alongside enduring structural constraints. The country's goods exports grew from approximately USD 260 billion in FY 2013–14 to over USD 437 billion by FY 2023–24 (Ministry of Commerce and Industry, Government of India, 2024), a creditable expansion, yet one that still positions India as a mid-tier exporter by global standards, accounting for roughly 1.8 percent of world merchandise trade (World Trade Organisation, 2024). In comparison, China commands nearly 15 per cent (World Trade Organisation, 2024), and Vietnam, a much smaller economy, has outpaced India in several manufacturing export categories.

The composition of India's export basket reflects both strengths and vulnerabilities. Petroleum products constitute the single largest export category, a function of India's large refining capacity rather than a sustainable comparative advantage. Engineering goods, pharmaceuticals, chemicals, and textiles form the backbone of non-oil exports. Notably, India has made limited inroads into electronics manufacturing exports, the fastest-growing segment of global trade, though the Production Linked Incentive (PLI) scheme has begun to yield early results, particularly in mobile phone exports.

On the import side, the structural challenge is starkly illustrated by India's trade relationship with China. India's bilateral trade deficit with China exceeded USD 85 billion in FY 2023–24 (Kumar, 2024), driven by dependence on Chinese inputs for electronics, solar panels, active pharmaceutical ingredients (APIs), and industrial machinery. This dependence has strategic dimensions that go beyond mere commercial economics, raising questions of supply security that have only sharpened since the Galwan Valley stand-off of 2020.

2.2 Services Trade: India's Comparative Advantage

India's services sector represents its most formidable trade asset. The country is the world's leading exporter of IT and business services, with Indian technology firms generating revenues that dwarf those of many sovereign economies. Exports of services crossed USD 340 billion in FY 2023–24 (Ministry of Commerce and Industry, Government of India, 2024), with software services, financial and professional services, and travel contributing the largest shares.

The rise of Global Capability Centres (GCCs), offshore arms of multinational corporations managing high-value functions, has added a new dimension to India's services export story. With over 1,700 GCCs now operating in India and employing nearly 1.9 million professionals (Chanda, 2023), the country

is cementing its position as an indispensable node in the global knowledge economy. This GCC ecosystem is increasingly moving up the value chain, encompassing research and development, data analytics, artificial intelligence, and chip design.

However, India's services trade surplus, while substantial, faces emerging challenges. The rise of automation and artificial intelligence threatens the labour-cost arbitrage that underlies India's IT outsourcing advantage. Visa restrictions in key markets, particularly the United States and the United Kingdom, constrain the movement of Indian professionals. The imperative to transition from body-shopping to product-led, IP-driven services exports is both urgent and formidable.

3. Foreign Direct Investment: Opportunities in Global Supply Chain Realignment

3.1 FDI Inflows: Trends and Sectoral Patterns

India's FDI landscape has undergone a significant transformation, reflecting both domestic policy improvements and the global reshuffling of supply chains. Gross FDI inflows reached USD 71 billion in FY 2023–24 (Ministry of Commerce and Industry, Government of India, 2024), with technology, financial services, infrastructure, and manufacturing attracting the largest volumes. The Make in India initiative, PLI schemes spanning fourteen sectors, and a series of foreign investment policy liberalisations have positioned India as a credible manufacturing destination.

The China+1 strategy, whereby multinational corporations seek to establish production bases outside China to reduce geopolitical concentration risk, has created a structural opportunity for India. Companies in the semiconductor, electronics, pharmaceutical, chemical, and textile sectors are actively evaluating India as an alternative or supplementary manufacturing hub. The government's success in attracting Apple's supply chain, with Tata Electronics and Foxconn now assembling iPhones domestically, is perhaps the most high-profile symbol of this shift.

3.2 Barriers to FDI Realisation

Despite its potential, India has captured only a fraction of the China+1 opportunity compared to Vietnam, Mexico, and Thailand. Structural impediments, including complex land acquisition procedures, rigid labour laws in certain states, inadequate logistics infrastructure, high input costs, and regulatory unpredictability, continue to deter large-scale manufacturing investments. The contrast with Vietnam's ability to absorb USD 35 billion in annual FDI while maintaining a leaner regulatory environment is instructive.

Additionally, India's outbound FDI, a marker of the maturation of its corporate sector and its global ambitions, has grown steadily, with Indian conglomerates (Tata

Group, Adani, Reliance, HCL, Infosys) acquiring overseas assets and building global footprints. Managing the regulatory architecture for outbound investment while maintaining macroeconomic stability is an evolving policy challenge.

4. Free Trade Agreements: Strategic Repositioning After a Decade of Caution

India's relationship with Free Trade Agreements has historically been ambivalent. After early enthusiasm in the 2000s, which produced bilateral FTAs with ASEAN, Japan, South Korea, and Sri Lanka, India grew increasingly wary of reciprocal liberalisation, citing adverse impacts on domestic manufacturing and agriculture. The decision to withdraw from the Regional Comprehensive Economic Partnership (RCEP) in 2019 was emblematic of this caution, driven by concerns about a flood of Chinese imports through RCEP members.

Since 2021, however, India has recalibrated its FTA strategy with notable energy. The India–UAE Comprehensive Economic Partnership Agreement (CEPA), signed in February 2022 and implemented within months, represented a new template, fast, focused, and commercially pragmatic. The India–Australia Economic Cooperation and Trade Agreement (ECTA) followed, establishing preferential access in critical sectors. Negotiations with the United Kingdom, the European Union, Canada, and the Gulf Cooperation Council (GCC) are at varying stages of advancement.

The India–UK FTA is particularly consequential. A successful agreement would grant Indian exporters preferential access to one of the world's largest consumer markets while strengthening the framework for cooperation in financial services, legal services, and the education sector. However, sticking points around intellectual property rights, agricultural market access, professional visa quotas, and government procurement have extended negotiations well beyond initial timelines.

India's FTA strategy reflects a broader tension: between the desire for market access abroad and the impulse to protect the domestic industry. The experience of the ASEAN FTA, which widened India's trade deficit with ASEAN rather than expanding its exports, has made policymakers wary of concessions that expose uncompetitive sectors to import competition. Resolving this tension requires not just a better negotiating strategy but deeper domestic reforms that enhance competitiveness in manufacturing, logistics, standards, and intellectual property.

5. Neo-Nationalism: The Global Retreat from Open Markets and India's Positioning

5.1 The Global Rise of Economic Nationalism

The post-pandemic global economy has witnessed a pronounced shift toward what economists have termed the 'new industrial policy', a revival of state-directed economic interventions aimed at securing strategic industries, strengthening domestic supply chains, and reducing dependence on geopolitical adversaries. The United

States' CHIPS and Science Act, the Inflation Reduction Act, and the BIOSECURE Act; the European Union's European Chips Act and Critical Raw Materials Act; and China's comprehensive industrial policy apparatus all reflect a fundamental reassessment of the costs of deep global economic integration.

For India, this shift is a double-edged sword. On one hand, the discrediting of hyper-globalisation and the legitimisation of industrial policy create political and normative space for India's own infant-industry protection, PLI-style subsidisation, and strategic import substitution. India's 2023 semiconductor policy, offering fiscal incentives of up to 50 per cent for chip fabrication facilities, exemplifies this alignment with global trends. On the other hand, rising protectionism in India's key export markets threatens the market access that underpins growth in services and goods exports.

5.2 India's Own Neo-Nationalist Impulses

India is not merely a passive recipient of global neo-nationalism, it is itself an active practitioner. The Atma-nirbhar Bharat (Self-Reliant India) initiative, launched in 2020, articulates a vision of reducing import dependence in strategic sectors while leveraging domestic scale to build competitive industries. Tariff increases on electronics, toys, furniture, steel, and other sectors have been significant, with India's average applied tariff rate among the highest in the G20.

This domestic economic nationalism creates friction with India's ambitions as an FTA negotiator and as a champion of rules-based multilateral trade. Trading partners point to India's tariff escalation and non-tariff barriers as inconsistent with its FTA commitments. Navigating this contradiction, being simultaneously protectionist at home and expansionist abroad, is a central challenge of India's external economic policy architecture.

6. De-dollarisation: India's Cautious Engagement with a Shifting Monetary Landscape

The question of dollar hegemony and the potential, pace, and consequences of its erosion has moved from the margins to the mainstream of international economic discourse. The weaponisation of the US dollar through sanctions (most dramatically against Russia following the 2022 invasion of Ukraine), the freezing of Russia's sovereign reserves held in Western financial institutions, and the demonstrated capacity of the United States to cut adversaries off from the SWIFT messaging system have collectively accelerated interest in alternative payment architectures.

India's engagement with de-dollarisation is characterised by strategic pragmatism rather than ideological opposition to dollar dominance. The Reserve

Bank of India's 2022 framework for Rupee trade settlement, enabling bilateral trade to be invoiced, settled, and cleared in Indian Rupees, was a significant, if modest, institutional step. As of 2024, eighteen countries have opened Vostro accounts with Indian banks to facilitate Rupee-denominated trade, with Russia being the most prominent early adopter amid Western sanctions (Reserve Bank of India, 2023).

However, the Rupee settlement framework has encountered structural limitations, underscoring the challenges of de-dollarisation in practice. The primary bottleneck is the non-convertibility of the Indian Rupee on the capital account. Surplus Rupees accumulated by trade partners, particularly Russia, cannot be easily repatriated or deployed in liquid global markets, limiting the attractiveness of Rupee settlement for a wide range of trading partners. Russia, for instance, has accumulated large Rupee balances that cannot be redeployed at the scale or liquidity that dollar-denominated settlements permit.

India's position within the BRICS framework, which now includes Saudi Arabia, UAE, Iran, Ethiopia, Egypt, and Argentina, adds another dimension. While India has participated in discussions around an alternative BRICS payment mechanism, including a potential mBridge-style central bank digital currency platform, it has been careful to avoid overt confrontation with the existing dollar-centric order. India's USD 600 billion in foreign exchange reserves are overwhelmingly dollar-denominated (Reserve Bank of India, 2023); its external debt is substantially dollar-invoiced; and its trade is financed in letters of credit, overwhelmingly denominated in dollars.

The strategic conclusion is nuanced: India benefits from a gradual, multilaterally managed diversification of the international monetary system, one that reduces single-currency dependence and creates space for Rupee internationalisation, but not from a sharp, disruptive rupture with dollar hegemony that could destabilise India's own external financial position. De-dollarisation for India is therefore a long-horizon ambition dressed in the clothing of near-term pragmatism.

7. Deglobalisation: Structural Risks and India's Strategic Imperatives

Deglobalisation, the partial reversal of economic integration through trade fragmentation, capital controls, technology barriers, and geopolitical bloc formation, poses significant risks to India's growth model. The IMF has estimated that a severe fragmentation of the global economy into two geopolitical blocs could reduce global output by up to 7 per cent over the long run, with emerging economies bearing a disproportionate share of the adjustment costs (International Monetary Fund, 2023).

India's particular vulnerability lies in three dimensions. First, export-led growth, a pathway used successfully by East Asian economies to achieve rapid

industrialisation, becomes more difficult in an environment where major consumer markets are erecting higher barriers and favouring domestic production. Second, technology fragmentation threatens India's ability to access frontier technologies, including semiconductors, AI chips, and dual-use technologies, as export control regimes (most notably the US-led Chip-4 alliance) tighten. Third, financial deglobalisation, manifested in capital account restrictions and the reconfiguration of correspondent banking relationships, could complicate India's external financing and investment landscape.

Nevertheless, India possesses attributes that make it a potential beneficiary of a partially deglobalised world. Its large domestic market, with a middle class projected to exceed 500 million by 2030, offers scale that many deglobalising economies need to serve. Its non-aligned strategic posture, carefully maintained under the banner of 'strategic autonomy', allows it to navigate between the US-led and China-centric economic blocs with greater flexibility than most emerging economies. India's G20 Presidency in 2023 and its role in articulating a 'Global South' perspective on trade, debt, and development reflect this positioning.

The concept of 'friend-shoring', the redirection of supply chains toward geopolitically aligned or neutral partners, creates an opportunity that India is actively courting. India's participation in the Indo-Pacific Economic Framework (IPEF), the I2U2 (India, Israel, UAE, USA) grouping, and deepening defence and economic partnerships with Japan, Australia, and the European Union all reflect a strategic calculus: that selective, geopolitically calibrated integration is preferable to either hyper-globalisation or autarchy.

8. Policy Framework: Towards a Resilient External Sector

Drawing together the threads of the preceding analysis, this section outlines a policy framework for India's external sector that is adapted to the realities of the current global transition. Five strategic imperatives emerge.

8.1 Export Diversification and Value Chain Upgrading

India must urgently diversify its export basket toward higher-value manufactures and technology-intensive services. The PLI scheme, while promising, must be complemented by aggressive export infrastructure development, streamlined trade logistics (reducing India's logistics cost-to-GDP ratio from its current 14 per cent toward the global benchmark of 8 per cent) (Ministry of Commerce and Industry, Government of India, 2024), and investments in standards and quality certification infrastructure. Export diversification toward Africa, Latin America, and Southeast Asia must accompany the traditional focus on the US, Europe, and the Gulf.

8.2 Strategic FTA Architecture

India's FTA strategy must evolve from defensive caution to proactive engagement grounded in domestic competitiveness. Completing the UK and EU FTAs while securing meaningful gains in services mobility, digital trade, and financial services must be prioritised. Within the WTO framework, India must champion the interests of developing countries in agricultural subsidies, intellectual property flexibilities, and special and differential treatment, even as it pursues bilateral market access.

8.3 FDI Ecosystem Improvement

To fully capitalise on the China+1 opportunity, India must address the supply-side constraints that limit its manufacturing competitiveness. A single-window clearance mechanism for large FDI projects, state-level land bank development, progressive labour law reform, and improvements in power and logistics infrastructure are non-negotiable requirements. The experience of successful investment facilitation in Gujarat, Tamil Nadu, and Telangana must be replicated nationally.

8.4 Managed Rupee Internationalisation

India should pursue a phased approach to Rupee internationalisation, deepen the Rupee settlement framework, develop offshore Rupee bond markets (Masala bonds), and gradually expand capital account convertibility in a sequenced, macro-prudentially managed manner. This approach must be embedded within a broader strategy to deepen India's domestic financial markets and build the institutional infrastructure, including central counterparties, deep government securities markets, and a credible inflation-targeting framework that anchors international currency credibility.

8.5 Strategic Autonomy in the Multipolar Order

India's most durable external sector asset may be its strategic positioning. Its refusal to align exclusively with either the US-led or the China-led economic bloc, while maintaining robust economic and security relationships across the spectrum, gives it unusual leverage. This 'multi-alignment' must be converted into tangible economic gains: preferential market access, technology partnerships, investment flows, and participation in the governance of emerging international economic institutions.

9. Conclusion

India's external sector is at the crossroads. The forces of neo-nationalism, de-dollarisation, and deglobalisation are reshaping the global economic architecture in ways that simultaneously challenge and create opportunities for India's development trajectory. The country is neither a passive victim of these forces nor

an innocent bystander — it is an active participant, shaping and being shaped by the new rules of international economic engagement.

The central argument of this article is that India's ability to navigate this transition will depend not merely on smart diplomacy or bold negotiating strategy, but on the quality and ambition of domestic economic reform. Export competitiveness cannot be conjured by trade agreements alone; it requires a productive base undergirded by efficient logistics, skilled labour, world-class infrastructure, and a regulatory environment that rewards enterprise. FDI cannot be attracted by policy proclamations alone; it requires demonstrable execution capacity and consistent governance.

On de-dollarisation, India must be clear-eyed: the internationalisation of the Rupee is a generational project, not a short-term policy lever. On deglobalisation, India must resist the temptation of autarchy while building the structural resilience in energy, food, technology, and finance that genuine strategic autonomy demands. Moreover, on the broader question of India's role in the emerging multipolar order, the country must translate its considerable demographic, economic, and diplomatic assets into tangible influence over the institutions and rules that will govern the next phase of global integration.

India's external sector transition, in sum, is inseparable from its broader economic transition. The challenges are formidable, the reforms are imperative, and the opportunities for those willing to pursue them with rigour and ambition are historic.

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7

Breathing in Silence: Environmental Degradation, Its Human Cost, and the Crisis of Political Will in Developing Economies with Special Reference to India

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Abstract: *Environmental degradation is no longer just an environmental issue; it has become a major social, economic, and political challenge of our time. In developing economies like India, the destruction of air, water, land, and forests is not happening in spite of governments; In many instances, it continues because of weak implementation of environmental laws, lack of political commitment, and limited accountability. This paper examines the multidimensional crisis of environmental degradation in India, the measurable human cost it imposes, and the structural reasons why political will to address it remains weak or performative. Drawing upon data from the Centre for Science and Environment (CSE), the Health Effects Institute, The Lancet, the World Health Organization (WHO), Global Forest Watch, and Indian government sources, this paper argues that the environmental crisis in India is inseparable from a crisis of democratic accountability and that without addressing the political economy of environmental neglect, no amount of policy-making on paper will translate into meaningful change on the ground.*

Keywords: *environmental degradation, political will, India, air pollution, deforestation, public awareness, developing economies, climate governance*

1. Introduction

Every winter, the skies above Delhi, Lucknow, Patna, and dozens of other Indian cities turn the colour of old cotton, grey, dense, suffocating. Children are bound to stay home, hospitals fill with respiratory cases, and governments only issue advisories telling citizens to stay indoors, as if the responsibility for a structural crisis rest with individuals rather than with those who hold power. This is the defining pattern of environmental governance in developing economies: the state manages

the optics of concern while the crisis deepens. Like India, across South Asia, sub-Saharan Africa, and Latin America, the trajectory is similar: rapid growth, extractive resource use, weak regulatory institutions, and electoral systems that reward short-term gains over long-term ecological stability. The result is a world in which the poor pay the heaviest price for pollution they did the least to create, and those with the power to act find persistent reasons.

This paper aims to examine the issue clearly and realistically. It explores the nature and scale of environmental degradation in India, its impact on human health and livelihoods, the reasons behind weak political commitment despite existing environmental laws, and the role of public awareness in addressing the crisis. Understanding these issues is essential for developing meaningful and long-term solutions.

2. The Scope of Environmental Degradation: Key Data

Table 1: India's Environmental Crisis — Key Indicators at a Glance

Environmental Indicator	Current Status	Source
Cities in the Global Top 100 Polluted	83 of 100	IQAir, 2023
Air-pollution deaths (2023)	~2 million	HEI / IHME, 2025
Rise in pollution deaths since 2000	+43%	State of Global Air, 2025
Land area degraded	~30% of India	Frontiers in Ecol. & Evol., 2023
Land degraded (hectares)	120.7 M ha	ICAR / Frontiers, 2023
Primary forest lost (2024 alone)	18,200 ha	Global Forest Watch, 2024
Total tree cover lost (2001–2024)	2.31 M ha	Global Forest Watch, 2024
MSW generated daily	1,50,000 tonnes	CSE / Down To Earth, 2023
India's SDG Global Rank (2022)	121 / 193	CSE, SoE Report 2023

Sources: IQ Air 2023; HEI/IHME 2025; Frontiers in Ecology & Evolution 2023; Global Forest Watch 2024; CSE 2023

The data clearly highlights the scale and seriousness of environmental degradation in India. Air pollution remains one of the gravest concerns, with 83 Indian cities ranking among the world's 100 most polluted cities according to IQAir (2023). Its human cost is equally alarming, as nearly two million deaths in 2023 were linked to air pollution, representing a 43 % rise since 2000. Environmental stress is also visible in land degradation, with almost 30 % of India's total land area affected, amounting to nearly 120.7 million hectares of degraded land. Forest resources are under pressure as well, with 18,200 hectares of primary forest lost in 2024 alone and a total loss of 2.31 million hectares of tree cover between 2001 and 2024. Rapid urbanisation and weak waste management systems have added to the crisis, with Indian cities generating around 1,50,000 tonnes of municipal solid waste

every day. These environmental challenges are reflected in India's global sustainability performance, where the country ranked 121 out of 193 nations in the Sustainable Development Goals (SDG) rankings in 2022. Overall, the data indicate that environmental degradation in India is not limited to one sector but affects air quality, forests, land resources, public health, and urban living simultaneously.

2.1 Air Pollution

According to the World Air Quality Report 2023, 83 of the 100 most polluted cities globally are in India.[1] A 2024 study in The Lancet Planetary Health covering 655 Indian districts from 2009 to 2019 found that every 10 ìg/m³ increase in PM2.5 led to an 8.6% rise in mortality. Around 3.8 million deaths over the decade were linked to pollution above India's own guidelines; measured against the WHO threshold, the toll climbs to 16.6 million, nearly 25 % of all mortality in that period.[2] The State of Global Air 2025 report estimated two million Indian deaths from air pollution in 2023 alone a 43 % increase since 2000.[3]

Figure 1: Air Pollution Death Rate per 100,000 Population- International Comparison (2023)

Figure 1: Air Pollution Death Rate per 100,000 Population (2023)

Country / Group	Deaths per 100,000 (bar proportional; max = India 186)	Value
India	186	186
Bangladesh	149	149
Pakistan	135	135
China	99	99
Brazil	56	56
High-Income Countries	17	17

Source: Health Effects Institute & IHME, State of Global Air 2025. India's death rate is ~11x higher than high-income countries.

2.2 Land, Water, and Waste

Approximately 120.7 million hectares of Indian land are degraded, 30% of the country's geographical area, with 85.7 million hectares suffering soil erosion.[4] Between 2001 and 2024, India lost 2.31 million hectares of tree cover, releasing an estimated 1.29 gigatonnes of CO, equivalent.[5] Groundwater levels in Haryana and Rajasthan are declining by 1–1.5 metres annually, threatening the agricultural base of two of India's most food-productive states.[6] India generates 150,000 tonnes of Municipal Solid Waste daily, over half of which is unmanaged, while over 30,000 water bodies nationwide have been encroached upon.[7]

3. The Human Cost -Who Bears the Burden?

Approximately 75% of India's population lives in areas where PM2.5 exposure exceeds the WHO interim target of 35 ìg/m³.[8] States, including Uttar Pradesh, Bihar, West Bengal, and Maharashtra, each recorded over 100,000 air-pollution deaths in 2023.[9] These are not wealthy urban consumers equipped with air purifiers; they are, predominantly, outdoor workers, rural households cooking on solid fuels, and those dependent on an already overstretched public health system.

The burden is not just mortal. Over two million children in Delhi, half the city's child population, have lung function abnormalities, according to the Delhi Heart and Lung Institute. Long-term exposure to PM2.5 damages brain tissue, contributing to cognitive decline and neurological conditions.[10] Land and water degradation, meanwhile, translate directly into crop failures, displacement, and livelihood collapse for rural communities. Between January and April 2023, extreme weather events intensified by environmental breakdown killed 233 people and damaged 0.95 million hectares of cropland, a 31-fold increase in agricultural loss compared to the same period in 2022.[11] Environmental degradation, in this light, is not an ecological abstraction — it is a mechanism of deepening inequality.

4. The Political Economy of Environmental Neglect

4.1 Structural Barriers to Political Will

Environmental neglect in developing economies is not primarily a knowledge deficit; it is a political choice shaped by structural incentives. Three factors are decisive.

First, growth-oriented governance frameworks treat environmental regulation as a friction on investment and output.

Second, democratic election cycles of four to five years systematically disadvantage policies whose benefits appear over decades. The politician who restricts a polluting industry forgoes visible, immediate economic gains; the environmental cost arrives after the next election.

Third, regulatory institutions, pollution control boards, and environment ministries are routinely underfunded and politically constrained, designed to exist without being fully functional.

4.2 Performative Environmentalism

India's legislative framework is, on paper, comprehensive. The Environment Protection Act (1986), the Water (Prevention and Control of Pollution) Act (1974), the National Green Tribunal (2010), and the National Clean Air Programme (2017) collectively represent serious statutory ambition. The reality of implementation, however, tells a different story.

Table 2: Environmental Policy Intent vs. Implementation Reality in India

Policy / Programme	Stated Objective	Ground Reality
National Clean Air Programme (2017)	Reduce PM2.5 by 20–30% in 122 cities by 2024	PM2.5 continued to rise in many target cities (Lancet, 2024)
National Green Tribunal (2010)	Fast-track environmental justice	245 cases must be decided daily to clear backlog (CSE, 2023)
Forest Conservation Act (1980)	Protect forest land from diversion	1.5 M ha diverted since 1980; 18,200 ha primary forest lost in 2024
PM Ujjwala Yojana (2016)	Replace solid fuels with LPG for rural households	Household pollution deaths declining; ambient PM2.5 deaths rising
Net Zero by 2070 Commitment	Decarbonise India's economy	Emissions rose 190 M tonnes in 2023 due to GDP growth & weak monsoon
Sources: Lancet Planetary Health 2024; CSE 2023; Global Forest Watch 2024; Wikipedia / Air Pollution in India 2026		

The gap documented in Table 2 reflects what political scientist Pratap Bhanu Mehta has called the Indian state's tendency toward 'the politics of announcements, ' a mode of governance in which the declaration of intent substitutes for the delivery of outcomes. In environmental politics, this substitution is literally lethal. When India faced a severe air pollution crisis in 2025, the Union Health Ministry's official position was that there was no data linking air pollution to deaths.[12] This is not ignorance it is deliberate political management.

5. The Awareness Deficit and Democratic Accountability

Political will, in a democracy, is ultimately a function of citizen demand. Environmental awareness in India is real but uneven: urban, educated, English-speaking citizens increasingly engage with air quality data and climate discourse; rural communities who bear the sharpest costs tend to experience degradation as a series of local crises (the dried well, the failed crop, the sick child) without connecting these to the systemic political causes that produced them. Without that connection, grievance does not translate into organised political demand.

Indian media coverage of environmental issues remains episodic rather than structural. A pollution crisis event is news; the slow depletion of an aquifer is not. This episodic framing lowers the political salience of environmental issues and, consequently, the electoral cost of environmental neglect. Until clean air and clean water figure as consistent, decisive electoral demands as jobs, price rises, and identity politics currently do, politicians will continue to calculate that managing optics is safer than managing the crisis itself.

6. Conclusion

Two million people died in India from air pollution in 2023. The soils are thinning, the forests shrinking, the rivers slowing. The evidence base is not in dispute. What is in dispute, or rather, what is in paralysis, is the political will to act on it. Three conclusions follow from this analysis. First, environmental degradation in India is not a technical problem awaiting a technical solution; the technologies for cleaner energy and sustainable agriculture exist. What is lacking is political will, and will is a political variable. Second, political will in a democracy is ultimately built by citizens, and building it requires connecting the lived experience of environmental harm to its systemic political causes, particularly among the communities that suffer most. Third, the 'pollute now, clean up later' logic available to earlier industrialisers is foreclosed by today's ecological and climatic constraints. For India, environmental protection is not a luxury of prosperity; it is a precondition for the kind of prosperity that is durably and equitably shared. India has every intellectual and institutional resource needed to better govern its environment. What remains is the political reckoning that transforms those resources into accountability, and the citizen voice that makes that reckoning unavoidable.

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8

New Global Economic Order: De- Dollarization, De-Globalisation & India

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Abstract: *India holds a pivotal position in the emerging multipolar international economic order as the world's fastest-growing major economy, projected to become the third-largest by 2028. Its resilient growth, strategic reforms and balanced diplomacy position make it as a bridge between Global south and Western markets. India Ranks 4th globally in nominal GDP at $4.19 trillion in 2026, surpassing Japan, with forecast of 6.6% to 6.8% growth driven by domestic demand, infrastructure, and services. Unlike export reliant peers, India's inward focus buffers it from De-globalization shocks like USA tariffs. India pursues De- dollarization cautiously through rupee trade promotion and diversification without fully abandoning the dollar. India has enabled rupee- based trade via Special Vostro Rupee Accounts in more than 30 countries banks including Russia, UAE and Malaysia facilitating oil and commodity settlements. RBI's currency swaps like $75 Billion with Japan and deals with SAARC nations, support local currency use, UPI expansion aids cross border payments. This article explores the origins, principles, challenges, and prospects of the NIEO, its interconnections with De- dollarization and de-globalization, and the implications of these phenomena for the future of the global & Indian economy.*

Keywords: *NGEO, NIEO, De-globalisation, De- dollarization, BRICS, UPI.*

Introduction:

The global economic system that emerged after World War II was defined by US predominance, a liberal trade regime, and the Bretton Woods institutions that anchored monetary order. However, by the late 20th and early 21st centuries, this system has come under increasing strain. Rising geopolitical tensions, financial crises, and a growing critique of Western dominance have prompted calls for a

New International Economic Order (NIEO), a restructuring that addresses systemic inequalities and power imbalances. Concurrently, movements toward de-dollarization and de- globalization have gained traction, driven by countries seeking greater autonomy and resilience in an increasingly multipolar world.

A New Global Economic Order (NGEO) is important because the current international system no longer reflects today's realities or serves most of the world fairly. Developing countries have limited voice in decision making, Wealth and Power are concentrated in a few nations and many countries remain trapped in debt and dependency. Countries like India, China, Brazil, Indonesia, and Others now contribute significantly to global growth, but governance structures have not caught up. Old rules do not match multipolar realities, NGEO recognizes shared leadership, not dominance by one block. This New Economic Order promote De-dollarization, local currency trade, and diversified reserve system, and increasing financial sovereignty. It encourages Cooperation, resilience, and shared responsibility.

De-dollarization and De-globalization represent major shift in global economic order, driven by geopolitical tensions, sanctions, and a push for self-reliance. These trends matter because they challenge U.S. dominance, reshape trade and could lead to higher costs, fragmentation, or multipolar stability. De-dollarization involves reducing reliance on U.S. dollars for trade, reserves, and payments, often through local currency settlements or alternative currencies like the Rupee. De-globalization means retreating from economic integration via tariffs, reshoring supply chain, and protectionism, prioritizing national security over efficiency.

This article explores the origins, principles, challenges, and prospects of the NGEO, its interconnections with de-dollarization and de- globalization, and the implications of these phenomena for the future of the Indian and global economy.

NIEO & New Global Economic Order (NGEO):

The term New International Economic Order (NIEO) originated in the 1970s as a policy framework advanced by developing countries within the United Nations. It was formally articulated during the UN Conference on Trade and Development (UNCTAD) and championed by the Group of 77 (G77), a coalition of developing nations seeking to revise what they regarded as a skewed global economic architecture. Countries of the Global South argued that the existing system perpetuated unequal exchange, commodity dependence, and economic marginalization. They sought reforms in trade, investment, technology transfer, commodity prices, and financial relations. The NIEO represented not only economic demands but also a broader quest for sovereignty, dignity, and equitable participation in global governance.

The NIEO articulated several key principles: Equitable Access to Resources: Developing countries sought fairer terms of trade, better access to markets, and sustainable commodity pricing. Technology Transfer: A reduction in technological dependency through voluntary and mutually beneficial technology transfer and capacity building. Control over Natural Resources: National sovereignty over natural resources and control of foreign investments. Revision of International Institutions: Reforming institutions such as the International Monetary Fund (IMF), World Bank, and General Agreement on Tariffs and Trade (GATT) to reflect the interests of developing countries. Stabilization of Commodity Prices: Mechanisms for stabilizing prices of primary commodities critical to developing economies. These principles were rooted in a critique of neo-colonial relations and aimed at reshaping global economic norms.

While the NIEO did not achieve its full agenda, it influenced global debates on development and fairness. It catalyzed the creation of several mechanisms, including the Commodity Exporting Developing Countries (CEDC) and pushed topics such as trade preferences for developing nations onto international agendas. However, resistance from advanced economies and the reluctance of global institutions to relinquish influence meant that many NIEO demands remained unmet.

In Contrast, "New Global Economic Order" (NGEO) often describes contemporary shift in the world economy, such as multipolarity, de-globalization, Artificial Intelligence, Green Technology and Multipolar governance. This new global economic order based on broader economic transformations amid geopolitical changes and discussion on sustainable development. NGEO reduce dominance of advanced Western countries, Increase voice of Global South and Ensure Equitable growth, development finance, and policy autonomy.

The Concept of De- dollarization

De- dollarization refers to the process by which countries reduce their reliance on the US dollar in international trade, finance, and foreign-exchange reserves. Since the end of the Bretton Woods system and especially after the 1970s, the US dollar has served as the dominant global currency for trade invoicing, reserve holdings, and cross-border financial flows. This dominance provides the United States with considerable economic leverage, often referred to as the exorbitant privilege. Countries pursuing de- dollarization aim to mitigate this reliance by adopting alternative currencies for trade settlements, diversifying reserve holdings, and developing regional or national payment systems.

Motivations Behind De- dollarization:

1. Geopolitical Tensions: Sanctions and financial coercion (e.g., against Iran, Russia) have motivated affected countries to seek alternatives to the dollar-dominated system.
2. Financial Autonomy: Reducing exposure to US monetary policy and exchange rate volatility that can disrupt domestic economies.
3. Regional Integration: Strengthening regional currencies (e.g., the euro, yuan) and financial systems to enhance economic cooperation.
4. Risk Mitigation: Diversifying foreign exchange reserves to hedge against dollar depreciation or instability.

Mechanisms of De- dollarization:

De- dollarization can occur through several channels:

1. Bilateral Trade Agreements: Countries agree to settle trade in local currencies (e.g., China–Russia trade in renminbi and rubles).
2. Reserve Diversification: Central banks increase holdings of other currencies or gold. Development of Alternative Payment Systems: Creating systems like the Cross-Border Interbank Payment System (CIPS) as alternatives to SWIFT. Regional Currency Blocs: Efforts such as the BRICS Contingent Reserve Arrangement and discussions of a common BRICS currency aim to facilitate non-dollar settlements.

U.S. sanctions on Russia and others have accelerated the shift, with BRICS nations using local currencies for 90 percent of Russia's intra-group trade by 2024. Over reliance on the dollar exposes countries to inflation risks from USA deficits and policy changes, prompting diversification into Rupees, yuan, or gold. Geopolitics conflicts like Russia- Ukraine and Red Sea attack disrupted chains, fueling protectionism such as U.S. tariffs and India's PLI schemes. Pandemic exposed vulnerability, leading to reshoring; Donald Trupm's "America First Policy" including 500% tariff proposal, intensify this. De-dollarization empowers BRICS against USA coercion, shifting to power-based trade from rules, while weakens institutions like WTO, raising conflicts risks via nationalism, e.g. Indo- China tensions.

De-Globalization: A Shift Away from Globalization

De-globalization refers to the reduction of global economic integration characterized by declining cross-border flows of goods, services, capital, and labor. This is not a return to complete economic isolation but a rebalancing of global interdependence. De-globalization is driven by:

1. Resurgent Nationalism: Policies prioritizing domestic industries and supply chain resilience.
2. Geopolitical Frictions: Trade wars, sanctions, and strategic competition (notably between the US and China).
3. Economic Crises: Post-2008 structural shifts and the COVID-19 pandemic underscored vulnerabilities in global supply chains.
4. Technological Shifts: Automation and reshoring reduce the cost advantage of offshoring. De-globalization does not necessarily reverse all gains of globalization but reshapes the terms and intensity of international economic exchanges.

Indicators of De-globalization:

Several measurable indicators point to de-globalization trends including, trade as a Share of GDP, after peaking in the early 2010s, global trade growth has slowed relative to world output. Foreign Direct Investment (FDI): Cross-border investment flows have become more selective and regionally concentrated. Reshoring and Nearshoring: Companies relocating production closer to home markets. Fragmentation of Standards: Diverging technological standards and supply networks based on geopolitical alignments. These indicators suggest a shift toward a more regionalized global economy.

Relation of NGEO, De-dollarization, and De-globalization

The New Global Economic Order (NGEO), de- dollarization, and de-globalization are deeply interconnected processes. Together, they reflect a structural transformation of the global economy away from Western -centric dollar dominated hyper globalized systems toward a multipolar and more sovereign world order.

The rise of multipolarity, with the emergence of China, India, and other economies, challenges the unipolar dominance of the United States that underpinned the post-war economic order. This geopolitical shift accelerates de- dollarization and supports calls for institutional reforms envisioned by the NIEO. At the same time, de-globalization reflects both push factors (crises, political backlash) and pull factors (regional cooperation, technology shifts), indicating that the global economic order is in a state of transition.

China's Role in De-dollarization and Global Economic Restructuring was actively promotion for alternatives to dollar dominance by Bilateral Currency Swap Agreements with multiple countries to facilitate trade in renminbi, Belt and Road Initiatives, Internationalization of Yuan i.e. inclusion of yuan in The IMF's SDR basket in 2016 increased it legitimacy. These efforts align with broader trends towards diversifying the international monetary system.

BRICS (Brazil, Russia, India, China & South Africa) has engaged in initiatives like New Development Bank (NDB) and discussion on alternative trade and reserve arrangements. While the idea of a common BRICS currency remains speculative, the group's action reflects a desire to build financial infrastructure outside traditional western dominated institutions. The European Union (EU), while still deeply integrated with global markets, has pursued strategic autonomy in the trade and technology. The EU trade agreements, digital policies and supplier diversification demonstrate a nuanced response to globalization i.e. balancing openness with strategic interests.

India and New Global Economic Order (NGEO):

India holds a pivotal position in the emerging multipolar international economic order as the world's fastest- growing major economy, projected to become the third largest by 2028. Its resilient growth, strategic reforms and balanced diplomacy position make it as a bridge between Global south and Western markets. India Ranks 4th globally in nominal GDP at $4.19 trillion in 2026, surpassing Japan, with forecast of 6.6% to 6.8% growth driven by domestic demand, infrastructure, and services. Unlike export reliant peers, India's inward focus buffers it from De-globalization shocks like USA tariffs. India leads BRICS 2026, advocating pragmatic de- dollarization via rupee trade and CBDC linkages, while maintaining dollar reserves for stability. As a G-20 voice for the Global South, India pushes WTO reforms and digital public infrastructure, fostering South- South ties without alienating the West. Gold reserve diversification and rupee internationalization counter dollar dominance risks.

India supports NGEO through promoting rupee-based trade, advocating reform of IMF and World Bank, Supporting Atmanirbhar Bharat and Championing Global south interest. India pursues De- dollarization cautiously through rupee trade promotion and diversification without fully abandoning the dollar. India has enabled rupee- based trade via Special Vostro Rupee Accounts in more than 30 countries banks including Russia, UAE and Malaysia facilitating oil and commodity settlements. RBI's currency swaps like $75 Billion with Japan and deals with SAARC nations, support local currency use, UPI expansion aids cross border payments. Under 2026 BRICS presidency, India pushes pragmatic local settlements, DPI sharing (UPI & Aadhar) and proposes linking BRICS CBDC's for trade, while rejecting full de- dollarization rhetoric. These steps cut transaction costs 1 to 2 percent shield from USA sanctions and boost monetary autonomy with gold reserve rising to hedge risks. India maintains strong U.S. ties, focusing on Diversification not Replacement-amid rupee's limited convertibility.

Conclusion:

The New Global Economic Order is important because it seeks to make the global economy fairer, more inclusive, multipolar, resilient and development oriented, especially for the global south. De-dollarization and De-globalization represent major shifts in the global economic order. A multi- currency system boots stability by diluting USA policy shocks. De-globalization causes stagflation, higher inflation, and vitality from barriers, on the other hand it spurs green, inclusive growth via localization. De-dollarization reduces US asset demand, potentially depreciating the dollar and hiking USA borrowing costs. For emerging markets like India, Benefits include sanction shields and reserve diversification, but service exports suffer from reduced trade. India can leverage rupee trade and Atmanirbhar for strategic autonomy. De-dollarization offers India opportunities for greater monetary autonomy and reduced sanction risks, but it also poses challenges to foreign investment and remittances. India's forex reserve, around $693 billion in 2026, remain heavily dollar- dominated, prompting cautious diversification efforts. Though India boosting gold holdings to $110 billion and exploring Euros, Yen, and Yuan.

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9

Impact of GST Implementation on Tax Efforts in Uttar Pradesh: An Empirical Analysis (2010-2024)

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Abstract

The study examines the impact of the Goods and Services Tax (GST) implementation on tax effort in Uttar Pradesh over the period 2010-2024, using an empirical framework based on the own tax revenue-to-Gross State Domestic Product (GSDP) ratio. GST, introduced in India on 1 July 2017, unified multiple indirect taxes into a single, streamlined levy system aimed at simplifying taxation and improving compliance at both the central and state levels. Within this framework, State GST (SGST) represents the part of GST revenue that accrues directly to states and forms a key component of State Own Tax Revenue. SGST has emerged as the largest source of own tax revenue in Uttar Pradesh, accounting for a significant share of the total in recent years, alongside other important sources such as state excise, VAT, stamps, and registration fees.

To assess the effect of GST on revenue mobilisation of the state, the analysis is organized into Pre- GST (FY 2010-11 to FY 2016-17) and Post-GST (FY 2017-18 to 2023-24) periods, with FY 2016-17 selected as the reference year for constructing a tax effort index that enables relative comparison over time. The tax effort is calculated as the proportion of own tax revenue to GSDP, while the index expresses annual values relative to the baseline of the reference year.

This empirical setup of this paper provides a foundation for comparing tax efforts dynamic before and after GST implementation. By contextualizing changes in tax effort and revenue composition over time, it contributes to deeper understanding of how major tax reforms influence sub-national fiscal performance and revenue sustainability, offering insights of relevance to policymakers and researchers engage in state-level fiscal reforms.

Keywords: *Tax Effort, GST Implementation, Own Tax Revenue, GSDP, Uttar Pradesh*

Introduction:

The ability of state governments to generate enough revenue from their own sources is central to the functioning of federal fiscal system of India. With the increase in roles of states in such sectors as infrastructure creation, social services, education and medical care, states experience increasing pressure to improve their sources of income. Tax effort in this context has emerged as a major fiscal performance measure, which shows the efficiency with which a state can collect tax revenue based on the size of its economy. The tax effort expressed as the ratio of the own tax revenue to the Gross State Domestic Product (GSDP), tax effort not only reflects the level of the activity of the economy but also shows the effectiveness of the tax administration, the size of the tax base, and the compliance rates in the economy. Goods and Services Tax (GST) introduced on 1st July 2017, the system of the indirect taxation of India was removed by the launch of the Goods and Services Tax (GST). GST replaced an unwieldy, disjointed system of numerous indirect taxes at the central and state levels with a unified system aimed at streamlining the taxation process and improving its transparency. The motive of the reform was to reduce the cascading effects, enhance the smooth flow of goods and services, and encourage voluntary compliance by introducing a single input tax credit system.

From the perspective of state governments, GST was a significant transformation of the revenue structure, with State GST (SGST) an essential component of State Own Tax Revenue, replacing taxes such as Value Added Tax (VAT), entry tax, and purchase tax. The impact of GST on state finances is not limited to changes in the tax system. Even though the reform was supposed to increase the efficiency and raise the revenue generation with time, the transition process faced many challenges. The first difficulties in the implementation, the changes in the compliance standards, and reliance on the central government compensation affected revenue streams in different states. In addition, these problems were compounded by external shocks after the implementation of the GST like the economic crisis caused by the COVID-19 pandemic. The impacts of GST on the performance of state revenues should be assessed with a careful and contextual approach. Uttar Pradesh is the most important example of one to examine these issues. A state in India that is the most populated, and among the largest contributors to the national economy, Uttar Pradesh has a significant economic potential. Nevertheless, the level of tax effort of the state has been relatively low in context of its GSDP. There has often been a large informal sector, uneven and patchy

industrialization, and the difficulty of reorganizing economic activity into tax revenues. Prior to the introduction of GST, the state was largely reliant on revenue of taxes like VAT, state excise duties and stamp and registration fees to raise its own taxes. After implementation of GST, SGST has emerged out to be the biggest source of the own tax revenue of the state.

Based on this situation, the present study examines the impacts of GST implementation on tax efforts in Uttar Pradesh from the year 2010 and 2024. It also includes both years of the pre-reform and post-reform periods, which helps to compare the revenue results regarding the reform. The evaluation of tax effort, it is the proportion between the State Own Tax Revenue and the GSDP, and an index is built with the year 2016-17 as the reference point. Using this methodology enables one to comparatively examine the changes in tax effort across time and enables one to establish whether GST has resulted in a structural improvement of the mobilization of revenues. The study aims to make a contribution toward the general debate on tax reforms and fiscal federalism in India by targeting a long time horizon and a state that has high economic weight. The results will provide information on the ability of GST to enhance the revenue potential of Uttar Pradesh

Review Literature:

Tax effort is a widely used concept in the literature in the field of public finance to determine how well governments can mobilize tax revenue in comparison with their economic ability. According to **Keen and Lockwood (2010)**, tax effort refers to the ratio of the actual to the potential tax collection and that simplification of tax systems is essential in enhancing compliance as well as minimizing evasion. Their work forms the background of the analysis of large-scale indirect taxation reforms like the Goods and Services Tax (GST), majorly in the federal economies where sub-national governments rely on consumption-based taxes. This framework is particularly applicable in the Indian context due to the fact that states in the past had been dependent on fragmented indirect taxes and this hobbled effective tax mobilization. **Rao and Chakraborty (2017)** critically analyze the pre-GST indirect taxation system in India and note how the cascading taxes, a multi-rate system, and inter-state trade barriers undermined the tax effort of the states under the VAT system. They cite that GST was supposed to deal with these inefficiencies by establishing one market, enhancing tax compliance, and increasing the tax base. They also warn that the real implication to tax effort would vary across states given the administrative capacity, economic structure and size of informal sector. These are some of the structural considerations that are of great significance to the post-GST revenue performance in a large and economically diverse state such as Uttar Pradesh.

Further, **Mukherjee (2019)** studies the trend in the early post-GST and observes that GST led to transparency and reporting by digital invoicing and submission of returns, it also created short-term revenue uncertainty among the states. The analysis notes that the initial effect of compliance costs and technological issues on revenue growth was observed in the states where the administrative preparedness was low. Mukherjee also states that the states that have heavy consumers like Uttar Pradesh must have been better off in the medium run due to the broadening of the base and the enhancement of better tax collection once the transitional problems have settled. **Lahiri and Mukherjee (2020)** in a working paper of the National Institute of Public Finance and Policy (NIPFP) make a substantial contribution to the body of empirical estimation of the GST and tax effort. His work is based on the panel data concerning the Indian states, they discuss how tax capacity and tax effort vary following the implementation of GST. According to their findings, GST changed the balance structure of state taxation and initially limited the fiscal autonomy of states, and with time, there was a positive impact of compliance and reporting mechanisms to tax effort especially in states where informal economies were large.

Uttar Pradesh, which was highly informal before GST, has now become a state where GST could have made a difference in enhancing tax effort through registration of hitherto unregistered firms in the tax bracket. Research by Aggarwal and Chaudhary (2021) investigates the GST revenue performance in major states in India, and the results reveal that Uttar Pradesh enjoyed a consistent growth in the State GST (SGST) collections subsequent to the adjustment period. They also trace this growth on the increase in the number of registered taxpayer, enhanced digital monitoring and focused enforcement measures that the state tax administration has undertaken. In their analysis, they claim that GST helped to enhance the tax effort in Uttar Pradesh, they also observe that revenue growth was uneven between sectors and districts.

Singh and Verma (2021) examine the buoyancy of tax and revenue responsiveness before and after GST, focusing on North Indian states. According to their findings, GST enhanced tax buoyancy by decreasing tax evasion by invoice matching and sharing of real-time data. The elasticity of tax revenue in relation to the Gross State Domestic Product (GSDP) in Uttar Pradesh was improving as compared to the VAT period, which shows a positive change in tax effort. The author also noted that the advantages of GST were more significant in large firms whereas smaller enterprises still had a problem with compliance. **Sharma (2022)** offers an analysis of Uttar Pradesh based on its state and studies the trends in the

GST registrations and collections. The research concludes that GST has impacted positively to boost the number of registered taxpayers in the state and this is as a consequence of tax base expansion. He also noted that a very large percentage of GST revenues in Uttar Pradesh is collected by the relatively few large dealers. This level indicates that although GST has led to formalization, it has not affected broad-based tax effort, as small-sized firms make a minor contribution to total collections further **Kumar and Mishra (2022)** design a firm-level analysis of the presence of GST in Uttar Pradesh and present a mixed results. Whereas medium and large companies indicated the process of simplifying taxation and increasing transparency, small businesses suffered greater compliance expenses and technological challenges. According to him limitations might constrain the degree of GST supplementing tax effort due to compliance fatigue among small firms that might influence accurate reporting and continued involvement in the tax regime.

Administrative evidence on the performance of GST in the state is available using official reports published by the Government of Uttar Pradesh (2023). Budget reports and reports of the GST department reveal that SGST collections are steadily upsurged during the post-pandemic time, which is an indication of enhanced effort towards taxation. As well as these reports also identify challenges of input tax credit fraud, false registrations, and volatile revenues to the deterioration of net revenue mobilization. These problems underscore the significance of capacity of enforcement and institutional performance to conversion of GST reforms to sustained gains in tax efforts. **Pandey (2024)** studies the compliance behaviour with the GST in Uttar Pradesh and concludes that the growing use of electronic surveillance and data analytics has reinforced voluntary compliance. The research concludes that GST has led to a positive contribution to tax effort by lessening discretionary enforcement and enhancing transparency. Author also highlights that GST benefits are disproportionate regionally and sector-wise, based on disparity in economic activity, digital literacy, and administrative coverage. On the whole, it is possible to state that the literature indicates that GST implementation has positively affected tax effort on the whole in Uttar Pradesh because it has increased the tax base and enhanced compliance also enhanced transparency. The level of improvement is limited by structural forces that include the predominance of the informal sector, revenue concentration among big companies, and administration problems. The available research is mostly based on descriptive analysis or small post-GST periods, meaning that there is a vacuum to conduct rigorous econometric studies in comparing the pre- and post-GST tax effort based on long run data on GSDP, sectoral output, and compliance indicators.

Objective:-

- Impact of GST implementation on tax effort in Uttar Pradesh.
- To compare tax effort in pre-GST and post-GST Periods.

Research Methodology:-

The study relies exclusively on secondary data obtained from official government sources. The data is borrowed by the Handbook of Statistics on Indian States which is published by the Reserve Bank of India (RBI) and the Accounts at a Glance which is published by the Government of Uttar Pradesh. Using the current price GSDP ensures consistency of the new taxes revenues with the current price GSDP. The taxes collected by the state include SGST and state excise duties and the stamping and registration costs among other minor taxes that the state collects itself. In order to assess the impacts of GST, the analysis period is divided into two phases, pre-GST phase (2010-11 to 2016-17) and post-GST phase (2017-18 to 2023-24). The reference year is the financial year 2016-17 as it is the previous year before the introduction of GST. Tax effort is measured as the ratio of State Own Tax Revenue to Gross State Domestic Product, capturing the extent to which the state mobilizes tax revenue from its economic base. The tax effort for each year is calculated using the following formula:

Tax Effort = State Own Tax Revenue/GSDP

To enable relative comparison over time, a Tax Effort Index is constructed by taking 2016–17 as the base year and assigning it an index value of 100. The index for other years is computed as:

$\text{Tax Effort Index}_t = (\text{Tax Effort}_t / \text{Tax Effort}_{2016\text{-}17})*100$

This approach allows for a clear comparison of tax effort pre and post the introduction of GST and helps identify changes in revenue mobilization relative to the pre-GST baseline.

Empirical Results: Tax Effort and Tax Effort Index in Uttar Pradesh :

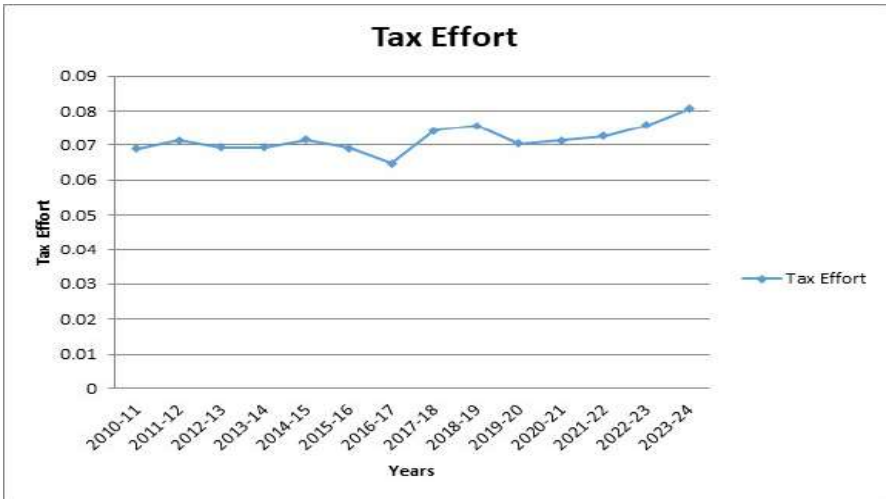
***a)* Year-wise Trend in Tax Effort**

The year-wise pattern of tax effort in Uttar Pradesh shows gradual changes rather than sudden movements over the study period. In the initial years, tax effort remained largely stable, indicating that growth in state own tax revenue broadly kept pace with the expansion of Gross State Domestic Product. Between 2010–11 and 2012–13, tax effort increased marginally, followed by minor fluctuations in the subsequent years. Although small improvements are visible in certain years, such as 2014–15, these revenue gains were not sustained for long. Overall, the pre-GST

period does not exhibit a strong upward trend, suggesting limited enhancement in the state's capacity to mobilize tax revenue relative to its economic base.

Year	Tax Effort
2010-11	0.0688
2011-12	0.0713
2012-13	0.0693
2013-14	0.0692
2014-15	0.0715
2015-16	0.0691
2016-17	0.0646
2017-18	0.0742
2018-19	0.0757
2019-20	0.0703
2020-21	0.0712
2021-22	0.0726
2022-23	0.0758
2023-24	0.0806
Source:- Author's Calculation	

A noticeable change in the pattern emerges after the introduction of GST. From 2017–18 onwards, tax effort shows a clear improvement, rising above the pre-GST average. The increase in tax effort during this period reflects better tax compliance and a broader tax base under the GST regime. While a temporary decline is observed during 2019–20 and 2020–21 was because of economic slowdown and the impact of the COVID-19 pandemic, the recovery in later years is steady and pronounced. By 2023–24, tax effort reaches its highest level in the entire study period, indicating a strengthening of the state's revenue mobilization capacity in the post-GST phase.



Source:- Author's Calculation

***b)* Year-wise Movement of Tax Effort Index**

The tax effort index, constructed by taking 2016–17 as the base year, provides a clearer picture of relative changes in tax effort over time. Before the introduction of GST, the index values were not growing swiftly, but were standing just above the line. This very low difference shows that the progress made in tax activity before GST was only minor and slows with no substantial structural transformation of the performance of revenues. On another side, there is a significant increase in the tax effort index after the introduction of GST. In 2017-18 the index significantly increased, and its improvement occurred in 2018-19, which indicates a significant change in the trend. The short run decline recorded in 2019-20 and 2020-21 is because of poor economic performance of the years, and not the decline in the quality of the tax system itself.Notably, the index bounces back with a gust in subsequent years whereby it is expected to reach its highest value in the year 2023-24. This ever-growing increment in the tax effort index following implementation of GST shows that GST has been very useful in enhancing efficiency of tax collection in Uttar Pradesh, over the years.

Year	Tax Effort Index
2010-11	106.57
2011-12	110.42
2012-13	107.25
2013-14	107.13
2014-15	110.65
2015-16	107.03
2016-17	100
2017-18	114.84
2018-19	117.15
2019-20	108.87
2020-21	110.20
2021-22	112.41
2022-23	117.30
2023-24	124.71
Source:- Author's Calculation	

Conclusions:

This study examined the impact of the Goods and Services Tax on the tax effort of Uttar Pradesh over the period 2010–11 to 2023–24 by analyzing the ratio of state own tax revenue to Gross State Domestic Product and constructing a tax effort index. The results indicate that the implementation of GST has resulted in a significant change in both tax mobilization ability of the state in the short run especially in medium term.

The tax effort of Uttar Pradesh in the pre-GST period was quite stable, with slight changes being experienced throughout the years. Even though the increase in own tax revenue was actually increasing, it was growing in the same direction as the state economy, and thus it was not making a significant improvement in terms of tax effort. This shows that the old system of pre-GST taxation that was typified by various indirect taxes and various administrative divisions failed to bring a lasting improvement in the efficiency of revenue mobilization.

It is evident that this pattern is changing in the post-GST period. The tax effort is above the pre-GST level and possesses an overall increasing trend, even though there were some disruptions that occurred over the years, owing to the economic slowdown and the COVID-19 pandemic. Its gradual recovery and later improvement in the progress of tax effort during the later years can be taken to indicate that GST has enhanced the connection between the economic activity and tax collection in Uttar Pradesh. The improvement in tax effort index to the high point in 2023-24 is the result of better compliance, widening of tax base, and better administration of taxes in the GST regime.

All in all, it is evident that GST has helped in improving tax effort in Uttar Pradesh, but the returns have not come fast but it has come gradually. These findings emphasise the role of long-term administrative reforms and policy grants in achieving full potential of the GST regime on the state level in terms of revenue.

Policy Implications:

First, the sustained improvement in tax effort and the upward movement of the tax effort index in the post-GST period imply that structural reforms in indirect taxation can strengthen the revenue capacity of states when supported by a unified tax framework. Uttar Pradesh indicates that the GST has helped to and enhanced the connection between the economic activity and the collection of taxes. This suggests that more improvements through the GST system as opposite to going back to the multi-indirect taxes would produce improved fiscal results in large, heterogeneous state economies.

Second, the annual changes in tax effort, despite the introduction of GST, mean that the performance on tax revenue is not entirely depend on the design of the tax design but also on the efficiency of the administration, and economic circumstances. The temporary declines recorded in some years underline how revenue systems are resilient particularly when the economy is under pressure. This means that institutional capacity and enhancing flexibility in the GST administration is important in ensuring predictable and stable revenue mobilization at the state level.

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10

Temple Economies in India: Scientific Foundations, Institutional Logic and Their Role in Economic Development

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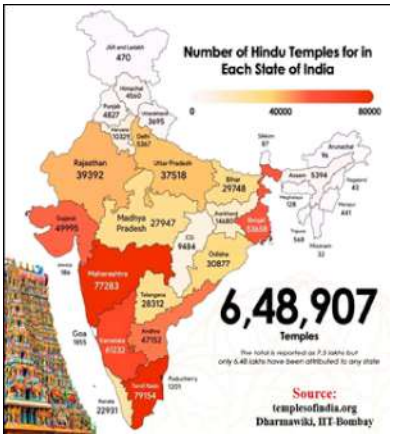
Abstract: *Temples in India are conventionally perceived as religious institutions; however, their economic significance extends far beyond spiritual functions. This paper reconceptualizes temples as dynamic economic systems embedded within cultural and spatial frameworks, contributing to sustained regional development and broader macroeconomic processes. Drawing upon interdisciplinary literature, the study examines the underlying rationale behind temple construction, emphasizing their role as centres of aggregation, redistribution and economic stabilization in historically uncertain and agrarian contexts. The paper further explores the scientific foundations of temple architecture and spatial planning, highlighting how principles rooted in traditional knowledge systems such as site selection, structural design and environmental integration align with modern concepts of efficiency, sustainability and behavioural economics. These features not only enhance the durability and experiential value of temples but also ensure continuous flows of human activity, thereby reinforcing their economic viability. In addition, the study analyses the contribution of temple economies to employment generation, tourism expansion and regional infrastructure development. By creating both formal and informal livelihood opportunities and generating multiplier effects through pilgrimage-driven consumption, temples play a significant yet under-recognized role in economic growth. Although their contribution remains partially obscured within conventional GDP measurement frameworks, it is implicitly reflected in sectors such as tourism, trade and services. The paper argues that temples function as decentralized economic institutions that combine cultural continuity with economic resilience, offering valuable insights into alternative models of inclusive and sustainable development.*

Introduction

The culture of India is a fusion of number of different civilizations that originated in and around the Indian subcontinent. With a total area of more than 32,87,263 km^2, India is a strategically significant region in Asian continent. Religion has always played a significant role in Indian culture. Four of the major world religions originated basically from the Indian subcontinent, known as native Indian religions or *Dharmic* religions and comprising approximately 83% of India's population i.e. Sikhism, Buddhism, Jainism and Hinduism (Doniger, W., 2009). As per 2011 census, the total population of 121.09 crores includes 96.63 crores (79.8%) Hindu, 17.22 crores (14.2%) Muslim, 2.78 crores (2.3%) Christian, 2.8 crores (1.7%) Sikhism, 0.84 crores (0.7%) Buddhism 0.45 crores (0.4%) Jainism and 0.37 (0.9%) others religions (PIB, 2015). Indian Constitution declares the freedom of religion to be a fundamental right and references India as a secular state in the Preamble (GoI, 1950). India, its religion and their religious places always reflects its rich cultural and spiritual heritage. India is called the land for temples. India is home for millions of temples but according to *Dharmawiki* (2022), a total of 6,48,907 temples were being attributed in the year 2022. In which maximum temples are in Tamil Nadu (79,154) followed by Maharashtra (77,283) and Karnataka (61,232). Temples draw adherents from all over the world because they are considered to be places of great faith and miracles. Every State in the economy possesses unique customs and a rich past, accompanied by an extensive number of temples that functions as the hubs of the societal cultural centers for the peoples in the county.



Temples in India are not only religious structures and are also economic centres of the country. They shape local markets, generate employment and influence regional development. Historically, temples acted as hubs of social life, education and redistribution. Even today, they remain embedded in the economic fabric of society. The idea of a "temple economy" refers to the system of economic activities generated directly and indirectly by temples. This includes donations, tourism, employment, crafts and services. Famous temples such as *Tirupati, Vaishno Devi, Shirdi* and many more attract millions of devotees every year. Their operations resemble complex institutional systems. They manage large funds, employ thousands

and stimulate local economies. At the same time, temples are often discussed only in cultural or religious terms. Their scientific and economic dimensions remain underexplored. There is also limited academic work connecting temple construction with rational planning, spatial economics and long-term development. This paper examines three key aspects. First, why temples are constructed from an economic and social perspective. Second, how temples hold scientific and spatial relevance. Third, their contribution to GDP and economic development. The paper argues that temples function as decentralized economic institutions that sustain livelihoods, promote regional growth and influence macroeconomic indicators.

Review of Literature:

The relationship between religion and economic systems has been studied across disciplines. Max Weber's work highlighted how belief systems influence economic behaviour (Weber, 1930). While his focus was on Protestant ethics, the broader idea applies to institutional religion in India. In the Indian context, Babb (1975) explored how temples function as redistributive institutions. He showed that temple donations often circulate within local economies. Similarly, Fuller (2004) examined the social organization of Hindu temples and their embeddedness in everyday economic life. Rao (2011) studied Tirupati temple and highlighted its role as a major economic hub. The temple generates large-scale employment and supports ancillary industries such as transport, hospitality and retail. This aligns with the concept of pilgrimage economies discussed by Singh (2009), where religious tourism drives regional growth. From a development perspective, the Ministry of Tourism (GoI, 2020) has identified pilgrimage tourism as a major contributor to domestic travel. Religious tourism accounts for a large share of total tourist visits in India. This directly impacts income generation and infrastructure development. On the scientific aspect, *Vastu Shastra* and temple architecture have been studied for their alignment with environmental and spatial planning principles (Acharya, 1997). Temples were often constructed using precise geometric and astronomical calculations. These principles ensured sustainability, thermal comfort and spatial harmony. However, there is still a gap in integrating these strands. Most studies treat temples either as religious institutions or tourism centres. Few works connect their construction logic with economic outcomes and macroeconomic contributions. This paper attempts to bridge that gap.

Scientific Foundations of Temple Design and their Economic Implications

The architectural and spatial logic underlying temple construction reveals a sophisticated integration of scientific principles with economic functionality. Far from being arbitrary or purely symbolic, the design and placement of temples reflect an acute awareness of geography, material science, environmental sustainability and

human behaviour. One of the most striking aspects of temple construction is the deliberate selection of location. Traditional architectural treatises such as the *Manasara* and broader principles of *Vastu Shastra* emphasize the importance of site characteristics, including topography, water availability and orientation (Acharya, 1997). While these guidelines are often interpreted in metaphysical terms, their practical implications are evident. Temples are frequently situated along riverbanks, trade routes or naturally accessible terrains, thereby ensuring a steady flow of visitors. From an economic standpoint, such positioning maximizes accessibility and enhances the potential for market development in surrounding areas.

Hindu Temple architecture always remains the hot topic among engineers and architects all around the globe. Even in the ancient times *Hindu* temples were built with a lot of *vedic* science which nowadays called as modern science (Acharya, 1997). According to recent studies, the magnetic and electric waves are constantly being produced by the earth. Thus, while designing the temples, the engineers and architects search for locations where these waves are abundant. The main idol of gods are kept in the center shrine, also known as *Garbhagriha*. *Pran Pratistha* is the ceremony used to sanctify the idol when the temple is constructed. The idols are situated in an area where magnetic wave are much actively very strong. Some copper plates with *Vedic* texts are concealed beneath the idol due to which the magnetic waves are emitted from the earth and absorbed by the copper plates. If someone visit's the temple routinely and round the idol in a clockwise manner, then the person's body will therefore absorb these magnetic waves and increases the positivity in the person which will result in increasing the concentration level along with better health.

Apart from *Pran Pratistha*, there is one more scientific reason of temples which is behind ringing the bells at temple. Almost all Hindu temple have bells at the entrance of the temple gate and also near to the idol of god which is to be rung before or while entering into the temple. The scientific reason is provided as the bell rings it makes a unique sound as it is the mixture of various metals like copper, zinc, nickel, manganese etc. the sound of bells bridges the left and right hemispheres of the brain (left and right). Further, in echo mode, the sharp sound and vibration remain for seven seconds in the mind which is long enough to reach to the seven healing points of the body. However, with this sound, the mind becomes empty from all thoughts and it works as cleansing process which helps a person to increase its ability to widen its thoughts, enhance its concentration, mental balance.

The structural design of temples also reflects long-term economic rationality. Built using durable materials such as stone and employing advanced engineering techniques, many temples have withstood centuries with minimal structural

degradation. This longevity significantly reduces lifecycle costs, making temples economically efficient as enduring public infrastructures. Furthermore, the construction process itself historically generated extensive employment, engaging skilled artisans, sculptors and labourers and thereby fostering specialized craft traditions that contributed to regional economies. Beyond physical durability, temples are designed to shape human experience in subtle yet impactful ways. The interplay of acoustics, spatial movement and visual alignment within temple complexes creates an immersive environment that influences psychological states. The resonance of chants, the rhythmic sound of bells and the progression through *mandapas* (halls) towards the sanctum are not merely ritualistic elements, they enhance the perceived value of the experience. In contemporary economic terms, this can be understood as an early form of experience optimization, which encourages repeat visitation and strengthens the economic viability of temple sites. Environmental considerations further underscore the scientific basis of temple design. Many traditional temple complexes incorporate water tanks, gardens and open courtyards that contribute to microclimatic regulation and groundwater recharge. Such features not only support ecological balance but also enhance the livability of surrounding areas, thereby attracting sustained human settlement. This integration of environmental sustainability with built infrastructure aligns closely with modern principles of sustainable development. In essence, the scientific design of temples extends beyond structural aesthetics; it constitutes a comprehensive framework that enhances economic efficiency, environmental resilience and human engagement.

Rethinking Temple Construction: Economic Intent, Social Design and Institutional Logic

The construction of temples in India cannot be adequately understood if viewed solely through a religious lens. Rather, temples emerge as carefully embedded institutions within the socio-economic landscape, reflecting a convergence of spiritual intent, political strategy and economic foresight. Their establishment historically coincided with the need to create stable centres of aggregation in otherwise fragmented and uncertain economic environments. In pre-industrial settings, where agricultural cycle dictated livelihoods and market exchanges were irregular, temples provided continuity. By attracting periodic yet predictable gatherings of people through rituals, festivals and pilgrimage cycles, temples effectively generated sustained demand within local economies. This recurring congregation was not incidental, it functioned as an informal yet highly effective mechanism for market consolidation. Economic intermediaries like traders, artisans, service providers could rely on these cycles to organize production and exchange,

thereby reducing uncertainty and transaction risks. Moreover, temple construction facilitated structured redistribution of wealth. Contributions made in the form of donations or offerings did not remain dormant within institutional confines. Instead, they were actively circulated through various channels such as food distribution, maintenance of temple complexes, patronage of arts and crafts and support for dependent occupational groups. As Babb (1975) observes, such redistributive mechanisms allowed temples to function as localized welfare systems, particularly in contexts where formal state intervention was limited or uneven.

The political dimension of temple construction further reinforces its economic significance. Rulers and regional authorities often invested in monumental temple architecture not only as an expression of devotion but also as a deliberate strategy to assert legitimacy, stabilize territories and stimulate economic activity. The emergence of temple-centred urban formations in regions such as Tamil Nadu illustrates this dynamic vividly. Cities like *Madurai* and *Thanjavur* evolved around temple complexes that acted as nuclei of economic and administrative activity, thereby shaping patterns of settlement, trade and mobility. Equally important is the role of temples in generating what may be termed as "cultural demand." Unlike conventional markets that are susceptible to fluctuations in income and preferences, temple-based demand is sustained through deeply internalized belief systems and ritual obligations. This imbues temple economies with a degree of resilience that is rarely observed in other sectors. Even in periods of economic slowdown, pilgrimage flows tend to persist, thereby maintaining a baseline level of economic activity. Taken together, temple construction can be interpreted as a form of long-term institutional investment, one that simultaneously addresses spiritual aspirations, social cohesion and economic sustainability.

Temple Economies and Their Contribution to Economic Development and GDP

The economic significance of temples becomes most visible when examined through their direct and indirect contributions to development processes. While their impact is often diffused across multiple sectors, a closer analysis reveals that temples function as dynamic economic systems with far-reaching implications. At the most immediate level, temples generate substantial direct economic output. Revenues derived from donations, offerings and institutional activities are systematically utilized for operational expenditures, infrastructure development and social services. Temple institutions such as the *Tirumala Tirupati Devasthanams* manage financial resources on a scale comparable to major corporate entities, thereby underscoring their economic weight (Rao, 2011). These expenditures translate into income for employees, contractors and service providers, creating a continuous cycle of economic activity.

Employment generation constitutes another critical dimension of temple economies. Unlike capital-intensive industries that concentrate income within a limited segment of the workforce, temple economies are inherently labour-intensive and inclusive. They provide livelihoods across a wide spectrum of occupations, ranging from formal roles such as administration and security to informal activities including vending, transportation and artisanal production. As Singh (2009) notes, pilgrimage centres often serve as important employment hubs, particularly in regions where alternative opportunities are scarce. The broader developmental impact of temples is further amplified through multiplier effects. Expenditure by pilgrims on travel, accommodation, food and local goods generates income that circulates within the regional economy, stimulating additional rounds of spending. This process leads to the expansion of markets, the emergence of new enterprises and the strengthening of local supply chains. Government data indicates that religious tourism constitutes a significant share of domestic travel in India, thereby reinforcing its role as a key driver of economic activity (Ministry of Tourism, 2020). Infrastructural development often follows the growth of temple economies. To accommodate increasing numbers of visitors, investments are made in roads, rail connectivity, sanitation and public services. These improvements, while initially intended to support pilgrimage, yield long-term benefits for local populations and facilitate broader economic integration. Regions such as *Tirupati, Shirdi* and *Vaishno Devi* exemplify how temple-centred growth can transform local economies into vibrant urban systems.

Despite these visible contributions, the role of temples in GDP remains underrepresented in formal economic statistics. A significant portion of temple-related activity occurs within the informal sector, making it difficult to capture through conventional measurement frameworks. Nevertheless, its impact is implicitly reflected in sectors such as tourism, retail and services. According to the World Travel and Tourism Council (WTTC, 2019), tourism contributes a notable share to India's GDP, with religious travel forming a substantial component of this sector. Therefore, the economic contribution of temples must be understood not as a discrete category but as an embedded force that permeates multiple layers of the economy. Their ability to generate sustained demand, support inclusive employment and catalyze regional development positions them as critical, though often overlooked, drivers of economic growth.

Conclusion:

Temples in India represent a unique synthesis of spirituality, science and economic organization. Their construction reflects deliberate choices that extend beyond religious expression to encompass spatial planning, resource management and institutional stability. By functioning as centres of aggregation, redistribution

and cultural continuity, temples have historically sustained economic systems in ways that remain relevant even in contemporary contexts. What distinguishes temple economies is their resilience and inclusivity. Rooted in enduring belief systems and supported by carefully designed infrastructures, they generate stable flows of economic activity that are less susceptible to external shocks. At the same time, they provide livelihoods across diverse social groups, thereby contributing to more equitable patterns of development. In recognizing temples as economic institutions, it becomes possible to broaden the analytical framework of development beyond conventional industrial and market-based models. Temple economies illustrate how culturally embedded systems can produce sustained economic value while maintaining social cohesion and environmental balance. Future research would benefit from developing more precise methodologies to quantify their contribution to GDP and to explore their integration within formal policy frameworks. Such efforts would not only deepen our understanding of temple economies but also offer valuable insights into alternative pathways of sustainable and inclusive development.

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11

Digital Transformation and Higher Education in India: Opportunities, Inequities, and the Road Ahead

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Abstract*: The rapid digital transformation of higher education in India, accelerated by the COVID-19 pandemic and the National Education Policy (NEP) 2020, has fundamentally altered how teaching and learning are organised at the tertiary level. This paper critically examines the trajectory of digital adoption in Indian higher education institutions, drawing on verified secondary data from the All India Survey on Higher Education (AISHE 2021–22), the Ministry of Education, SWAYAM platform statistics, and telecom regulatory data. Total student enrolment in higher education crossed 4.33 crore in 2021–22, while the SWAYAM platform accumulated over 56 million enrollments by 2024; yet, course completion rates remain alarmingly low at approximately 10–15%. These contrasting figures illustrate both the promise and the structural limits of digital education in a country still wrestling with a sharp rural–urban digital divide. While platforms such as SWAYAM, the National Digital Library, and DIKSHA have considerably democratised access, persistent inequities in connectivity, device ownership, faculty preparedness, and digital literacy continue to constrain equitable learning outcomes. The paper argues for a calibrated, evidence-based policy response, one that institutionalises blended learning, strengthens faculty capacity, and ensures that digital expansion does not inadvertently deepen existing socio-economic fault lines.*

Keywords: *Digital Higher Education, NEP 2020, SWAYAM, Digital Divide, Blended Learning, Learning Outcomes, India*

1. Introduction

Higher education has long been recognised as the backbone of human capital formation, economic productivity, and social mobility in India. With a population exceeding 1.4 billion and a demographic structure in which over 65% of citizens

are under 35, the demand on tertiary institutions is formidable and growing. Historically, the Indian higher education system was structured around face-to-face instruction, fixed curriculum, and rigid institutional hierarchies. While this model served generations of learners, it was ill-equipped to serve the scale, diversity, and dynamism that a twenty-first-century knowledge economy demands.

Two events have fundamentally reshaped this landscape. First, the COVID-19 pandemic forced a sudden, near-total migration to online modes of instruction. According to reports from the All India Council for Technical Education and the Ministry of Education, more than 80% of higher education institutions adopted some form of online or blended learning during 2020–21 (Ministry of Education, 2021). The transition exposed both the latent capacity of Indian institutions to adapt and the deep structural inequalities, particularly in internet access and device ownership, that made digital education profoundly uneven across geographies and socio-economic groups.

Second, the National Education Policy 2020 placed technology-enabled learning at the centre of India's educational reform agenda. By establishing the National Educational Technology Forum (NETF), promoting online and distance education, and integrating digital platforms such as SWAYAM into universities' credit frameworks, NEP 2020 gave digital transformation an institutional mandate rather than treating it as an emergency response. The Gross Enrolment Ratio (GER) in higher education rose to 28.4 in 2021–22, up from 23.7 in 2014–15, reflecting a decade of steady growth that digital tools have helped, but not single-handedly delivered (AISHE, 2021–22).

Against this backdrop, this paper asks a deceptively simple question: has digital transformation improved learning outcomes in Indian higher education, and for whom? The answer requires looking beyond enrollment statistics to assess the quality of digital engagement, the structural conditions that enable or constrain it, and the policy levers available to make digital higher education genuinely inclusive.

2. Objectives of the Study

This study pursues four interconnected objectives:

(i) To trace the pattern of digital adoption in Indian higher education institutions between 2015 and 2024, using verified secondary data.

(ii) To evaluate the impact of platforms such as SWAYAM and the National Digital Library on enrolment, access, and course completion.

(iii) To map the dimensions of the digital divide, geographic, gender-based, and socio-economic, that continue to mediate the effectiveness of digital education.

(iv) To derive evidence-based policy recommendations aligned with the vision of NEP 2020 and the UGC's online education framework.

The methodology is analytical and secondary in nature, drawing on data from AISHE reports, TRAI Telecom Subscription Reports, Ministry of Education publications, and peer-reviewed academic literature.

3. Enrolment Trends in Indian Higher Education

Before examining digital transformation specifically, it is important to situate it within broader enrolment trends. Table 1 below, compiled from AISHE data published by the Ministry of Education, illustrates how higher education participation has expanded significantly over the past decade.

Table 1: Gross Enrolment in Indian Higher Education (2014–15 to 2021–22)

Year	Total Enrollment (Crore)	Female Enrollment (Crore)	GER (18–23 yrs)
2014–15	3.42	1.57	23.7
2017–18	3.66	1.72	25.8
2019–20	3.85	1.88	27.1
2020–21	4.14	2.01	27.3
2021–22	4.33	2.07	28.4
Source: AISHE Reports, Ministry of Education, Government of India (2014–2024)			

Several observations emerge from this data. Total enrolment grew by approximately 26.6% between 2014–15 and 2021–22, rising from 3.42 crore to 4.33 crore (AISHE, 2021–22). Female enrolment grew faster than overall enrolment by 32% over the same period, resulting in a Gender Parity Index of 1.01 at the national level, a genuinely significant equity achievement. The GER for the 18–23 age group improved from 23.7 to 28.4 over seven years, though it remains considerably below the NEP 2020 target of 50% by 2035 (Ministry of Education, 2020).

These macro trends have been accompanied by a sharp increase in digital platform usage. The SWAYAM platform, launched in 2017, recorded 72.1 lakh (7.21 million) enrolments in 2023 alone, up from 31.4 lakh in its inaugural year. Cumulatively, the platform had crossed 56 million enrollments by 2024 (Class Central, 2024; Ministry of Education, 2024). However, it is critical to note that these enrollment figures do not reflect completion. Estimates from government and academic sources consistently place SWAYAM's course completion rates at only 10–15%, raising fundamental questions about engagement, motivation, and instructional design in the online environment (Singh & Kakkar, 2023).

4. SWAYAM and the Digital Learning Ecosystem

The SWAYAM platform occupies a central position in India's digital higher education infrastructure. Developed under the Ministry of Education with courses designed by faculty from the IITs, IIScs, IIMs, IGNOU, NCERT, and other premier institutions, it offers over 3,000 unique courses spanning undergraduate, postgraduate, professional, and school education levels (Ministry of Education, 2024). A critical policy innovation since 2021 is that students can now earn up to 40% of their degree credits through SWAYAM, a provision recognised by more than 305 universities across India (UGC, 2021).

Table 2 charts the growth of the SWAYAM platform from its launch to 2023, based on official Ministry of Education data presented before the University of Kashmir in May 2024.

Table 2: SWAYAM Platform – Year-wise Growth in Courses and Enrolments (2017–2023)

Year	No. of Courses	Enrollments (Lakhs)	Cumulative Growth (%)
2017	323	31.4	—
2018	856	36.7	+16.9
2019	1,160	46.0	+25.3
2020	1,319	55.8	+21.3
2021	1,770	49.9	–10.6
2022	2,065	55.5	+11.2
2023	2,301	72.1	+29.9
Source: Ministry of Education, Government of India / University of Kashmir Presentation, May 2024			

The pattern is striking. Enrolments grew by over 129% between 2017 and 2023, and course offerings expanded nearly sevenfold. Yet the dip in enrolments in 2021, despite an increase in course numbers, suggests that the initial pandemic surge did not translate into sustained engagement. The subsequent recovery in 2022–23 is encouraging, but the persistently low completion rates indicate that access and engagement are not the same thing. SWAYAM Plus, launched in February 2024, represents an attempt to address this gap by linking online learning to employment outcomes through partnerships with industry (Class Central, 2026).

5. The Digital Divide: Mapping Inequality in Digital Access

The most structurally entrenched obstacle to equitable digital education in India is the digital divide a multi-layered disparity that operates along the axes of geography, gender, income, and caste. At the national level, internet penetration has reached approximately 72% (TRAI, 2023–24). But this aggregate figure conceals

a profound rural–urban asymmetry: urban internet penetration stands at nearly 85%, while rural access remains around 55%, and even where rural connectivity exists, its quality, speed, and reliability are frequently inadequate for streaming video lectures or accessing interactive digital resources (Mandal, 2025; Devara, 2023).

Table 3 synthesises available indicators on the digital divide, drawing on data from TRAI, NSSO, and the Ministry of Education's UDISE+ surveys.

Table 3: Key Digital Divide Indicators – Urban vs. Rural India (2023–24)

Indicator	Urban	Rural	National Average
Internet Penetration (%)	~85%	~55%	~72%
Household Device Ownership (%)	~78%	~42%	~60%
Basic Digital Literacy (%)	~48%	~16%	~26.8%
Students with Dedicated Device (%)	~74%	~38%	~56%
Source: TRAI Telecom Subscription Reports (2023–24); NSSO 77th Round; Ministry of Education UDISE+ 2024–25)			

Digital literacy is perhaps the most underappreciated dimension of this divide. Only approximately 26.8% of Indian youth possess basic internet skills such as the ability to search for information, use email, or navigate digital platforms (NSSO, 2020). This means that even when physical access exists, large segments of the student population, particularly first-generation college students from rural and low-income backgrounds, lack the competencies to derive meaningful educational value from online resources. The intersections of the digital divide with caste, gender, and disability compound these disadvantages further.

This is not merely an infrastructural problem. It is a problem of institutional design. When digital education is deployed as a universal solution in a context of profoundly unequal access, it risks converting a technology meant to democratise learning into a mechanism that reinforces privilege.

6. NEP 2020 and the Policy Framework for Digital Higher Education

The National Education Policy 2020 represents the most comprehensive reimagining of India's education system since the Kothari Commission of 1964–66. On digital education specifically, it advances several significant commitments: the establishment of NETF as a think-tank for educational technology; expansion of online and open distance learning; promotion of blended learning models; and the development of a National Digital University to serve as a hub for quality online programmes (Ministry of Education, 2020).

NEP 2020 also introduces structural flexibility, multiple entry and exit options, an academic bank of credits, and the option for students to earn degree credits through approved online courses that are meaningfully enabled by digital infrastructure. The overall internet user base in India crossed 850 million by 2023, providing a substantial technical foundation for these ambitions (TRAI, 2023).

However, the gap between policy vision and implementation reality is considerable. A large proportion of institutions, particularly state universities and affiliated colleges in smaller cities and rural areas, lack the digital infrastructure, trained faculty, and institutional capacity to operationalise NEP's digital vision. The UGC's own data indicates that only around 57% of higher education institutions had functional computers and only 54% had internet connectivity as of recent surveys. Without addressing these baseline deficits, NEP 2020's digital ambitions will remain aspirational rather than transformative.

7. Structural Challenges in Digital Higher Education

Infrastructure Deficits: Government colleges, which serve the majority of first-generation, SC, ST, and OBC students, frequently lack reliable electricity, broadband connectivity, and functional computer laboratories. This institutional gap mirrors the broader digital divide, disproportionately disadvantaging the most vulnerable student populations.

Faculty Preparedness and Digital Pedagogy: Online and blended learning requires competencies in interactive content design, asynchronous facilitation, LMS use, and digital assessment, which many faculty, particularly those recruited before 2010, have not adequately developed. Compounding this, the UGC reported a faculty vacancy rate of 24.5% in state universities in 2020–21 (UGC, 2020), leaving institutions under-resourced even for conventional teaching, let alone digital delivery.

Quality Assurance in Online Assessment: Online Academic integrity in online assessment remains a serious concern. Proctoring tools are inconsistently deployed, and many institutions resorted to open-book, unsupervised formats during the pandemic that measured information retrieval rather than conceptual understanding. The lack of standardised online evaluation frameworks has produced inconsistent academic standards, casting doubt on the credibility of degrees awarded through predominantly digital modes.

Psychological Well-being and Learner Engagement: Prolonged screen exposure is associated with fatigue, eye strain, and diminished attention. More critically, the loss of physical learning communities, peer interaction, mentorship, and collaborative engagement generates social and emotional deficits that digital platforms cannot adequately replace. Post-pandemic research consistently records

heightened anxiety, isolation, and academic disengagement in online learning settings (UNESCO, 2021).

8. Policy Recommendations

Drawing on the evidence reviewed above, the following recommendations are proposed:

- Universal broadband access for higher education institutions should be treated as a non-negotiable infrastructure priority. The government's BharatNet initiative provides a framework; what is needed is accelerated implementation with specific targets for higher education institutions in Tier-II and Tier-III cities and rural areas.
- Faculty Development Programmes (FDPs) focused on digital pedagogy, content design, online facilitation, and blended assessment should be made mandatory for all faculty below the age of 55 and embedded in universities' promotion and performance review criteria.
- Blended learning should be institutionalised as the default model rather than treated as an emergency measure. The UGC's blended learning guidelines provide a starting framework, but institutions need targeted funding and technical support to implement them meaningfully, rather than simply offering a fraction of courses online to meet regulatory requirements.
- SWAYAM's quality and completion rate problems need urgent attention. The approximately 10–15% completion rate suggests that enrolment-based metrics are a poor proxy for learning. Course redesigns in regional languages with stronger learner support, peer learning communities, and incentive structures aligned with employment outcomes, as Swayam Plus attempts, should be rigorously evaluated and scaled.
- Mental health infrastructure in universities must be strengthened. Counselling centres, peer support networks, and structured screen-time guidelines should be embedded in institutional well-being frameworks, recognising that digital fatigue is a genuine and growing obstacle to student success.

9. Conclusion

Digital transformation in higher education in India represents a major structural change with both opportunities and challenges. While enrolment in higher education has reached 4.33 crore students and digital platforms like SWAYAM have expanded rapidly, significant inequalities in access, digital literacy, and learning outcomes continue to persist. The analysis shows that technology can increase the

reach of education, but it cannot by itself ensure quality or equity. Limited digital literacy and uneven internet access, especially in rural areas, risk widening existing educational gaps. Although the National Education Policy 2020 provides a strong framework for digital education, its success depends on effective implementation, investment in infrastructure, teacher training, and inclusive learning systems. India's higher education system can become more accessible and digitally empowered, but meaningful progress will require sustained focus on both technology and human development.

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12

Structural Deprivation and the Welfare Paradox: Understanding Poverty and Its Social Consequences in Uttar Pradesh

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Abstract: *Uttar Pradesh (UP), home to nearly 24 crore people, holds enormous promise in fertile land, a young population, and a civilisational heritage stretching back millennia. However, it remains one of India's poorest states, and that gap between potential and reality demands a serious explanation. This paper tries to provide one. Drawing on the NITI Aayog Multidimensional Poverty Index (MPI) 2023, NFHS-5 (2019–21), UNDP district-level data, and peer-reviewed research, it asks a straightforward but difficult question: why does poverty persist so stubbornly in UP, and what is actually being done about it? It traces the deep structural forces of caste, patriarchy, agrarian fragmentation, and institutional weakness that keep millions trapped, and shows how these forces shape real lives: what people eat, whether their children go to school, and whether they can see a doctor when they fall ill.*

The evidence on welfare schemes is honest rather than celebratory. Progress is real; the MPI poverty headcount fell from 37.68% in 2015–16 to 22.93% in 2019–21, a meaningful achievement by any measure. But the gains are uneven and fragile. Caste hierarchies, shrinking landholdings, gender discrimination, and weak local institutions continue to slow and sometimes reverse progress. The paper concludes by taking stock of both what has genuinely improved and what structural change still remains unfinished.

Keywords: *Multidimensional Poverty, Uttar Pradesh, Social Welfare, NFHS-5, MPI, Caste, Government Schemes, Rural Development*

Introduction

Poverty in India is not just a number on a chart; it is a daily reality that shapes life chances, limits access to resources, and locks generations into cycles of

deprivation. Nowhere is this more visible than in Uttar Pradesh (UP), India's most populous state, home to roughly 24 crore people, nearly 20% of the country's total population (Census 2011; NITI Aayog, 2023). Despite sitting on the fertile Indo-Gangetic plain, UP has long struggled with deep structural poverty that resists simple fixes.

In 2023, NITI Aayog ranked UP 25th out of 28 states in terms of multidimensional poverty. The state's MPI headcount ratio stood at 22.93% during 2019–21, down from 37.68% in 2015–16, a drop of nearly 15 percentage points in just four years (UNDP India, 2023). Progress is real, but over one-fifth of UP's population remains deprived across health, education, and basic living standards. Millions of people are still left behind.

This paper examines poverty in UP through the lens of social welfare studies, asking three core questions: What structural and social forces sustain poverty here? How does poverty affect real lives? And how effectively have government programmes broken these cycles? The analysis draws on official data and peer-reviewed research and is structured around these three dimensions.

Methodology and Data Sources

This paper uses a synthesis of secondary qualitative and quantitative data. Key sources include the NITI Aayog National MPI Progress Review 2023 (based on NFHS-4 and NFHS-5 data using the Alkire-Foster methodology); the UNDP District-Wise MPI Analysis for UP (2023); the Swaniti Initiative's socio-economic profile of UP (2024); and Tiwari et al.'s (2022) peer-reviewed study on caste, poverty, and wealth inequality in UP. Macroeconomic and policy data come from NITI Aayog reports and Ministry of Rural Development publications. No primary fieldwork was conducted; the approach is interpretive and synthetic.

The Scale and Structure of Poverty in Uttar Pradesh

Multidimensional Poverty: Trends Over Time

The shift from income-only poverty measures to the Multidimensional Poverty Index represents a conceptual maturation in how poverty is understood and measured. The MPI captures deprivations across 12 indicators under three broad dimensions: Health (nutrition, child and adolescent mortality); Education (years of schooling, school attendance); and Standard of Living (cooking fuel, sanitation, drinking water, electricity, housing, assets, bank accounts). This framework is especially relevant to Uttar Pradesh, where monetary income alone does not capture the breadth of social exclusion experienced by millions. Table 1 below shows the trajectory of multidimensional poverty in UP across three NFHS survey periods.

Table 1: Multidimensional Poverty Trends in Uttar Pradesh (NFHS-3 to NFHS-5)

Survey Period	MPI Headcount (%)	MPI Value	Intensity of Poverty (%)
NFHS-3 (2005–06)	55.34	—	—
NFHS-4 (2015–16)	37.68	0.177	47.14
NFHS-5 (2019–21)	22.93	~0.115	44.39
Est. 2022–23	~14–16 (est.)	—	—

These figures reveal a story of genuine but uneven progress. The decline from 55.34% in 2005–06 to 22.93% in 2019–21 is striking, reflecting both economic growth and the progressive expansion of welfare infrastructure. But the absolute numbers remain: at 22.93%, more than 5 crore individuals in UP remained multidimensionally poor as of 2019–21, more than the entire population of many countries. Further, the intensity of poverty, measuring how deprived the poor actually are, declined only modestly from 47.14% to 44.39%, suggesting that the poorest households face deeply layered and interlinked deprivations that incremental interventions have not fully resolved.

District-Level Disparities

Poverty in UP is not uniform. The UNDP District-Wise MPI Analysis (2023) reveals huge spatial inequalities. Eastern and northeastern districts, particularly Shravasti, Bahraich, Balrampur, and Siddharthnagar, consistently register the highest multidimensional poverty scores, characterised by acute nutritional deficits, high child and neonatal mortality, and near-absence of sanitation infrastructure. By contrast, districts such as Gautam Buddh Nagar (Noida), Lucknow, and Agra, which benefit from urban economic activity, industrial corridors, and better infrastructure, register considerably lower MPI values. Table 3 presents this disaggregation.

This geographic clustering of poverty along the eastern belt of the state is not accidental; it overlaps closely with historically marginalised caste populations, low agricultural land productivity, weaker road connectivity, and institutional neglect (Sahoo et al., 2024). Understanding these spatial patterns is critical for targeting welfare intervention.

Social Causes of Poverty in Uttar Pradesh- Poverty has its roots in various social factors like:

Caste, Exclusion, and Structural Marginalisation

One of the deepest roots of poverty in UP is caste-based inequality. The state's population includes approximately 22.1% Scheduled Castes (SCs), 24% Muslims, and a large share of Other Backwards Classes (OBCs) groups that have historically been shut out of land ownership, formal jobs, and quality education (Tiwari et al.,

2022). Nationally, SCs record the highest unemployment rates across all age and education groups, and UP reflects this pattern sharply (Swaniti Initiative, 2024).

A household survey of 7,124 families in UP found that around 75% earned less than ₹ 5,000 per month, with wealth inequality strongly tied to caste identity. In rural areas, 45% of households owned no land, with landholdings concentrated among upper-caste and dominant OBC communities (Tiwari et al., 2022). Even though the old Jajmani system, the caste-based labour arrangement between patrons and workers, though formally abolished, continues to limit occupational mobility and fair wage access (Sahoo et al., 2024)

Agrarian Crisis and Rural Distress

Agriculture is the backbone of rural UP, employing around 40% of rural households but it is increasingly unable to support them (Tiwari et al., 2022). Fragmented landholdings, poor market connections, low investment, and dependence on monsoons make farming both seasonal and unreliable for small farmers.

This creates a painful cycle: low agricultural productivity leads to low savings, which perpetuates poverty (Swaniti Initiative, 2024). Many families cope by migrating to cities or other states, but this rarely breaks the poverty trap. Remittances help, but migration also fragments families and drains rural communities of their most productive young workers.

Low Human Capital: Education and Health Deficits

Less than 70% of UP's population is literate, just below the national average (Tiwari et al., 2022). But beyond literacy, the quality of education is the real crisis. Teacher absenteeism, crumbling infrastructure, and high dropout rates, especially among girls, mean that even those who attend school gain little. Low education levels lock people into low-wage work and keep them unaware of government entitlements they could claim.

The health picture is equally not good. UP's neonatal mortality rate stands at 35.7 per 1,000 live births, nearly three times the global target of 12. Its infant mortality rate is 59.8 per 1,000, more than double the global benchmark of 25 (UNDP District-Wise MPI Analysis, 2023). In the eastern districts, childhood stunting and wasting are deeply entrenched. Poor health is itself a poverty trap: sick children fall behind in school, sick adults lose wages, and one serious illness can push an entire family into debt.

Gender Subordination

Poverty in UP is also powerfully gendered. Women, particularly in rural areas, face restricted mobility, lower wages for equivalent work, limited access to

credit and property, and restricted decision-making authority within households. Early marriage and high fertility rates, both more prevalent among poorer and lower-caste communities, further restrict women's access to education and employment. Gender discrimination is both a consequence and a cause of poverty, creating a compounding cycle that interventions must explicitly address (Sahoo et al., 2024).

Impacts of Poverty: Lived Consequences

Poverty in UP is not just a number; it is felt every day across multiple dimensions of life as:

- **Nutrition:** Child stunting and wasting remain severe across the eastern belt. Poor dietary diversity and food insecurity trap undernourished children in a cycle where they grow into less productive adults.
- **Health:** Without insurance, a single serious illness was enough to wipe out a family's savings and push them into debt. The expansion of Ayushman Bharat has begun to change this, but out-of-pocket health spending still drives thousands below the poverty line each year.
- **Housing and Sanitation:** Until recently, a large share of rural UP households lived in mud-and-thatch homes without toilets. The Swachh Bharat Mission helped reduce sanitation deprivation by 21.8 percentage points nationally between 2015–16 and 2019–21, with UP contributing significantly to that improvement (NITI Aayog, 2023).
- **Education:** Economic pressure forces children, particularly girls, to drop out and take up household or caregiving duties. School attendance has improved under NFHS-5, but learning outcomes in many districts still lag far behind national standards. Table 2 (below) maps district-level variations in deprivation to these lived impacts.

Table 2: District-Level Multidimensional Poverty Profile in Uttar Pradesh

Category	Representative Districts	Deprivation Profile
High MPI Districts	Shravasti, Bahraich, Balrampur, Siddharthnagar	High child mortality, low schooling, poor sanitation & cooking fuel
Medium MPI Districts	Sitapur, Hardoi, Kannauj, Azamgarh	Mixed deprivations; agriculture-dependent livelihoods
Low MPI Districts	Gautam Buddh Nagar, Lucknow, Agra, Kanpur Nagar	Better urban access; lower deprivation in housing, education
Source: UNDP District-Wise MPI Analysis for UP (2023)		

Effectiveness of Government Welfare Schemes

Over the past decade, both the central government and the Government of Uttar Pradesh have deployed a wide portfolio of welfare schemes targeting the

poor. Table 3 provides a summary of the major schemes and their coverage.

Table 3: Key Welfare Schemes in Uttar Pradesh- Coverage and Outcomes

Scheme	Coverage in UP (approx.)	Key Outcome Indicator
PM Jan Dhan Yojana	~9.4 crore accounts opened	Near-universal banking access
Ayushman Bharat (PMJAY)	5.3 crore Golden Cards issued	Healthcare access for vulnerable families
PM Awas Yojana (Rural + Urban)	Lakhs of houses completed; ₹12,031 cr granted (2025)	Shelter + sanitation + electricity linkage
MGNREGS	One of top states by person-days generated	Wage floor for rural poor; seasonal income buffer
PM Ujjwala Yojana	Significant coverage in rural UP	Clean cooking fuel deprivation reduced by 14.6 pts nationally
Zero Poverty UP Campaign (2025)	13.57 lakh families identified; 11.1 lakh homeless prioritised	Target: min. ₹1.25 lakh annual income per family by Oct 2025
Sources: Outlook India (2026); IBEF (2025); Wikipedia — Zero Poverty UP Campaign (2025).		

Financial Inclusion: The Jan Dhan Foundation

The Pradhan Mantri Jan Dhan Yojana (PMJDY) has reshaped financial access in Uttar Pradesh. With around 9.4 crore accounts opened, UP leads the nation in banking coverage. This network channels Direct Benefit Transfers (DBT) for pensions, MGNREGS wages, and food subsidies straight into beneficiaries' accounts, cutting out middlemen and reducing corruption. For the rural poor, who have long been shut out of formal banking, this has been a genuine game-changer.

Housing and Basic Amenities: PM Awas Yojana

PM Awas Yojana has delivered real, visible change for lakhs of UP families. Using geo-tagged monitoring and verified beneficiary lists, the scheme minimises duplication and fraud. In early 2025, UP's Zero Poverty Campaign flagged 11.1 lakh homeless families as priority beneficiaries, and the state was subsequently allocated ₹12,031 crore to build permanent homes for them. Beyond shelter, each home typically brings along toilets, electricity, and civic services. The scheme's March 2025 expansion targeting two crore additional rural houses by FY29 with an outlay of ₹3.06 lakh crore underscores the government's commitment to housing as a cornerstone of poverty reduction.

Healthcare Access: Ayushman Bharat

Ayushman Bharat – PM Jan Arogya Yojana (PMJAY) has dramatically narrowed the healthcare gap for UP's poor. Over 5.3 crore Golden Cards have been

issued in the state, opening doors to secondary and tertiary hospital care for vulnerable families. Before this, a single serious illness could tip a household into permanent poverty. Challenges around card activation and hospital quality remain, but the scheme has meaningfully expanded health protection for millions.

Employment and Livelihood: MGNREGS

MGNREGS remains the primary income safety net in rural UP. Its guarantee of 100 days of unskilled wage employment per household per year acts as a floor against destitution — especially during agricultural lean seasons. Research consistently links the scheme to reduced seasonal poverty, greater women's participation in the workforce, and useful rural infrastructure like roads and water bodies. That said, UP faces persistent issues: wage payment delays, muster roll irregularities in some districts, and person-days generated falling short of actual demand.

Zero Poverty Campaign: A State-Level Innovation

Launched in 2025, UP's Zero Poverty Campaign takes a sharper, more targeted approach. It identifies the 10–25 poorest families in every gram panchayat through data profiling, and then delivers multiple welfare benefits — housing, health cards, pensions, agricultural support — to these households simultaneously, rather than making them navigate each scheme on their own. By February 2025, data for 13.57 lakh families had been collected and 13.22 lakh verified. The campaign aims to raise each identified family's annual income to at least ₹1.25 lakh by October 2025. This convergence model is a smart step forward — putting welfare delivery on the government's shoulders rather than the beneficiary's.

Gaps and Persistent Challenges

Progress notwithstanding, serious gaps remain. Last-mile delivery is still patchy, especially across UP's eastern districts, where administrative capacity is thin, beneficiary awareness is low, and local power structures can distort who actually receives benefits. Quality is another concern — a Golden Card doesn't always mean a successful hospital visit; MGNREGS wages often arrive late; and some PMAY homes lack the durability needed in flood-prone regions. Most fundamentally, welfare schemes alone cannot dismantle the deeper roots of poverty — caste discrimination, gender inequality, and agrarian stress — which demand sustained social reform and stronger legal enforcement alongside financial support.

Discussion: Progress, Paradox, and the Path Forward

The data tell a striking, contradictory story. Uttar Pradesh reduced its multidimensional poverty rate from 37.68% to 22.93% in just four years, lifting 34.3 million people out of poverty between 2015–16 and 2019–21 — the largest absolute

reduction of any Indian state (NITI Aayog, 2023). Yet those who remain poor face deep, stubborn deprivation, shaped by caste hierarchies and agrarian distress that headline numbers simply cannot capture. Welfare schemes have worked, but only up to a point. Gains in financial inclusion, housing, and healthcare are real and measurable. The clearest impact, however, comes when schemes work in tandem: a family that receives a home, a Jan Dhan account, an Ayushman card, and livelihood support all at once benefits far more than one that receives any single intervention. The Zero Poverty Campaign attempts to institutionalise exactly this convergence, and its results through 2025–26 will offer valuable lessons for programme design going forward.

What UP now needs most is deeper investment in human capital, better rural schools, stronger vocational training for the non-farm economy, and meaningful economic opportunities for women. These returns come slowly, but they treat the disease rather than the symptoms. Material transfers matter; sustained human development is what makes them last.

Conclusion

Poverty in Uttar Pradesh runs deeper than material deprivation; it is woven into caste hierarchies, patriarchal structures, agrarian stagnation, and weak institutions. Welfare transfers alone, however well designed, cannot unravel these roots.

The MPI data tell an encouraging story: UP has cut its multidimensional poverty headcount by nearly 15 percentage points in just four years, the largest absolute reduction of any Indian state. Schemes like PM Jan Dhan Yojana, Ayushman Bharat, PM Awas Yojana, and MGNREGS have all played a meaningful role, proving that targeted, well-monitored public welfare genuinely works.

But the 22.93% still living in poverty and the tens of millions hovering just above that threshold are a sobering reminder that progress remains fragile and unequal. Eastern UP's poorest districts face levels of deprivation that demand urgent, emergency-scale attention. The 2025 Zero Poverty Campaign signals political will; the real test is delivery.

Going forward, research must track scheme beneficiaries over time, investigate who is being left out and why, and rigorously evaluate the Campaign's convergence approach. Most importantly, UP's social policy must move beyond pure transfers toward a model that pairs material support with structural social reform. Only then will poverty reduction be lasting — and truly transformative.

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13

De-Dollarisation and the Internationalisation of the INR: India's Search for Strategic Monetary Autonomy

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Abstract: *The post-Cold War global economic order has largely been shaped by the dominance of the United States dollar as the principal reserve currency and medium for international trade and financial transactions. However, recent geopolitical developments, including the Russia–Ukraine conflict, sanctions-based financial restrictions, disruptions in global supply chains, and the gradual emergence of a multipolar economic order, have intensified debates surrounding de-dollarisation and the diversification of global payment systems. In this changing international environment, several emerging economies have begun exploring alternatives to excessive dependence on the dollar-dominated financial architecture. India, as one of the world's fastest-growing major economies, has increasingly emphasised the internationalisation of the Indian Rupee (INR) as part of its broader vision of strategic autonomy, financial resilience, and enhanced global economic influence.*

This paper examines the opportunities, challenges, and strategic implications surrounding the internationalisation of the INR in the context of evolving global trade and financial systems. The study seeks to analyse the economic and geopolitical factors driving India's efforts to promote cross-border rupee settlement mechanisms and expand the role of the INR in international trade.

Keywords: *Rupee Internationalisation, De-dollarisation, Strategic Autonomy*

Introduction

The contemporary global economic order continues to be significantly shaped by the dominance of the USD as the principal reserve currency, medium of international exchange, and unit of global financial settlement. Since the Bretton Woods system and particularly after the collapse of the gold standard in 1971, the

dollar has remained central to global trade, investment flows, foreign exchange reserves, and energy markets (Cohen, 2015). The process of globalisation further strengthened the role of the dollar through expanding international trade networks, financial integration, and the institutional influence of Western-led organisations such as the International Monetary Fund (IMF) and the World Bank. However, the twenty-first century has witnessed growing concerns about excessive reliance on a dollar-centric financial architecture, particularly amid sanctions regimes, geopolitical rivalries, and financial weaponisation. (Eichengreen, 2011) The Russia–Ukraine conflict and the freezing of Russian foreign exchange reserves by Western nations intensified global debates surrounding strategic autonomy, reserve diversification, and de-dollarisation. Simultaneously, the emergence of a multipolar global order characterised by the rise of China, regional economic blocs, and South–South cooperation has encouraged several countries to explore alternatives to dollar-dominated trade mechanisms.

In this changing geopolitical and economic environment, India has increasingly sought to position itself as a major global economic and strategic actor. India is presently among the world's fastest-growing major economies and has significantly expanded its trade relations, diplomatic outreach, and technological capabilities over the past decade. Initiatives such as "Make in India," "Digital India," and the expansion of Free Trade Agreements (FTAs) have strengthened India's integration into global markets (Government of India, 2024). Furthermore, India's leadership in digital payment systems, particularly through the Unified Payments Interface (UPI), has demonstrated the country's growing financial and technological influence. India has also pursued a policy of strategic balancing, maintaining relations with multiple global powers while emphasising strategic autonomy in its foreign and economic policy. In this context, the internationalisation of the INR has emerged as an important component of India's broader aspiration to enhance economic resilience, reduce transaction costs, strengthen regional trade influence, and minimise vulnerabilities arising from external financial shocks.

Despite these developments, the global role of the Indian Rupee remains relatively limited when compared to major international currencies such as the US dollar, the Euro, or even the Chinese Yuan. A substantial proportion of India's international trade continues to be invoiced and settled in foreign currencies, particularly the dollar. Structural constraints, such as limited capital account convertibility, comparatively shallow financial markets, concerns about currency volatility, and limited global confidence in the INR, continue to hinder its wider international acceptance.

Against this backdrop, the present paper seeks to address the following research questions:

1. Why is India pursuing the internationalisation of the Indian Rupee in the contemporary global economic order?
2. What strategic and economic benefits can rupee internationalisation provide to India?
3. What structural and institutional challenges limit the global expansion of the INR?

Literature Review

The question of currency internationalisation has occupied a significant position within the fields of international political economy and global finance, particularly in relation to the dominance of the USD in the post-Second World War economic order. Scholars such as Cohen (2015) and Eichengreen (2011) have emphasised that reserve currencies derive their strength not merely from economic size, but also from institutional credibility, financial market depth, political stability, and global trust in the issuing state. The US dollar emerged as the dominant international currency after the Bretton Woods system and has maintained its primacy due to the scale of the American economy, the liquidity of US financial markets, and the strategic influence of American-led global institutions. According to Prasad (2014), internationalisation of a currency often enhances the issuing country's geopolitical influence and reduces transaction costs in international trade.

A significant body of scholarship has comparatively examined the rise of alternative currencies, particularly the Euro and the Chinese Yuan (Renminbi). McKinnon (2013) argues that, despite the Euro's importance in global trade, structural weaknesses within the European Union have limited its ability to fully challenge dollar dominance. Similarly, scholars such as Subramanian (2011) and Yu (2017) have extensively analysed China's efforts to internationalise the Yuan through offshore financial centres, bilateral swap agreements, and integration into global payment systems. These studies demonstrate that currency internationalisation is closely tied to broader geopolitical ambitions and economic restructuring. However, many scholars also caution that limited capital account convertibility and ongoing transparency concerns continue to constrain the Yuan's global acceptance.

The recent resurgence of debates surrounding de-dollarisation has further expanded academic discussions on alternative financial architectures. The increasing use of sanctions by Western powers, particularly after the Russia–Ukraine conflict, has intensified concerns regarding the weaponisation of the dollar-centric financial system (Tooze, 2022). Scholars argue that the freezing of Russian foreign exchange

reserves and restrictions on access to the SWIFT payment network prompted many countries to diversify their reserve holdings and seek local-currency trade mechanisms. BRICS countries, in particular, have increasingly emphasised the need for multipolar financial arrangements and reduced dependence on Western-controlled financial systems (Armijo & Katada, 2015). Nevertheless, scholars believe that the entrenched global trust and liquidity associated with the dollar cannot be easily replaced.

Within the Indian context, literature on the internationalisation of the Indian Rupee remains comparatively limited and fragmented. Existing studies primarily focus on India's external trade policy, exchange rate management, and regional trade mechanisms rather than on the INR's broader strategic role in the global financial order. Recent policy discussions have examined initiatives introduced by the Reserve Bank of India (RBI), including the establishment of Special Rupee Vostro Accounts and bilateral trade settlement arrangements with countries such as Russia, the United Arab Emirates, Sri Lanka, and Bhutan (RBI, 2023). Scholars have also noted the significance of India's digital payment infrastructure, especially the expansion of UPI-based financial systems, in facilitating cross-border financial integration. However, existing literature has extensively examined China's yuan internationalisation while giving comparatively limited attention to India's evolving rupee settlement mechanisms in the post-Ukraine geopolitical context. Therefore, this paper seeks to address this gap by analysing the strategic, economic, and institutional dimensions of rupee internationalisation within the emerging multipolar global order.

Method

The present study adopts a qualitative and analytical research methodology to examine the internationalisation of the INR within the broader context of evolving global financial and geopolitical transformations. Given the subject's conceptual and policy-oriented nature, the study primarily relies on secondary sources of data and literature. The research draws upon official reports and publications issued by the Reserve Bank of India (RBI), the International Monetary Fund (IMF), the World Bank, and the Bank for International Settlements (BIS), along with government policy documents, Economic Surveys, scholarly books, peer-reviewed journal articles, and research papers related to international political economy, reserve currencies, and global trade systems.

The study employs a policy analysis approach to examine India's recent initiatives to promote rupee-based trade settlements and strengthen the international role of the INR. Particular attention is given to mechanisms such as Special Rupee Vostro Accounts, bilateral trade arrangements, and regional financial cooperation initiatives. In addition, a comparative analytical framework has been utilised to

situate India's efforts alongside broader debates surrounding the internationalisation of other currencies, particularly the US dollar, the Euro, and the Chinese Yuan.

Conceptual Framework: Understanding Currency Internationalisation

Currency internationalisation refers to the process by which a national currency gains increasing acceptance and use beyond the issuing country's territorial boundaries for international trade, investment, financial transactions, and reserve holdings. In the contemporary global economy, only a limited number of currencies perform significant international functions, with the United States dollar occupying the dominant position, followed by the Euro, Japanese Yen, and, increasingly, the Chinese Yuan.

Scholars generally identify three principal functions of an international currency. First, it serves as a medium of exchange, facilitating cross-border trade and financial transactions. A widely accepted international currency reduces transaction costs and minimises exchange-rate risks in international commerce. Second, it functions as a unit of account, meaning that global trade contracts, commodity pricing, and financial assets are denominated in that currency. The dominance of the US dollar in global oil trade and international invoicing effectively demonstrates this role. Third, an international currency acts as a store of value, enabling governments, institutions, and investors to hold reserves and assets in that currency with confidence regarding its long-term stability and liquidity (Cohen, 2015).

The process of currency internationalisation depends upon several structural and institutional factors. Economic size and trade volume are important prerequisites, as countries with larger economies and extensive trade networks naturally generate greater international demand for their currencies. However, economic size alone is insufficient. A stable and credible currency, supported by low inflation, macroeconomic stability, and sound monetary policy, is equally essential. Financial market depth also plays a crucial role, as global investors prefer currencies associated with liquid and sophisticated financial markets capable of supporting large-scale transactions. Furthermore, trust in the political and institutional stability of the issuing country significantly influences global confidence in a currency. Finally, capital account convertibility and the ease of cross-border capital movement remain important determinants of international currency acceptance (Prasad, 2014).

Drivers of Rupee Internationalisation

The internationalisation of the Indian Rupee is being driven by a combination of geopolitical, economic, technological, and strategic factors.

A. Strategic Autonomy and Financial Sovereignty

One of the most significant drivers of rupee internationalisation is India's long-standing emphasis on strategic autonomy in foreign and economic policy. The

Russia–Ukraine conflict highlighted the vulnerabilities associated with excessive dependence on Western-controlled financial systems. The freezing of Russian foreign exchange reserves and restrictions imposed on Russian banks' access to the SWIFT payment network demonstrated how global financial infrastructure could be used as an instrument of geopolitical pressure (Tooze, 2022).

For India, which maintains strategic relations with multiple global powers, reducing vulnerability to external financial disruptions has become increasingly important. India continued energy trade with Russia despite Western sanctions and subsequently explored rupee-based settlement mechanisms to facilitate bilateral trade. In July 2022, the RBI introduced a framework permitting international trade settlement in Indian Rupees through Special Rupee Vostro Accounts (SRVAs) (RBI, 2022). This measure was intended to promote smoother trade settlements while reducing dependence on third-country currencies.

B. Reducing Dependence on the US Dollar

Another major factor driving rupee internationalisation is the desire to reduce excessive dependence on the US dollar in international transactions. Since a large proportion of India's imports, exports, and external debt settlements are denominated in dollars, fluctuations in the value of the dollar significantly affect India's trade balance and exchange-rate stability. Dollar dependence also increases transaction costs because international trade often requires currency conversion through intermediary financial systems. Scholars have argued that overdependence on a single reserve currency exposes countries to sanctions risks, liquidity disruptions, and imported inflation during periods of global financial instability (Prasad, 2014).

C. India's Expanding Trade Networks and Regional Engagement

India's expanding trade partnerships and regional economic engagement have also contributed significantly to the push for rupee internationalisation. India has actively pursued bilateral and regional trade agreements with countries in South Asia, the Gulf region, Southeast Asia, and beyond. Trade agreements with the United Arab Emirates and Australia, along with negotiations involving the European Union and the United Kingdom, reflect India's growing integration into global trade systems (Government of India, 2024).

South Asia is an especially important region for rupee-based trade settlement, given India's economic centrality within it. Countries such as Nepal and Bhutan already maintain significant economic dependence on India, while Sri Lanka has increasingly relied upon Indian financial assistance and trade cooperation in recent years. Similarly, India's energy trade relations with Gulf countries offer opportunities for local-currency settlement mechanisms. Within multilateral platforms such as

BRICS, discussions surrounding alternative financial architectures and local currency trade have further strengthened interest in reducing dollar dependence and promoting multipolar financial systems.

D. Digital Financial Infrastructure and FinTech Diplomacy

India's rapid advancement in digital financial infrastructure has emerged as another important driver of rupee internationalisation. The Unified Payments Interface (UPI), developed by the National Payments Corporation of India (NPCI), has transformed domestic digital transactions and attracted international attention for its efficiency, low transaction costs, and scalability. India has increasingly sought to internationalise UPI through agreements with countries such as Singapore, the United Arab Emirates, France, Nepal, and Sri Lanka.

In addition, the RBI has initiated pilot projects related to the Central Bank Digital Currency (CBDC), commonly referred to as the digital rupee. Although still in its early stages, the CBDC could facilitate faster, more secure cross-border transactions in the future. India's growing use of fintech diplomacy and digital payment partnerships reflects an attempt to strengthen financial connectivity while gradually enhancing the international acceptance of the INR.

E. Diaspora and Remittance Flows

India's large global diaspora and substantial remittance inflows also provide a supportive foundation for rupee internationalisation. According to World Bank estimates, India remained the world's largest recipient of remittances in recent years, receiving over $125 billion in 2023 (World Bank, 2024). Furthermore, stronger rupee-based financial linkages with diaspora communities may contribute to greater long-term integration of India's financial systems with global markets.

Challenges and Limitations of Rupee Internationalisation

Despite India's growing economic stature and increasing efforts to promote cross-border rupee settlements, the internationalisation of the Indian Rupee continues to face several structural, institutional, and geopolitical constraints.

A. Limited Capital Account Convertibility

One of the primary constraints on rupee internationalisation is India's limited capital account convertibility. Full internationalisation of a currency generally requires the free movement of capital across borders, enabling foreign investors and institutions to buy, sell, and hold assets denominated in that currency without significant restrictions. India, however, continues to maintain partial capital controls in order to protect macroeconomic stability and shield the domestic economy from volatile capital flows.

While these controls have helped India avoid severe financial instability during periods of global economic turbulence, they also limit the INR's attractiveness as an international reserve and investment currency. Scholars have argued that reserve currencies generally emerge from economies with open, highly liquid financial systems capable of accommodating large-scale global capital movements (Eichengreen, 2011). Consequently, India faces the challenge of balancing financial openness with economic stability.

B. Continued Dominance of the US Dollar

Another major challenge is the entrenched dominance of the US dollar in global trade, investment, and reserve holdings. The dollar remains the principal currency for international invoicing, commodity pricing, sovereign reserves, and cross-border financial settlements. The dominance of the dollar creates strong network effects, whereby countries and firms prefer using a currency already widely accepted in global transactions. Since much of global trade infrastructure, including payment systems and financial contracts, is designed around the dollar, shifting toward alternative currencies becomes institutionally and economically difficult. As a result, the internationalisation of the INR faces substantial structural barriers irrespective of India's economic growth trajectory.

C. Relatively Shallow Financial Markets

The depth and sophistication of domestic financial markets play a critical role in determining a currency's global acceptance. International investors generally prefer currencies associated with large, liquid, transparent, and stable financial markets that can support high-volume transactions. Although India's financial markets have expanded considerably over the past two decades, they remain less developed than those of the United States or major European economies.

D. Trade Imbalances and External Vulnerabilities

Persistent trade deficits also pose challenges for rupee internationalisation. India remains heavily dependent on imports of crude oil, technology products, defence equipment, and industrial inputs. Since a significant proportion of these imports is invoiced in dollars, India continues to require substantial foreign exchange reserves to maintain external stability. Countries are generally more willing to hold and transact in currencies associated with major exporting economies possessing strong and stable external balances. Furthermore, exchange-rate volatility and dependence on imported energy create vulnerabilities for the INR during periods of global uncertainty. Sharp depreciation of the rupee may discourage international actors from holding rupee-denominated assets and conducting long-term settlements.

E. Investor Confidence and Currency Stability

Global acceptance of a currency is fundamentally linked to investor confidence in the issuing country's macroeconomic and institutional stability. Although India has emerged as one of the fastest-growing major economies, concerns about inflation management, fiscal deficits, banking-sector stress, and regulatory consistency continue to influence perceptions of currency stability. (Prasad, 2014). During periods of global economic uncertainty, investors often shift toward traditionally "safe" assets, such as the US dollar and US Treasury securities, thereby weakening emerging-market currencies.

F. Geopolitical Constraints

Finally, geopolitical realities continue to shape the prospects of rupee internationalisation. The contemporary global financial order remains heavily influenced by Western-led institutions and strategic alliances. India's complex geopolitical positioning i.e. balancing relations with the United States, Russia, the Gulf region, and BRICS countries simultaneously, creates both opportunities and constraints. While multipolarity may create greater space for alternative currency arrangements, geopolitical rivalries and strategic competition may also slow the emergence of new financial architectures.

India's Policy Initiatives and Regional Strategy

In recent years, India has gradually adopted several policy initiatives to expand the international role of the Indian Rupee. One of the most significant policy initiatives undertaken by the RBI was the introduction of the 'framework for international trade settlement in Indian Rupees' in July 2022. Under this mechanism, authorised Indian banks were permitted to open Special Rupee Vostro Accounts (SRVAs) for correspondent banks of partner countries (RBI, 2022). The arrangement enables trade transactions to be invoiced, paid, and settled in INR rather than relying exclusively on third-country currencies such as the US dollar. The mechanism was introduced particularly in the context of disruptions arising from sanctions on Russia and broader uncertainties in the global financial system. By facilitating rupee-denominated trade, India sought to ensure continuity of trade flows while simultaneously promoting greater international use of the INR.

India's bilateral trade relations have played a crucial role in advancing these initiatives. Russia emerged as one of the most important cases for rupee-based trade settlement following Western sanctions related to the Russia–Ukraine conflict. Similarly, India and the United Arab Emirates signed agreements promoting local currency settlement and cooperation in digital payment systems. Countries such as Nepal and Bhutan possess deep economic integration with India, with a substantial

proportion of their trade conducted with the Indian market. The Indian Rupee already enjoys varying degrees of circulation and acceptance within these economies due to geographic proximity, trade dependence, and financial linkages. Sri Lanka's severe economic crisis in 2022 further strengthened India's financial role in the region, as India extended lines of credit, provided currency support, and provided humanitarian assistance.

Beyond bilateral arrangements, India has also engaged with broader multilateral platforms that advocate reforms to the global financial architecture. Within the BRICS, discussions on de-dollarisation, local currency trade, and alternative payment systems have gained prominence. BRICS member states have increasingly emphasised reducing dependence on Western-controlled financial institutions and strengthening multipolar financial arrangements. India's participation in institutions such as the New Development Bank (NDB) and the Asian Infrastructure Investment Bank (AIIB) also reflects its broader efforts to diversify global financial partnerships.

Additionally, India's push for digital financial connectivity through UPI-linked payment systems and fintech partnerships complements its regional currency strategy. Agreements enabling cross-border digital payments with countries such as Singapore, Nepal, and the UAE represent early steps toward building a wider financial ecosystem centred around Indian digital infrastructure. Collectively, these policy initiatives demonstrate that India's approach to rupee internationalisation is gradual, regionally focused, and closely linked with its broader geopolitical and economic objectives.

Conclusion

The internationalisation of the Indian Rupee represents an important dimension of India's evolving economic and strategic aspirations within a rapidly transforming global order. The study demonstrates that India's push toward rupee internationalisation is being driven by multiple factors, including the desire to reduce vulnerability to external financial shocks, strengthen regional trade integration, lower transaction costs, and enhance financial sovereignty in an era marked by sanctions, politics and geopolitical uncertainty. India's growing economic size, expanding trade networks, leadership in digital payment infrastructure, large remittance inflows, and increasing engagement with regional and multilateral institutions support its aspirations. Policy initiatives such as Special Rupee Vostro Accounts, local-currency settlement mechanisms, and cross-border digital payment partnerships demonstrate that India has already begun laying the institutional foundations for greater international use of the rupee. Limited capital account convertibility, relatively

shallow financial markets, exchange-rate volatility, persistent trade deficits, and the entrenched dominance of the US dollar remain major obstacles.

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14

How MSMEs and Startups are Shaping Food Processing and Exports in U.P.

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Abstract: *The chapter discusses the transformative role of Micro, Small, and Medium Enterprises and Startups in shaping the food processing industry and the export performance of Uttar Pradesh. It tends to dive deep into the knowledge of food processing sector, ties India's primary and secondary sectors together. Uttar Pradesh, India's most populous state, is also blessed with a large agricultural base, providing a foundation for value addition to the food processing industry. The study analyses how MSMEs and food Startups are driving supply chains, reducing post-harvest losses, and creating enlarged markets for customers and farmers by diversifying food options, with special reference to dairy, Fruits & vegetables, and packaged foods. The chapter highlights the roles of digital platforms, e-commerce, and cluster-based development. State- and national-level initiatives, industrial corridors, and export promotion policies are enabling small firms to map their way into global markets. Despite challenges, MSMEs and startups are providing employment in rural and semi-urban areas. The chapter effectively concludes that a supportive ecosystem is significant for achieving inclusive and sustainable growth in Uttar Pradesh.*

Keywords: *Food Processing, industry, MSME, Startup, UP economy, Infrastructure, employment, policies, Exports.*

Introduction

Food processing industries are a significant player in India's economy. It is an emerging sector offering opportunities at different levels across both the agriculture and manufacturing sectors, thereby adding value to primary sector output. It contributes 8.80% of manufacturing GVA and 8.39% of agricultural GVA, accounting for about 13% of India's exports. The food processing sector attracted approximately 1.02 trillion dollars in investment in 2025, including 13.4 billion dollars in foreign direct investment (FDI), and is a priority sector under the Make in India initiative.

Growing exports of foods such as cereals, fruits, vegetables, and meat products also help India expand its global trade footprint to over 59,118 crores in exports from April to August 2025. It improves foreign exchange earnings and the balance of trade by creating value addition to farmers' produce, turning it into packaged and Frozen food, which means more income in the hands of farmers, something not possible if sold raw. Further, it has reduced farmers' dependence on seasonal farming, encouraging entrepreneurship through MSMEs and startups.

The sector utilises manpower in both organised and unorganised categories at different levels of processing, logistics, packaging and marketing.

Projections suggest a growth of 535 US billion dollars by financial FY26 and 2150 billion dollars by 2047 under Viksit Bharat@2047.

Relevance for the Uttar Pradesh Economy

Uttar Pradesh is India's most populous and agrarian state; hence, food processing and its exports are important for its economy. It is a leading producer of wheat, sugarcane, fruits, vegetables and milk, providing top-quality raw materials for the concerned industry. Rapid urbanisation is driving the demand for convenience food, which subsequently boosts the demand for the food processing sector.

The state has understood the demand and established various food parks and processing clusters in the districts like Varanasi, Barabanki, Saharanpur, Gorakhpur in support of industrial growth. Mega food parks and cold chains help in efficient storage before distribution and exportation.

Government initiatives, such as crop-specific commodity boards, aim to increase export earnings from agricultural goods by processing them for export.

Dairy	16%	1st
Meat & Marine	9%	3rd
Cereals, Grains & Oilseed	18%	1st
Packaged Food	8 %	2nd
Fruits & Vegetables	12%	1st
Beverages (Non- Alcholic)	15%	2nd

[27] RBI, 2020
[28] Invest India, 2023
[29] Annual Survey of Industries

Table: Opportunities with respect to 6 major sub- segments of Food Processing Industry[7]

Dairy	• Huge demand of Value Added Dairy Products i.e Cheese, custard, Flavored Milk.
Meat & Marine	• Huge scope of Export to different Countries with increasing demand of frozen foods. • Innovation in product development such as ready-to-cook, ready-to-eat, canned and frozen food.
Cereals, Grains & Oilseed	• Major Exporters of various food grains.
Packaged Food	• Investing in Improving Packaged foods manufacturing capacities.
Fruits & Vegetables	• Advancement of new technology to reduce wastage levels. • Increasing focus on processed food products.
Beverages (Non- Alcholic)	• Advancement in Quick Service Restaurants (QSRs), and changing food habits will increase demand of the beverages sector.

[6] MoFPI, 2021
[7] Invest India, 2022

Role of MSMEs and Startups

In the state of Uttar Pradesh, MSMEs and startups are not near marginal actors of industry they are pivotal point between both domestic markets and global trade, linking rural level hold to economic growth they help in:

a. Employment generation
b. Value addition to Agricultural
c. Export diversification.

In essence Uttar Pradesh's geographical location infrastructure development has linked it to domestic markets and export hubs reducing distribution costs of goods meant for overseas market.

Importance of the Food Processing Industry

Uttar Pradesh has a large agricultural base, as it is a leading producer of many important crops, including wheat, sugarcane, mangoes, potatoes, peas, and milk, many of which rank high nationally. The fertile lands of UP yield substantial agricultural output, which can further provide raw materials for the food processing sector. The state has the largest share in Indian food grains and horticulture, which provides for both volume-based processing, such as rice and greens, and also for value-added goods, for example, GI-tagged mangoes, in both national and international markets. Not only has the food processing sector significantly contributed to reducing agricultural waste and adding value to farmers' produce, but it has also introduced buyers to a variety of food options and increased the market size. Up has 65,000 food processing units that process agricultural commodities into marketable products such as cereals, fruits, juices, frozen

vegetables, and a variety of dairy and meat products. According to state policy data, the sector contributes about 8% of the agriculture and allied sectors, accounting for 2,41,900 and 84,00,00,000, which is 5.12 billion dollars. The target is to double the units 2 meet the rising demand for processed food.

The sector has also proven itself as an engine 2 infrastructural development in UP, through specialised industrial parks, gold chains and logistic networks. The state has built an ecosystem of 65,000 units of value addition with the help of mega food parks in Bareilly and Agra, and establishment of Agro parks extending 250 regulated markets 225 rural markets and 100 e-Nam mandis, 10 inland container depots have been set up to connect farmers with processing firms followed by agricultural universities like SHUATS (Prayagraj) and IVRI in Bareilly for tech support and skill development.

The food processing sector is a leading employer in rural and semi-urban Uttar Pradesh. These 65,000 MSME units provide jobs to approximately 2.5 lakh people, and the number would increase further if more units were set up or doubled, as targeted. Already, many units are specifically concentrated in the agrarian districts, facilitating. Processing jobs and reducing dependency on farm incomes alone. This transition focuses heavily on the government's plan to double farmers' incomes through skill development and by providing simultaneous opportunities for growing and processing.

Micro, small and medium enterprises dominate the food industry, with about 70% of food processing activities carried out in the unorganised sector through MSMEs. According to Policy data, policy support through UP's Food Processing Industrial Policy 2023 provides subsidies, interest subsidies, grants, and fiscal incentives to encourage more private investment and MSMEs. The state offers a high approval rate under the Pradhan Mantri formalisation of micro food processing enterprises (PMFME), facilitating quick loans and providing formal recognition.

Initiatives of Uttar Pradesh Government

1. Uttar Pradesh food processing industry policy 2023

This is the government of Uttar Pradesh's flagship policy that aims to transform Uttar Pradesh into a major food processing centre by providing financial incentives, infrastructural support and ease of doing business. Under the financial incentive part, the scheme offers up to 35% subsidy of capital (Plant machinery), maximum up to 5 cr. If a firm wants to expand and wants to upgrade technically, then it can get a maximum of 1 cr or up to 25% and 25% subsidy on transportation of exportable goods. The highlight of the scheme is that it offers up to 50% subsidy

on solar power systems, and women entrepreneurs can get up to 90% of subsidies on solar projects. the scheme provides exemption on rebates on land conversion fees, stamp duty EC in the form of regulatory support. This policy encourages increased processing capacity to attract investment in the rural-urban food processing ecosystem.

2. Expansion of processing capacity

The government of Uttar Pradesh plans to add 75,000 plus new units of food processing with a target of 1000 units per district, it aims to increase rural employment and value addition facilities, that will include cold storage grading, packaging and logistic support.

3. One district one cuisine (ODOC) cuisine cluster model

The aim is to link local food heritage with modern markets. The state government has launched the ODOC Add Cuisine Cluster initiative. Each district promotes their signature foods like Petha, Litti chokha, Peda and so on as branded products by focusing on packaging, quality marketing and e-commerce linkage. it helps with food startups, micro, small and medium enterprises and women entrepreneurs to connect with national international consumers

4. Crop-specific export strategy

To strengthen the agro-processing value chain and boost exports, the state plans to set up crop-specific boards, for example, the potato board, the banana board and so on, so that specialised extension can be given to specific crops and their separate quality control, branding and marketing can be managed to encourage their exports and meet overseas demand.

MSMEs and Food Processing Start-Ups as Engines of Growth

1. The most important function that micro small and medium enterprises and startups perform is adding value to the raw agricultural products that expand food market by diversifying the variety of food options available to consumers. This further increases farmers income by transforming raw produce into marketable goods. Processing units like rice mills, oil press, dairy processing units convert their raw into serials cheese like high prized products, s they would have been sold raw into mandi's at cheap prices. schemes like Pradhan Mantri formalization of micro food processing enterprises standardised and bring the processing units to mainstream markets by linking producers to production sites.

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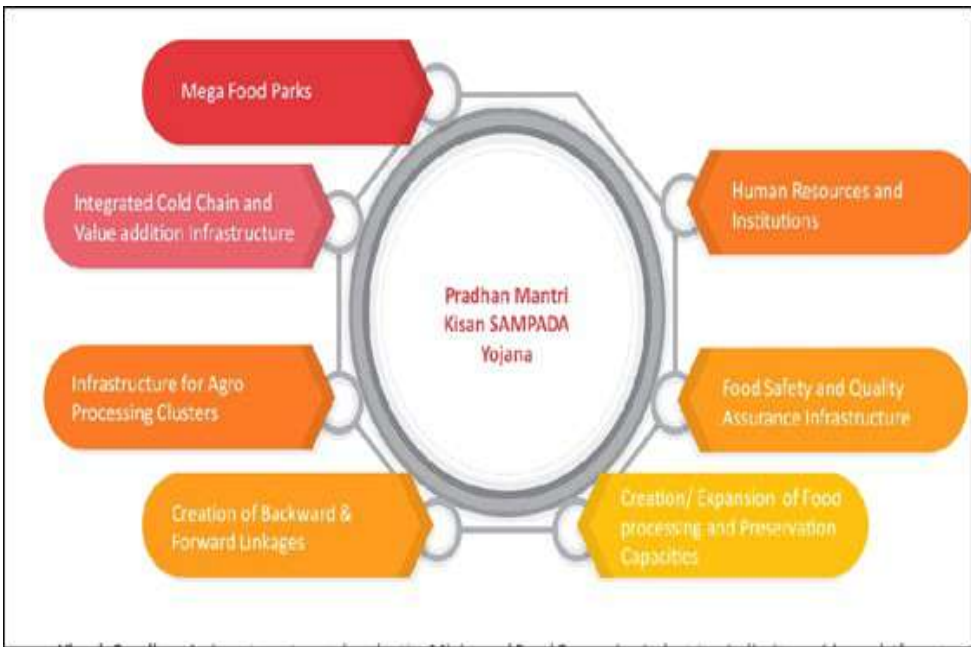
2. The second important function is to reduce post-harvest losses. The supply for an agricultural commodity is greater than the demand for it; if not taken care of, the excess supply will convert itself into post-harvest loss. Food processing startups and MSMEs can combat this problem efficiently by transforming the excess into high-priced packaged products. The access can also be stored in cold storage for the time of excess demand. Cold storage these days are tech-driven, solar-powered, having decentralised refrigeration systems that prevent spoilage before the surplus produce can be transformed and processed. Government schemes like Pradhan Mantri Kisan Sampada Yojana (PMKSY) Provide grants and loans for cold storage and value addition infrastructure like solar dehydrators and control drying units, which significantly cut down drying time of fruits as compared to conventional sun drying, preserving nutrients, tastes and reducing fungal spoilage, increasing their shelf life.

3. MSMEs and startups help improve supply chain, they built digital and physical networks that connect sellers with markets, whether online or offline and also work to make consumers aware of the products. Remove excessive middlemen that facilitate better price realization for farmers. Refrigerated transport assures freshness and quality while bringing food to the market. Digital tools like mobile platforms help farmers track prices of their products, manage inventories, reducing inefficiencies and minimising waste. ICT-based marketplaces democratise access for both buyers and sellers, allowing MSMEs in rural areas to connect with local and global markets.

4. MSMEs' Employee local youth that includes women and seasonal workers in logistics, distribution, packaging and other non-farm activities, which reduces

pressure on urban labour and controls rural migration. Every investment in rural food processing and supply infrastructure creates multiple job opportunities, with people directly involved in processing food or indirectly through supporting activities. The benefits include income diversification, opportunities beyond crop cultivation, skill development in managerial and technical jobs, and greater rural resilience.

5. Start-ups and MSMEs use digital platforms to scale up their sales beyond just domestic markets, with online platforms allowing businesses to access foreign customers. Digital marketplaces such as Amazon, Flipkart and others help MSMEs list their products online for global visibility. Smaller firms, through these channels, successfully eliminate multiple middlemen and can directly sell their products to customers, removing traditional barriers such as the need for consumers to be physically present in the market and, for sellers, the complexities of import bureaucracies, intermediaries, and the logistics of foreign sales. E-commerce platforms improve the competitive positions of MSMEs and start-ups by lowering their distribution and marketing costs, allowing start-ups to get real-time insights into demand for their products and their price trends, which traditional export channels lack.



Success Stories

1. Dairy processing- Barabanki and Sitapur districts

It is a case of women-led dairy MSME clusters, as Barabanki and Sitapur have strong milk production bases, with thousands of smallholder farmers working there. Local milk collection and processing are done through the national dairy plan and the ODOP dairy.

This set up chilling and pasteurisation units and introduced packaged curd, cottage cheese, and flavoured milk. It is linked with self-help groups and women farmer producer organisations.

Impact- It reduced post-harvest losses and spoilage, increased farmers' income by 30 to 40%, created local jobs related to transport and packaging, and strengthened supply chains. It is a perfect example of how raw milk converted to value-added products.

2. Snacks and packaged food- Gautam Budh Nagar or Noida

Case of a Millet healthy snacks startup, where a startup produces baked Millet chips and protein snacks. They sourced millets from Bundelkhand and eastern farmers and developed ready-to-eat snacks for urban markets using direct-to-consumer platforms.

Impact- The connected poor regions to premium markets created skilled jobs in food tech and logistics using climate-resilience crops and promoted nutrition. They also have customers in Singapore and the UAE. It is a perfect example of export diversification.

3. Fruits and processing- Malihabad Lucknow district

Case of mango pulp and pickle MSME Malihabad is famous for Dashehri mangoes. This MSME produces mango pulp, jams, squash and Pickles by installing small pulp and bottling units. Branded GI-tagged mango products are linked with the ODOP and PMFME scheme.

Impact- It reduced waste during the glut season, created off-farm employment, encouraged women's participation, and strengthened the export branding of UP mangoes. It is a classic example of district specific specialization.

4. Packaged namkeen and traditional snacks - Kanpur Nagar

A case of homegrown Namkeen MSME - National brands where a small family firm produces mixture bhujia, namkeen by standardising taste and hygiene and adopting barcoding techniques, they entered organised retail chains.

Impact- Now they have expanded from local markets to pan India. they have increased their sales and still have MSME identity. They have created women

in intensive job as well it shows how traditional food becomes scalable MSME brand. All these examples and many more present, enterprises innovation, value addition and generate employment by linking supply chains and show market integration through exports.

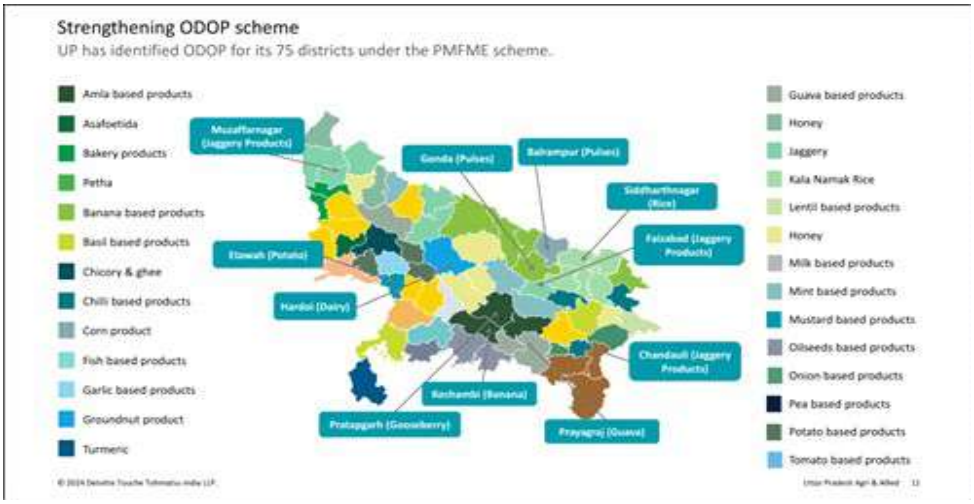
Export Dynamics

India's agricultural and processed food exports are rising steadily, In FY 2024-25, exports grew sharply by about 13% year-on-year, reaching around $25.14 billion (₹ 2 lakh crore), In the April-Feb FY25 period alone, exports were $22.67 billion, up 13% from the prior year, Rice exports (basmati + non-basmati) saw a 21% jump in FY25 (Apr-Feb) compared to last year. Organic food exports in FY2024-25 saw a notable recovery and expansion, totalling 3.68 lakh tonnes valued at $665.97 million.

U.P. exports growth

The One District One Product (ODOP) initiative has had measurable effects on state export performance, especially in Uttar Pradesh (UP):

UP's total exports increased from ₹ 88,000 crore in 2017 to ₹ 186,000 crore in 2024, a 112% increase over 8 years. ODOP-linked products now account for nearly half of total state exports, highlighting how district-specific food and traditional products are becoming a major export driver.



Export Contribution Doubled

ODOP product exports grew from ₹ 58,000 crore to ₹ 93,000 crore over this period (from original scheme baseline to recent figures), showing clear upward

momentum in value share. The government has set a target to double the share of ODOP exports again by 2030 through dedicated export desks, logistics support, digital traceability and global market expansion.

Structural Export Contribution Trends

Food processing in India accounted for around 13% of total merchandise exports in 2024, according to industry estimates, underscoring its growing importance. APEDA-mandated food exports (rice, processed foods, fruits & veg) make up approximately 51% of India's agricultural exports basket, showing that processed and high-value products are critical export segments.

Specific Breakdown

Cereal Preparations	$933.8 millions
Processed vegetables	$897.1 million
Pulses, Nuts, Fruits and juices	$854.9 millions
Miscellaneous processed foods	$1476.7 millions

1. Geo-specific cuisine and speciality exports through ODOC

One district one cuisine is a new scheme to highlight and promote district-specific culinary traditions by associating each district with one food item as their signature dish, for example, Agra's petha, Mathura's Peda, Lucknow's Revadi and Malai Makhan, Barabanki's Chandrakala, and so on. The scheme is modelled on the successful one district one product scheme. The idea is to preserve traditional foods and brand them with GI tags, Quality standards, and hygiene; support local artisans and halwais; and boost employment, entrepreneurship, and exports, which will attract global audiences and link them with export channels once demand is established.

2. Crop-specific export boards to boost horticulture and processed goods exports

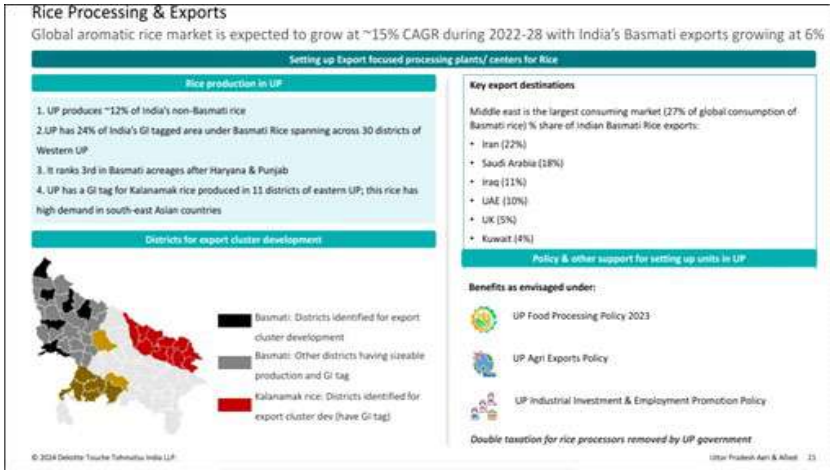
The government of Uttar Pradesh aims to establish crop-specific commodity boards, similar to national boards, such as the spice board. It would focus on key horticulture crops such as potatoes, bananas, strawberry flowers, and others with export potential. It will improve their productivity and quality and position them as exportable goods. IT will stimulate exports and integrate farmers, start-ups, and export markets to capture higher revenue.

3. Digital exports through Amazon global, IndiaMART, Udyam tools

These digital platforms help Indian MSMEs and exporters sell their products directly to consumers like Amazon, a major e-commerce platform that offers Indian brands to list their items on 20-plus international marketplaces. Over 2,00,000 Indian

sellers have joined, crossing $ 20 billion in exports, with a target to reach $80 billion by 2030.

IndiaMART is a buyer-to-buyer online marketplace connecting Indian manufacturers with domestic and global buyers. It provides exporters enhanced visibility and business contracts in international supply chains. These Platforms lower the barrier to entry into global markets, offer reach, and enable made-in-India products to gain global appeal through online sales.



Major Challenges

Here are key challenges faced by MSMEs and start-ups, and how they affect growth.

1. Infrastructure and logistics- Inadequate cold chains, Limited warehousing and logistics hamper the competitiveness of perishable goods, increasing post-harvest losses. Many start-ups and MSMEs have brilliant business ideas but lack the infrastructure to support them, making scaling up difficult and preventing them from meeting growing demand and maintaining quality due to logistical gaps.

2. Access to finance and working capital- MSMEs and start-ups often face challenges to get formal credit or are charged with high interest rates at their initial stages, when they already have fund crunches, or they face loads of procedures that discourage young food businesses from collecting working capital for businesses they can't invest in technology upgrades facing a setback in exports as well

3. Compliance standard and export readiness- To export food products in the markets of the European Union, USA, GCC countries, etc., food safety, quality standards, labelling, are important; often MSMEs and start-ups lack in

documentation, quality, compliance and required certificates. Small enterprises often remain out of the export competitiveness due to non-compliance with FSSAI, export norms and the expectations of global buyers.

4. Technology and skill gaps- Many start-ups in MSMEs in their initial phases often lack the required new technology and skills to produce orders in bulk, and sometimes they keep using old technology due to a lack of knowledge and finances, which they fail to meet rising demands, and their yield remains low. Further, they lack quality assurance, processing, and packaging as their workforce doesn't possess the required skills that match those of other advanced enterprises, which keeps them out of the competition.

5. Market access and digital integration- Though government policies support are there, still e- commerce initiatives and global market tie ups like Walmart and Flipkart make difficult for small MSME's to get access to digital marketing, export channel network access, poor brand visibility on digital platforms makes it hard for the enterprises to keep up like global peers, and they keep on struggling to make and retain global customers.

6. Regional disparities in development- Industrial infrastructure, policy support and awareness are uneven across states like western UP and major cities have better environment for start-ups and MSMEs, and areas like eastern UP and Bundelkhand lack business infrastructure. Start-ups built in these areas face high cost of logistics and for market entry.

7. Policy awareness and administrative hurdles- While national and state-level policies are supportive of the food processing sector, export awareness and ease of access vary widely on the basis of areas and phases of businesses for MSMEs and start-ups. Sometimes they lack awareness sometimes the bottlenecks like, licensing, regulatory compliance and paperwork delay market entry causing them to miss out the opportunities and benefits.

Further Opportunities and Future Perspectives

A detail explanation for future outlook and opportunities is:

1. Shift in consumption patterns- As I mentioned earlier in this chapter urbanization and working culture in both the genders have led to an increasing demand for quick convenience food. Rising income, changing lifestyle, demographic shifts like a higher young population demand for quick, safe, packaged and nutritious food in both developed and emerging markets. Countries are opened readily to international trade for food products because natives of one country living in other country demand their native taste and food, for example Indians living abroad want

to consume Indian food for which they strategically shop from Indian markets located abroad.

2. Innovation ecosystem- Startups these days are tech-driven in the food processing sector, and by adopting technology, they focus on producing innovative, sustainable, organic health food without compromising on customers' taste palettes. They are using millets and other superfoods for their health-conscious consumers. Research in smart packaging, like censored integrated technology, extends the shelf life of food and reduces waste. Worldwide incubators, such as the ProWedge Incubator in Germany, have helped start-ups develop plant-based protein and other sustainable products. In Uttar Pradesh, initiatives such as state startup funds and Technical Support from incubators strengthen the food start-up ecosystem.

3. Targeted actions- To harness global demand and develop a robust innovation ecosystem, targeted strategic actions significantly boost the growth of this sector. Actions such as specific crop boards and commodity institutions for millets, rice, fruits, and so on, as mentioned earlier, help standardise product quality and branding. Indian initiatives like the Makhana board are an ideal example of how specific actions can raise global visibility. Export clusters trade networks help combine production capacities and logistics they enhance economies of scales by reducing transactional costs and facilitate export readiness examples like APEDA led BHARATI initiative Focuses on scaling exports to new heights by 2030., enhanced incubation centres global trade missions and participation in exhibitions and summits help showcasing products focusing buyers, Example World Food India summit held in New Delhi from 25 to 28th September 2025 and At last policy linked incentives can catalysed investment, capacity expansion and employment in this sector.

The global food processing market is expected to expand in the future due to demand for convenience, nutritious, and sustainable food. Regions like Uttar Pradesh with a strong agricultural base and output will keep on transitioning raw commodities to higher-value processed hubs.

Policy Recommendations

1. District-specific processing and export clusters, such as food parks and hubs, can be formed especially for districts that produce certain products in the majority, such as dairy belts, Sugarcane zones, snacks clusters and so on and then would provide facilities like cold storage, grading, testing labs, and logistics that are common to all. This will reduce costs for MSMEs and improve quality.

2. Improve access to finance at affordable rates by expanding credit facilities to small MSMEs and start-ups. Dedicated funds for food processing sectors can be

created that should encourage new entrepreneurs to take related start-ups and will support those MSMEs that often fail due to a lack of long-term capital.

3. Promote skill development, especially for this sector, by establishing training Centres for food processing skills, such as how to minimise post-harvest losses by reducing food wastage. Skills like processing, quality control, packaging, branding, and marketing can be learned. Furthermore, these centres can be connected to the PMFME and ODOP programs. New businesses often fail due to a lack of technical skills and export awareness.

4. Upgrading infrastructure, like investing in cold storage, refrigerators, transport and warehousing, is an important step. Subsidies can be provided to new MSME's and start-ups to upgrade their infrastructure. Public-private partnerships for establishing cold chain development are encouraged; this will ensure export-quality consistency remains intact.

5. Simplifying regulations and over-documentation by creating a single window clearance system for MSMEs. Easing the process of FSSAI licensing for small and micro units. District-level offices for food processing industries can be set up, which can then help new firms establish MSMEs and start-ups, as small firms often face setbacks due to complex regulations.

6. Encouraging adoption of technology by providing subsidies and grants on automation, food testing tech, modern packaging, labelling and barcoding, facilitates MSMEs' listing on Amazon Global, IndiaMART and other export portals. Customised digital dashboards can be created for UP exports to improve productivity and market reach.

7. Support women in rural entrepreneurship by giving special credit, mentoring women-led start-ups, and promoting self-help group-based food enterprises under PMFME. Rural entrepreneurship should be encouraged by providing affordable loans and simplified documentation, promoting awareness of food processing, and providing export knowledge from experts, thereby enhancing inclusive growth and rural employment.

Apart from these, a strong monitoring and data system should be set up to maintain district-wise data on MSME units, employment, output, and exports, which will be used for policy correction and support. This will improve evidence-based policy-making.

Conclusion

The economy of Uttar Pradesh offers significant potential for the food processing industry, MSMEs, and start-ups, which are proven engines of

transformation for the Indian economy. They bridge the gap between raw agricultural production and value-added markets by minimising post-harvest losses, regulating supply chains and creating decentralised employment in rural areas and semi-urban regions. Through innovation and the adoption of digital methods, these enterprises have increased productivity and diversified exports, connecting local producers to global value chains. Moreover, they have also helped generate employment opportunities for both youth and women by influencing development at the district level through the ODOP AND ODOC Models. These are supported by various policy initiatives, such as access to finance and digital markets, to help build resilience against market shocks.

Therefore, the transformative role of MSMEs in start-ups lies in their ability to unlock local potential by adding value and making start-ups competition-ready, thereby facilitating long-term growth and socio-economic inclusion.

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15

Fiscal Sustainability in India in the Context of Viksit Bharat @ 2047

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Abstract: *Fiscal sustainability has become a central macroeconomic challenge for India as the country pursues its ambition of becoming a developed nation under the Viksit Bharat @2047 vision, with fiscal imbalances, rising public debt, and expanding public expenditure requirements raising concerns about long-term macroeconomic stability and intergenerational equity. This chapter, titled Fiscal Sustainability in India in the Context of Viksit Bharat @2047, aims to examine the relevance of fiscal sustainability in supporting India's growth aspirations while maintaining fiscal discipline. The primary objective of the chapter is to analyze India's fiscal position in the context of recent economic developments and to assess how a sustainable fiscal framework can enable inclusive and resilient growth. The research methodology is qualitative and descriptive in nature, relying on secondary data from authorized sources and existing literature on fiscal sustainability. The chapter adopts a macroeconomic perspective to evaluate trends in fiscal deficit, public debt, and public spending priorities. The key arguments of the chapter emphasize that fiscal sustainability should not be viewed merely as a constraint on development but as a strategic enabler of long-term economic transformation. It argues for a shift from a narrow focus on annual deficit reduction toward a forward-looking approach centred on debt dynamics, quality of public expenditure, and effective fiscal governance. The chapter highlights that prudent fiscal management is essential for financing infrastructure, social development, and a digital transformation, thereby supporting India's transition toward a developed, inclusive, and resilient nation by 2047, which will help achieve the long-term development goal of Viksit Bharat @2047 vision of the Indian Government.*

Keywords: *Fiscal sustainability, Viksit Bharat @2047, Long-term development goal, Fiscal deficit, Public debt, Macroeconomic stability.*

1. Introduction

Fiscal imbalances are a major obstacle in developing countries. India is

one of the examples of this, and India has a long history of fiscal imbalances, so maintaining fiscal consolidation and achieving fiscal sustainability is the key macroeconomic issue in front of India (Olekalns and Paul, 2000). Fiscal sustainability refers to a government's ability to maintain its current spending, tax, and other fiscal policies without risking solvency or imposing untenable burdens on future generations (Buiter, 1985). In the Indian context, fiscal sustainability has become central to economic policy debates, as the economy transitions towards higher growth, structural reforms, and inclusive development.

In this global era, every country wants to become a developed nation because a developed nation has a quality-based economy and a high standard of life enjoyed by all citizens. To fulfill this dream, the Indian government launched the Viksit Bharat initiative to transform the economy into a developed nation by the 100th anniversary of its independence in 2047. The main characteristics of the initiative are economic prosperity, social advancement, environmental sustainability, and effective governance. The Viksit Bharat initiative sets the target of achieving GDP from 30 trillion USD to 40 trillion USD by the year 2047. Achieving this goal, the Indian economy requires a stable macroeconomic environment reflecting high sustained growth, large-scale public investment and a better fiscal management regime (NITI Aayog, 2023).

India's fiscal imbalances have been deteriorating over the past few years. The fiscal deficit refers to the gap between revenue and expenditure that the government finances through borrowing remained 4.8% of GDP for FY 24-25. The government of India set a fiscal deficit target of 4.4% of GDP for FY25-26, indicating tighter control over public finances after pandemic-era spending expansion (Union Budget, 2025). According to IMF data on India, general government gross debt was 81.6% of GDP in 2024 and 81.4% in 2025, reflecting both pandemic-related borrowing and long-term fiscal imbalances.

The relevance of fiscal sustainability in the context of Viksit Bharat @2047 is well-suited for emphasising accelerated economic growth, inclusive development, infrastructure development, and digital transformation (NITI Aayog, 2023). Financing these sectors requires high public expenditure, which can raise the fiscal deficit and pose a major obstacle to macroeconomic stability. In this sense, fiscal sustainability should not be viewed as a constraint on development, but rather as a strategic enabler of long-term growth and economic resilience.

This chapter focuses on India's fiscal sustainability, which should shift from a narrow framework of annual deficit reduction to a broader, forward-looking framework centred on debt dynamics, the quality of public spending, and intergenerational equity. By examining India's evolving fiscal trajectory, this chapter

highlights how a sustainable fiscal framework can support India's transformation into a developed economy by 2047.

2. Literature review

2.1 Conceptualizing Fiscal Sustainability

Fiscal sustainability plays an important role in the macroeconomic stability of any developing country. Due to high public expenditure and rising debts, developing countries often face fiscal deficits, which are not healthy for a country's macroeconomic stability. Buiter (1985) defines fiscal sustainability as the government's capacity to maintain its current spending, tax, and borrowing policies without risking solvency or shifting undue burdens onto future generations. The International Monetary Fund (IMF, 2013) further operationalizes the concept as a condition in which the public debt-to-GDP ratio remains stable or declines over time under existing fiscal policies.

Blanchard (2019) argues that when growth exceeds the interest rate on public debt, governments can sustain higher debt levels without running persistent primary surpluses. Escolano (2010) argues that growing economies face high vulnerabilities due to volatile capital flows, inflation risk, and growth shocks, which weaken the favorable r-g conditions.

2.2 India's framework and FRBM Regime

The FRBM Act of 2003 is the cornerstone of India's present fiscal discourse. It aimed to set the targets for fiscal deficits and public debt to institutionalize the fiscal discipline that provided the momentum for fiscal consolidation (Government of India, 2003). Many studies show that the FRBM Act provides momentum to the fiscal consolidation of India. On the other hand, the financial crisis and COVID-19 pandemic shocked the economy, which shifted the government's focus to revising fiscal targets (Rangarajan and Srivastava, 2019). The IMF (2013) notes that the COVID-19 shock increased India's public debt-to-GDP ratio and threatened the long-term fiscal sustainability and macroeconomic stability.

2.3 Structural Challenges to Fiscal Sustainability in India

Empirical studies identify several structural challenges to India's fiscal sustainability. Mohanty (2020) highlights a narrow tax base, high revenue deficits, and substantial interest payments as constraints that crowd out productive public investment. The introduction of the GST in 2017 was the biggest step to rationalize indirect taxation. However, Rao and Kumar (2017) observe that short-term revenue changes imply the instability of macroeconomic indicators, and coordination challenges between the centre and states have a limited stabilisation impact. The rising welfare expenditure and subsidy commitments worsen the economy's fiscal condition and even create pressure within India's public finance framework.

2.4 Long-Term Vision and the Viksit Bharat@2047 Context

The recent studies emphasize the policy-oriented fiscal sustainability aligning with long-term development goals. In this way, NITI Aayog's vision of Viksit Bharat @2047 underscores inclusive growth, infrastructure expansion, and a green transition, all of which require significant fiscal commitments (NITI Aayog, 2022). Public investment in infrastructure, human capital, and technology can improve debt dynamics by raising long-term growth, making higher debt sustainable (Abbas & Christensen, 2010). For India's Viksit Bharat vision, sustainability must be evaluated in terms of growth-enhancing deficits, not just numerical targets.

2.5 Research Gaps

Moreover, the existing literature largely emphasizes a medium-term policy-oriented framework for fiscal sustainability and public debt in India. This chapter contributes to developing a long-term policy-oriented framework that connects fiscal sustainability with the Viksit Bharat @2047 vision. It links debt dynamics with public capital expenditure, green fiscal reforms and digital tax modernization, while largely addressing fiscal sustainability. The chapter offers actionable policy insights for sustaining high growth without compromising intergenerational equity.

3. Research Methodology

This chapter adopts a policy-oriented analytical framework combining quantitative macro-fiscal analysis with qualitative institutional review to examine fiscal sustainability in India within the long-term development vision of Viksit Bharat@2047. The study relies on secondary data from authoritative national and international sources such as the Reserve Bank of India (RBI), the Ministry of Finance (Union Budgets, FRBM statements, and Economic Surveys), the IMF (World Economic Outlook and fiscal Monitor), the World Bank (World Development Indicators), and the NITI Aayog reports. The period of study is chosen from 2000 to 2024, capturing major fiscal reforms, crises and phases. The analysis is based on a descriptive and trend-based method which includes key indicators like debt-to-ratio, fiscal deficit, primary balance, revenue receipts, tax buoyancy, interest payments, and capex. A forward-looking approach is applied to explore fiscal sustainability pathways aligned Viksit Bharat@2047 vision.

4. India's Fiscal Trajectories

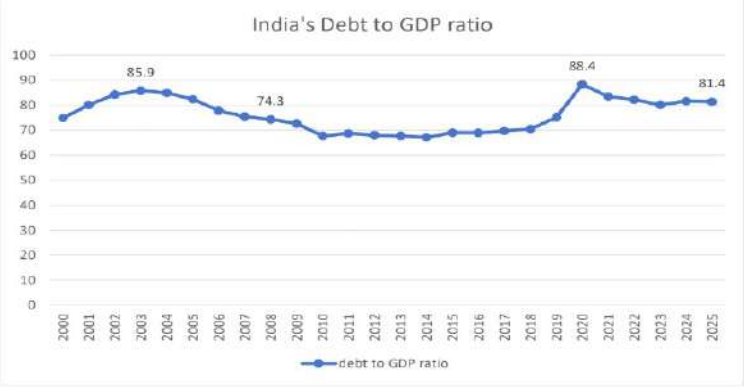
Analysis of some key indicators, such as debt-to-GDP ratio, fiscal deficit, primary balance, revenue and capital expenditure composition collected from different sources, which show India's fiscal dynamics, is given below:

Figure 1 shows the evolution of India's general government debt-to-GDP ratio from 2000 to 2025 based on IMF World Economic Outlook Data. The trajectory

can be divided into four phases. First is the early 2000s (pre-FRBM) period, where the public debt burden peaked at 85.9% of GDP in 2003. Second is the post-FRBM phase from 2004-2008, which shows a steady decline in the debt ratio, falling from above 80% to about 74.3% by 2008. Third, between 2009 and 2019, that is, the pre-pandemic or post-global financial crisis phase, the debt ratio remained stable but on a mildly upward trend, ranging from 66% to 75% of GDP. Finally, COVID-19 shocks triggered a sharp increase in the debt ratio, which reached approximately at 88.4% of GDP in 2020. In the post-pandemic period, the debt-to-GDP ratio is expected to decline to 81.4% by 2025.

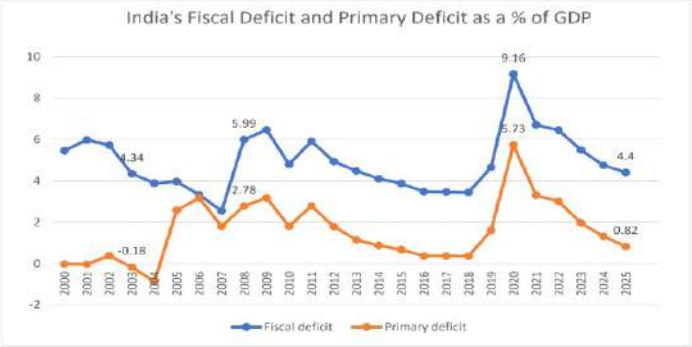
In Figure 2, the chart shows that India's government deficits change in phases. Before the FRBM law (early 2000s), the fiscal deficit remained high at about 5-6% of GDP, and the primary deficit was near zero, meaning the government was borrowing mainly to pay old interest and had weak spending controls. After FRBM (2004-08), both deficits fell, showing better financial discipline and the healthiest period for government finances. During the 2008 global financial crisis, deficits rose sharply because the government increased spending to support the economy. In the years before COVID-19, deficits slowly came down again, but the pandemic caused a sharp increase, with a 9.16% fiscal deficit and a 5.73% primary deficit. After COVID, both deficits have been decreasing, which shows that the government is slowly returning to better fiscal control, though not yet as strong as in the FRBM years.

Figure 1: India's Debt to GDP Ratio



Source: World Economic Outlook, October 2025, IMF

Figure 2: India's Fiscal deficit and Primary deficit as a % of GDP



Source: Handbook of Statistics of Indian Economy 2024-25, RBI

Table 1 illustrates the evolution of India's revenue and capital expenditure as a percentage of GDP across four fiscal phases. In the pre-FRBM phase (2000-01 to 2003-04), revenue expenditure remained high at around 12.7-13.3% of GDP, while capital expenditure rose from 2.19% to 3.84%, indicating fiscal stress and weak discipline. Post-FRBM (2004-05 to 2007-08) shows improvement, as revenue expenditure declined from 11.85% to 11.92%, and capital expenditure contained between 1.6-2.4%, reflecting consolidation. During the pre-pandemic period (2008-09 to 2019-20), revenue expenditure stayed relatively rigid at 11-14%, while capital expenditure remained low at 1.8%, limiting growth potential. Post-pandemic (2020 onward), both revenue and capital expenditure increased, supporting recovery but raising sustainability concerns.

Table 1: Revenue and Capital Expenditure of Central Government (as % of GDP)

Year	Revenue Expenditure (% of GDP)	Capital Expenditure (% of GDP)	Interest Payments (% of GDP)
2000-01	12.76	2.19	4.56
2001-02	12.80	2.58	4.56
2002-03	13.35	2.94	4.64
2003-04	12.74	3.84	4.37
2004-05	11.85	3.50	3.92
2005-06	11.90	1.80	3.59
2006-07	11.98	1.60	3.50
2007-08	11.92	2.37	3.43
2008-09	14.10	1.60	3.41
2009-10	14.08	1.74	3.29
2010-11	13.37	2.01	3.01
2011-12	13.12	1.82	3.13
2012-13	12.51	1.68	3.15

2013-14	12.21	1.67	3.33
2014-15	11.77	1.58	3.23
2015-16	11.17	1.84	3.21
2016-17	10.98	1.85	3.12
2017-18	10.99	1.54	3.10
2018-19	10.62	1.63	3.08
2019-20	11.71	1.67	3.05
2020-21	15.53	2.15	3.42
2021-22	13.56	2.51	3.41
2022-23	12.81	2.75	3.45
2023-24	11.60	3.15	3.53
2024-25	11.18	3.08	3.44
Source: Handbook of Statistics of the Indian Economy, 2024, RBI			

Table 1 also shows interest payment as a % of GDP, illustrating clear phase-wise shifts in India's fiscal sustainability. In the pre-FRBM period, interest payments were high and rising, at about 4-5% of GDP, reflecting a heavy debt burden and weak sustainability. After the FRBM Act, they declined to around 3.5-4% of GDP, indicating improved sustainability due to fiscal consolidation and lower deficits. In the pre-pandemic years, the interest burden stabilised at about 3.5-3.8%, but the pandemic led to a high rise to around 4.5% of GDP. In the post-pandemic phase, interest payments remained high but showed stronger growth, improving fiscal sustainability.

5. Key Challenges to Fiscal Sustainability in India

India's fiscal sustainability is influenced not only by short-term shocks but also by deep structural, cyclical, and institutional constraints. These are given below:

5.1 Structural Challenges

5.1.1 Narrow tax base: India's tax-to-GDP ratio remains around 17-18%, well below many emerging economies, because only a small proportion of individuals and firms are in the formal tax net. This limits stable revenue generation and increases borrowing even for routine expenditures, raising long-term debt and weakening fiscal sustainability (RBI, 2023; World Bank, 2022).

5.1.2 Low tax buoyancy: Despite GST reforms, tax revenues remain weakly responsive to GDP growth, with buoyancy often near or below 1. Meanwhile, infrastructure and social sector expenditures rise faster than revenues, locking the government into recurring deficits and slowing fiscal consolidation (RBI, 2022)

5.1.3 Subsidy pressures: Food, fertiliser, and fuel subsidies often exceed 2-3% of GDP during global commodity shocks. Poor targeting and procyclical

increases crowd out capital expenditure and raise revenue deficits, weakening the quality of fiscal adjustment (Government of India, 2023).

5.1.4 Social sector spending needs: Health expenditure remains around 2.1% of GDP and education near 4-4.5%, below policy targets. Meeting these needs requires borrowing, raising long-term debt, and incurring an interest burden (IMF, 2023).

5.2 Cyclical and External Risks

5.2.1 Post-COVID fiscal effect: The pandemic pushed the central government deficit to 9.8% of GDP in 2020-21 and public debt to 88.4% of GDP. This permanent increase in debt and interest burdens reduces fiscal space and raises problems for growth (RBI, 2023).

5.2.2 High global interest rates: Tighter monetary conditions raise domestic borrowing costs, increasing interest payments, which have already reached 3.5-4.5% of GDP and over 20% of revenue receipts. Higher rates crowd development spending and slow consolidation, increasing debt-interest risk (RBI, 2023).

5.2.3 Oil price volatility: India imports over 85% of crude, which typically increases the deficit by 0.2-0.3% of GDP. Rising oil costs worsen subsidies, reduce indirect tax revenue and weaken macroeconomic stability (IMF, 2023).

5.3 Institutional Challenges

5.3.1 FRBM credibility issues: Repeated deviation from FRBM targets weakens rule-based discipline. Market doubts about fiscal commitment increase borrowing costs, making sustainability harder to achieve. (FRBM Review Committee, 2017; RBI, 2023).

5.3.2 Off-budget borrowing: Extra-budgetary resources have exceeded Rs 3-4 trillion in recent years. While temporarily improving headline indicators, these hidden liabilities create a burden reflected in the budget, undermining fiscal sustainability (CAG of India, 2021).

6. Reforms and Their Impacts

India's fiscal and economic reforms over the last two decades, such as FRBM, GST, direct tax reforms, and expenditure-side changes, were introduced to fix deep structural problems in public finance. The impact of these reforms is given below:

6.1 FRBM Reform

The FRBM framework aimed to control fiscal deficits and government debt by setting a target of 3% of GDP. It helped to reduce the fiscal deficit from 5.9% in 2002-03 to 2.5% in 2007-08, showing early success. (NK Singh Committee,

2017). However, the rule lost credibility after the targets. The deficit rose sharply to 9.2% of GDP in 2020-21 and remained above 6% in 2022-23 (RBI, 2023). These figures show that FRBM failed to ensure long-term fiscal discipline. For the future, India needs debt-based fiscal rules and an independent fiscal council.

6.2 GST Reform

GST tried to unify the national market and improve tax compliance. The number of GST taxpayers increased from about 6.5 million in 2017 to over 14 million by 2023 (RBI, 2023). Monthly GST collection crossed Rs 1.6 lakh crore several times in 2023-24, compared to about Rs 90,000 crore in the early years. However, GST revenue remains modest at around 5.5-6% of GDP, below expectations (Rao and Chakraborty, 2020). The multi-rate structure and frequent rule changes increased compliance costs and disputes. Centre-State tensions also grew due to compensation payments exceeding Rs 3 lakh crore between 2017 and 2022.

6.3 Direct Tax Reforms

Direct tax reforms focused on making taxes simpler and more competitive. The corporate tax rate, cut from 30% to 22% in 2019, reduced revenue by about Rs 1.45 lakh crore annually (OECD, 2021). However, private investment stayed weak at around 30% of GDP, showing limited impact. Personal tax filings increased from 36 million in 2014 to over 80 million in 2023. Indicating better compliance (CBDT, 2022).

6.4 Expenditure-Side Reforms

Expenditure-side reforms showed stronger results. Direct Benefit Transfers saved an estimated Rs 2.7 lakh crore between 2013 and 2022 by reducing leakages (NITI Aayog, 2021). Public capital spending rose from Rs 4.4 lakh crore in 2017-18 to over Rs 10 lakh crore in 2023-24, supporting infrastructure growth (RBI, 2023).

7. Fiscal Sustainability and Viksit Bharat @2047: An Empirical Analysis

India's vision of becoming a developed nation by 2047 (Viksit Bharat @2047) depends not only on high economic growth but also on stable and credible public finances. Fiscal sustainability is the financial foundation for this long-term development goal. For this stabilizing, important pillars are given below:

7.1 Post-Pandemic Consolidation

India's fiscal deficit widened sharply during the COVID-19 shock, rising from 3.5% of GDP in FY19 to 9.2% in FY21. (Ministry of Finance, 2023). This was a deliberate countercyclical response to prevent economic breakdown. Further,

the deficit declined to 6.7% in FY22, 6.4% in FY23, 5.6% in FY24, and about 4.8% in FY25 (RE), with a target of 4.4% in FY26 (BE) (Union Budget, 2025-26). Instead of this fiscal consolidation, India's fiscal sustainability is being pursued without obstructing economic momentum. For Viksit Bharat @2047, this matters because long-term development requires predictable, credible public finances.

7.2 Capital Expenditure

Capex has risen from Rs3.36 trillion in FY20 to Rs 10.0 trillion in FY24, about 3.0% of GDP, and further to 3.2% of GDP in FY25 (Ministry of Finance, 2025). Research shows that infrastructure and human capital spending raise long-term growth more than routine consumption spending. For Viksit Bharat @ 2047, this capex push supports logistics, digital systems, clean energy, and urban development.

7.3 Debt Stabilization and Intergenerational Equity

India's central government debt rose from 52.2% of GDP in FY20 to around 62% in FY21 due to pandemic borrowing (IMF, 2022). The government has since announced a shift towards a debt-to-GDP anchor, aiming to reduce central government debt to about 57% by FY26 and 55% by FY28. This shift matters not only for macroeconomic stability but also for intergenerational equity. High public debt increases future interest payments, which already exceed Rs. 10 trillion per year, reducing funds available for future generations (RBI, 2023). In this sense, fiscal discipline became a moral as well an economic requirement for Viksit Bharat @2047.

7.4 Revenue Growth

India's revenue growth grew by 34% in FY22, 22% in FY23, and 13% in FY24. GST collection rose from Rs 11.4 trillion in FY19 to over Rs trillion in FY24. (Ministry of Finance, 2024). This matters because higher revenues allow India to reduce deficits while keeping capex high. For Viksit Bharat @2047, this revenue momentum is a critical financing channel.

7.5 Climate Dimension

Strengthening GST systems and municipal taxation is therefore essential for balanced development, climate finance is also becoming a fiscal priority. India has committed to 500 GW of non-fossil energy capacity by 2030. To support this, the government issued sovereign green bonds worth Rs 16,000 crore in FY23-24 (World Bank, 2020). These investments protect not only the environment but also the welfare of future generations.

Table 2: Key Dimensions of Fiscal Sustainability and their Relevance to Viksit Bharat @2047

Dimension	Policy Instruments	Relevance to Viksit Bharat@2047 Vision
Revenue mobilization	GST reform, tax base widening, digital tax	Funds infrastructure, health, education, R&D
Expenditure quality	Capital spending, DBT, outcome budgeting	Higher growth multipliers, reduced leakage
Debt management	FRBM rules, maturity management	Prevent debt stress, preserves fiscal space
Federal fiscal strengthening	Conditional grants, GST compensation	Inclusive and balanced regional development
Climate-aligned fiscal policy	Green taxes, fossil fuel subsidy reform	Environmentally sustainable growth
Source: Author's compilation based on IMF (2022), RBI (2023), and World Bank (2020)		

8. Conclusion

India's journey toward Viksit Bharat @2047 is inseparable from the question of fiscal sustainability. The analysis shows that fiscal discipline in India is being treated as a long-term development instrument. The steady reduction of fiscal deficit from the pandemic era, the structural rise in capital expenditure to over 3% of GDP, and shift toward a debt-to-GDP ratio together signal a deliberate effort to align public finance management with long-term development goals. Intergenerational equity is equally important. By stabilizing public debt and relying more on revenue growth than on borrowing, India is seeking to ensure that today's development does not become tomorrow's fiscal burden. Overall, India's evolving fiscal strategy reflects the structural link between macroeconomic stability and fiscal sustainability. If the current consolidation path and debt stabilization goals are sustained, fiscal sustainability can serve as the financial backbone of Viksit Bharat @2047.

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16

From Dairy Tt Digital: Cooperative Models as A Pathway to Inclusive Growth in India

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Abstract: *A deep and growing contradiction marks India's economic transition: while the country aspires toward inclusive development under the Viksit Bharat 2047 vision, the dominant corporate model of the digital economy continues to concentrate wealth in the hands of platform intermediaries, often at the direct expense of workers and consumers. This paper examines the cooperative model as a structurally viable and historically validated alternative to corporate platform capitalism, using two cases to anchor the analysis. The first is Amul — formally the Gujarat Cooperative Milk Marketing Federation (GCMMF) — which, through the Anand Pattern of three-tier cooperative organisation, transformed an exploitative middleman-dominated dairy sector into the world's largest dairy cooperative, now connecting 3.6 million farmer-members and surpassing ¹ 1 lakh crore in brand turnover. The second is BharatTaxi, a proposed platform cooperative model for India's ride-hailing sector, which is examined here as a potential application of cooperative principles to counter the documented exploitation of gig workers by corporate aggregators such as Ola and Uber.*

Drawing on the theoretical frameworks of platform cooperativism and the classical Drain of Wealth thesis, this paper argues that corporate platform intermediaries in the gig economy replicate a neo-colonial pattern of value extraction — capturing labour and consumer surplus while repatriating profits abroad. A cooperative alternative, by contrast, returns value to its worker-owners, strengthens local economic resilience, and aligns with India's stated goals of inclusive growth and reduced inequality. The paper concludes with policy recommendations for enabling a cooperative digital economy in India.

Keywords: *cooperative economics, platform cooperativism, Amul, gig economy.*

Introduction

India's economy stands at a defining crossroads. As the country charts its course toward the ambitious Viksit Bharat 2047 vision — aspiring to become a

fully developed nation within a generation — the central question is not merely one of growth, but of *whose* growth. The structural reforms and technological transitions driving India's economic expansion have simultaneously created new forms of inequality, particularly in the labour market, where the rise of the digital platform economy has generated employment at scale while systematically denying workers security, ownership, and a fair share of the value they create.

India's gig and platform sector employed an estimated 7.7 million workers in 2020, a figure NITI Aayog projects will nearly triple to 23.5 million by 2029–30 (NITI Aayog, 2022). By 2047, government-affiliated projections suggest this workforce could reach 61.6 million, forming nearly 15 per cent of India's non-agricultural workforce (VV Giri National Labour Institute, as cited in NITI Aayog, 2022). However, the very model powering this growth is under serious scrutiny. Ola and Uber are not obligated to provide social security benefits to drivers, while simultaneously treating them as conventional employees — imposing controls and extracting maximal labour (Surie & Koduganti, 2017). The platform intermediary thus occupies a familiar and troubling role in India's economic history: that of the middleman who captures the surplus while the producer and the consumer both lose.

It is precisely this structural parallel that makes a historical detour instructive. In 1946, dairy farmers in Anand, Gujarat, faced an almost identical predicament — milk traders formed cartels, bought produce cheaply, and sold to consumers at steep markups. Their response, guided by Sardar Vallabhbhai Patel and institutionalised under the visionary leadership of Dr Verghese Kurien, was to eliminate the middleman and form a cooperative owned by themselves. The result was Amul — today the world's largest dairy cooperative, connecting 18 district unions, 18,000 cooperative societies, and 3.6 million farmers, with a brand turnover exceeding ₹1 lakh crore (GCMMF, 2025). Amul returns 85 per cent of every rupee earned on a product back to its farmer-members — far above the global average of 33 per cent (Doughnut Economics Action Lab, 2023).

This paper argues that the cooperative model, far from being a relic of India's agrarian past, offers a structurally sound and democratically superior alternative to the corporate platform economy of the present. Drawing on the theoretical framework of platform cooperativism developed by Trebor Scholz, who coined the term in 2014 to describe democratically controlled cooperative alternatives that allow workers to exchange their labour without the manipulation of the middleman (Scholz, 2014), the paper examines two cases: Amul as a proven model and BharatTaxi as a proposed application of cooperative principles to the ride-hailing sector. It further draws on Dadabhai Naoroji's Drain of Wealth thesis, which argued that Britain systematically

transferred Indian resources to itself through trade imbalances and repatriated profits (Naoroji, 1901, as cited in Shinde, 2024), applying this analytical lens to the contemporary repatriation of platform profits by multinational aggregators.

Literature Review

The literature relevant to this paper spans four interconnected areas: cooperative economics, platform capitalism, the Amul model, and platform cooperativism.

Cooperative Economics: From Rochdale to Ostrom

The modern cooperative movement traces its origins to the Rochdale Equitable Pioneers Society established in England in 1844 (International Cooperative Alliance [ICA], n.d.). Formed in response to exploitative market practices, the Rochdale model institutionalised principles of voluntary membership, democratic control, and equitable surplus distribution, later formalised by the ICA in 1995 (ICA, 1995). These principles remain central to cooperative movements globally, including in India, and reflect a recurring structural response to exploitative intermediaries.

Elinor Ostrom's *Governing the Commons* (1990) provided the strongest theoretical defence of collective self-governance. Challenging Hardin's "tragedy of the commons," Ostrom demonstrated through extensive empirical evidence that well-designed member-governed institutions can sustainably manage shared resources. Her framework highlights the importance of clear membership rules, democratic participation, and conflict-resolution mechanisms, offering a strong theoretical basis for cooperative enterprises (Ostrom, 1990).

The Political Economy of Platform Capitalism

Critical scholarship on platform capitalism argues that digital platforms function as intermediaries that extract value while externalising risk onto workers. Srnicek (2017) describes platforms as data-driven systems dependent on continuous expansion and labour precarity. Once established, platforms acquire monopolistic power that enables ongoing extraction from users with minimal productive contribution (LSE Review of Books, 2017).

In India's ride-hailing sector, this dynamic has produced declining driver incomes and widespread protests. Drivers associated with Ola and Uber experienced earnings declines of 30–45% in 2017 (Economic & Political Weekly, 2018), while platforms simultaneously avoided obligations associated with formal employment despite exercising significant control over workers (Surie & Koduganti, 2017). This structural imbalance forms the basis for exploring cooperative alternatives.

The Amul Model in the Literature

Amul is widely studied as a successful cooperative development model. Scholars identify its three-tier Anand Pattern structure — village societies, district

unions, and state federations — as the institutional innovation that enabled both scale and member ownership (Rajendran & Mohanty, 2004, as cited in ScienceDirect, 2022). The model combines democratic ownership with professional management accountable to elected producer representatives (NDDB, n.d.).

Its success was also supported by state-led initiatives such as Operation Flood (1970), which transformed India into the world's largest milk producer and significantly increased milk availability nationwide (Agriculture Institute, 2025). The literature, therefore, situates Amul at the intersection of cooperative governance, professional management, and enabling public policy.

Platform Cooperativism: An Emerging Framework

The concept of platform cooperativism, developed by Trebor Scholz (2014), proposes democratically owned digital platforms as alternatives to corporate gig-economy models. In *Uberworked and Underpaid* (2016), Scholz argues that platform infrastructure can be collectively owned and governed by workers, enabling more equitable distribution of profits and decision-making power.

Examples such as Up & Go, Green Taxi Co-op, and Stocksy United illustrate the practical viability of this model (Scholz, as cited in Glasp, 2021). However, the literature also highlights significant challenges, including limited access to capital, governance complexities, and competition from heavily subsidised corporate platforms. These tensions are central to evaluating the feasibility of BharatTaxi in India's ride-hailing economy.

Taken together, this literature establishes the conceptual foundation of the paper. It demonstrates that cooperative institutions possess deep historical roots, strong theoretical legitimacy, proven success in India's dairy sector, and growing relevance in the digital economy. At the same time, the adaptation of cooperative principles to platform-based industries remains an evolving and underexplored area of research.

Conceptual Framework

This paper employs an integrated conceptual framework built around three interconnected analytical lenses: the Exploitation–Elimination Model of cooperative formation, the Ownership–Surplus Nexus, and the Neo-Colonial Value Drain thesis. Together, these explain both the persistence of exploitative intermediary structures and the structural advantages of cooperative alternatives.

The Exploitation–Elimination Model

Historical cooperative movements, from the Rochdale Pioneers to Amul, emerged as institutional responses to exploitative intermediaries. In such systems, intermediaries possess disproportionate bargaining power, suppress producer incomes, inflate consumer prices, and capture surplus without contributing productive value. As Judge (2022) notes, the very role of intermediaries gives them outsized economic

power. Cooperatives respond by transforming the intermediary into a member-owned institution and redistributing surplus to producers, workers, and consumers.

This logic applies directly to both case studies in this paper. In 1946, Anand, exploitative milk traders dominated the dairy economy; in contemporary India, digital intermediaries such as Ola, Uber, and Rapido similarly extract commissions while controlling exchanges between drivers and passengers. In both cases, the cooperative model seeks to reclaim surplus for those who generate it.

The Ownership–Surplus Nexus

The key distinction between cooperatives and corporations lies in ownership structure and surplus distribution. Corporate profits primarily benefit shareholders, whereas cooperative surpluses are reinvested or redistributed to members in proportion to their participation (NCBA CLUSA, n.d.). Consequently, cooperatives prioritise the welfare of members — farmers, drivers, or workers — rather than external investors.

This distinction has major distributive implications. In corporate systems, labour is treated as a cost to be minimised; in cooperatives, workers are also owners whose welfare the institution is designed to protect. While stakeholder capitalism advocates broader participation in governance (Institute for the Study of Complex Systems, n.d.), cooperatives institutionalise this principle through democratic ownership and decision-making.

The Neo-Colonial Value Drain Thesis

The third lens adapts Dadabhai Naoroji's Drain of Wealth thesis to contemporary platform capitalism. Multinational digital platforms often extract commissions and repatriate profits abroad rather than reinvesting locally, creating what CCCB Lab (2025) describes as a form of "digital colonialism." Much like colonial trading companies, these platforms are structurally incentivised to extract surplus while maintaining producer dependency.

Applied to India's ride-hailing sector, this framework suggests that the commission structures of Ola and Uber represent not merely labour exploitation but a broader economic drain from Indian workers and consumers to foreign shareholders. Cooperative platforms counter this process by retaining ownership, profits, and economic value within local communities (Sustainability Directory, n.d.).

The Integrated Framework

Together, these three lenses provide a framework for evaluating both Amul and BharatTaxi. The model predicts that cooperatives emerge when: (a) exploitative intermediaries create structural surplus extraction; (b) workers or producers possess the collective capacity to organise alternatives; and (c) supportive policy conditions enable scaling and sustainability. Amul fulfilled all three conditions historically.

BharatTaxi's long-term success will similarly depend on whether India's evolving regulatory environment can provide sustained institutional and policy support.

Case Study I — Amul: The Anand Pattern as Proof of Concept

The genius of Amul's model lies not in any single innovation but in its three-tier organisational architecture, known as the Anand Pattern. At the base, village dairy cooperative societies (DCS) are formed by milk producers — any producer can become a member by purchasing a share and committing to sell milk to the society. Each DCS has a milk collection centre where members bring milk daily. Every member has one vote regardless of how much milk they contribute, keeping small farmers on equal footing with larger producers (Agriculture Institute, 2025). At the middle tier, district milk unions aggregate the village societies, handle processing, quality testing, logistics, and technical training — all through elected bodies that maintain democratic accountability up the chain. At the apex, the Gujarat Cooperative Milk Marketing Federation (GCMMF) manages national and international marketing, branding, and distribution, employing professional managers who are structurally accountable to elected farmer-representatives below them.

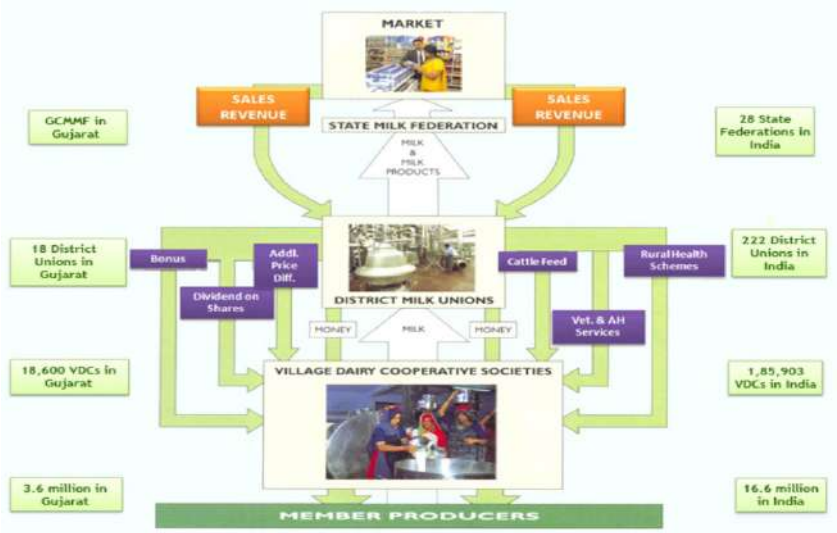

Fig. Diagrammatic representation of the AMUL Cooperative.

The Anand Pattern succeeds because it involves people in their own development through cooperatives where professionals are accountable to leaders elected by producers — the institutional infrastructure, from village cooperative to national marketing, is owned and controlled by farmers (NDDB, n.d.). This separation of professional management from democratic ownership is the key design

insight: it captures the efficiency advantages of corporate management while preserving the equity advantages of cooperative ownership.

The outcomes of this institutional design are measurable and remarkable. Amul's three-tier cooperative structure today connects over 18,600 village dairy cooperatives with approximately 3.6 million milk producers across India, the majority of them women (Krishi Jagran, 2025). Amul collects more than 32 million litres of milk daily and delivers over 24 billion product packs annually (Fair Observer, 2025). In the financial year 2025, the cooperative achieved a brand turnover of ₹ 65,911 crore and total revenues of approximately ₹ 90,000 crore (Fair Observer, 2025). In 2025, the International Cooperative Alliance ranked Amul the world's number one cooperative in its World Cooperative Monitor, recognising its GDP per capita performance and expanding economic footprint (Krishi Jagran, 2025).

The social impact is equally significant. The Amul cooperative model ensured farmers received 80 per cent of the end-product price, compared to just 20 per cent under the previous middleman-dominated system, thereby directly transforming farmers' incomes. Women constitute approximately 70 per cent of the dairy workforce, and cooperative membership has enhanced their control over income and decision-making roles. Operation Flood — the national scaling of the Anand Pattern launched in 1970 — transformed the lives of more than 13.4 million farmers, most of them poor, of whom 3.7 million were women (Boloji, n.d.).

Evaluated against the three conditions identified in the conceptual framework, Amul's success is explicable rather than miraculous. First, the condition of exploitative intermediation was clearly met — Polson's cartel created the structural injustice that motivated collective action. Second, producers had sufficient collective will, organisational capacity, and credible leadership (Tribhuvandas Patel, Verghese Kurien) to build an alternative institution. Third, and critically, the Anand Pattern was strengthened by a larger policy architecture built through the National Dairy Development Board and Operation Flood, which created the National Milk Grid and used the Anand model to expand dairy cooperatives across states (Policy Circle, 2026). All three conditions were met simultaneously — and the result was transformative.

An honest assessment of Amul must acknowledge its limitations. Political interference, mismanagement, and corruption have crept into some cooperative unions, and the challenge of ensuring that cooperatives remain truly member-driven rather than politically captured is ongoing (The Hind, 2025). The biggest obstacle that dairy cooperatives face today is political and bureaucratic interference — business decisions are often guided by considerations other than business, and management is superseded when opposition political parties come to power (Amul,

n.d.). The attempted political merger of Amul with Karnataka's Nandini cooperative in 2023 drew sharp criticism precisely because it threatened the organisational independence that has been central to Amul's governance integrity (Policy Circle, 2024). India has tried to reproduce the Anand Pattern in other states with uneven results — the difference between success and failure has been governance. In India, cooperatives often collapse under their own contradictions (Policy Circle, 2026).

Furthermore, Amul's model is structurally better suited to dairy than to most other sectors. Dairy is a daily cash-flow business, unlike seasonal crops — it depends on millions of small producers, not a few large ones, which gives it relatively low liquidity risk and regular cash flow for producers (Policy Circle, 2026). This structural advantage does not automatically transfer to the services sector or the digital platform economy. The question this paper addresses in Section 6 is whether the core *logic* of the Anand Pattern — democratic ownership, professional management, surplus redistribution, and enabling policy — can be adapted to a structurally different sector: urban ride-hailing.

Case Study II — BharatTaxi: Cooperative Principles in the Digital Platform Economy

India's ride-hailing market was valued at approximately USD 21 billion in 2025 and is projected to reach USD 44.3 billion by 2032, growing at a compound annual rate of 11.2 per cent (Persistence Market Research, 2025). This expansion, however, has been accompanied by a deepening structural problem. Ola and Uber — the two dominant aggregators — operate on a commission model that typically extracts 20–30 per cent of every fare from drivers (Business Standard, 2026; Quora driver testimonials, 2024). A 2023 survey by the Indian Federation of App-Based Transport Workers (IFAT) found that 74 per cent of Uber and Ola drivers viewed incentive systems as unfair and confusing, while 65 per cent reported a sharp decline in income compared to pre-2020 levels (BusinessToday, 2026).

The structural logic is identical to that which confronted Anand's dairy farmers in 1946. The platform intermediary sets the terms of exchange between driver and passenger, captures a substantial share of every transaction, bears minimal operational cost — drivers own their vehicles and absorb fuel, maintenance, and insurance costs — and repatriates profits to foreign shareholders. Uber's predatory business model allows it to undercut local taxi industries, extract commissions on every fare, and repatriate profits to the United States, ensuring that the wealth generated in India is never reinvested in the country's economic growth. This is the neo-colonial value drain, as theorised earlier, operating through a digital rather than a colonial architecture.

BharatTaxi: Institutional Design and Operating Model

BharatTaxi — formally Sahakar Taxi Cooperative Limited (STCL) — was registered under the Multi-State Cooperative Societies Act, 2002, on June 6, 2025, and officially launched on February 5, 2026, at Vigyan Bhavan, New Delhi, by Union Home and Cooperation Minister Amit Shah. The project is backed by India's most respected cooperative institutions — IFFCO, Amul (GCMMF), KRIBHCO, NDDB, NABARD, NCEL, and NCDC — which together have infused an authorised capital of ₹ 300 crore (Organiser, 2025). Amul's Managing Director, Jayen Mehta, chairs the platform, explicitly extending the Anand Pattern logic into the digital mobility sector.

The ownership and revenue architecture represents a deliberate structural inversion of the corporate platform model. Drivers joining BharatTaxi become co-owners of the platform by contributing just ₹ 500, turning them from gig workers into stakeholders (Shital Life Blog, 2026). The model eliminates commission charges and surge pricing, enabling drivers — referred to as *Sarathis* — to retain full ride earnings, while also sharing cooperative profits. A nominal daily subscription fee of ₹ 30 covers operational costs (The Researchers, 2026). Officials report that fares may be up to 30 per cent lower than those on competing platforms, reflecting the zero-commission architecture. The platform also provides social security benefits, including personal accident insurance cover of ₹ 5 lakh and family health insurance cover of ₹ 5 lakh — areas where gig workers have long flagged critical vulnerabilities (BusinessToday, 2026).

Early Evidence: Pilots and Preliminary Data

As an early-stage cooperative, BharatTaxi's evidence base is limited but meaningful. By March 23, 2026 — barely seven weeks after the formal launch — approximately 4.31 lakh drivers had joined the platform (Angel One, 2026). Over one lakh users have registered, and roughly 10,000 daily rides were recorded during pilot operations in Delhi-NCR and Gujarat. The cooperative has distributed approximately ₹ 10 crore directly to drivers (The Researchers, 2026). The platform has expanded onboarding to Chandigarh and Lucknow, with nationwide operations targeted by 2029. Shaik Salauddin of IFAT described the launch as "a landmark step towards ending the exploitative commission-based model in ride-hailing — for the first time, drivers are being recognised as owners, not expendable gig workers" (Business Standard, 2026).

Against the three conditions identified earlier, BharatTaxi's position is instructive. The first condition — structural exploitation by an intermediary — is unambiguously met. The second condition — sufficient collective will and organisational capacity — is partially met: driver discontent is extensive and well-organised, and the institutional backing of IFFCO, Amul, NABARD, and NCDC provides rare organisational depth for a cooperative startup. The third condition —

enabling policy — is now being actively constructed. BharatTaxi's registration under the Multi-State Cooperative Societies Act, its integration with Digital India infrastructure (DigiLocker, UMANG, API Setu), and government promotion within official channels represent a qualitatively different policy environment from what most cooperatives have historically enjoyed.

Intellectual honesty requires a candid acknowledgement of the significant challenges BharatTaxi faces. Despite onboarding over four lakh drivers, scaling usage remains a key challenge — barriers such as limited familiarity with digital platforms among some driver-partners, and competition from established players, are slowing adoption (Angel One, 2026). Balancing commercial viability with cooperative principles, particularly in the absence of competitors' dynamic pricing strategies, could create disincentives for drivers during peak demand or periods of passenger availability. Ola and Uber jointly hold a majority of India's ride-hailing market, with superior technology, brand recall, and scale.

There are also structural differences from the Amul context that cannot be ignored. Dairy is a daily-necessity product with captive demand; urban ride-hailing is discretionary, competitive, and highly price-sensitive. Amul built its scale over decades with consistent state support; BharatTaxi must compete against entrenched billion-dollar platforms in real time. Furthermore, the risk of political capture — which has undermined many Indian cooperatives — is not hypothetical: the platform was launched by a serving Union Minister, raising legitimate questions about its long-term organisational independence from government influence.

Finally, BharatTaxi is, at the time of writing, a very early-stage initiative. A 2026 paper cannot offer the longitudinal outcome data that the Amul case provides. It is more accurately characterised as a *live application* of platform cooperative theory — a real-world experiment testing, in the Indian context, whether the institutional logic of democratic ownership can be translated from physical commodity cooperatives to the digital platform economy. Its success or failure over the next five years will be one of the most instructive case studies in global cooperative economics.

What Amul's Success Teaches BharatTaxi

Synthesising the comparative evidence, three lessons from Amul's institutional history are directly actionable for BharatTaxi. First, the separation of democratic ownership from professional management is non-negotiable. Amul's defining governance innovation — electing farmer leaders while hiring professional managers — is what prevented it from becoming either a political club or an inefficient democracy. BharatTaxi must enshrine this separation in its bylaws and resist the tendency, visible across Indian cooperatives, for governance to collapse

into management. Second, enabling state policy is a condition, not a bonus. Amul did not succeed despite state support; it succeeded because of it — through Operation Flood, NDDB, and the National Milk Grid. BharatTaxi similarly requires not just rhetorical government backing but also a substantive policy architecture: preferential access to public procurement, integration with urban transport policy, and regulatory protection against predatory pricing by incumbent platforms. Third, cooperatives facing competition from dominant platform players face significant challenges in public awareness, work allocation, and wage levels — BharatTaxi must invest in demand-side loyalty, not just supply-side driver recruitment, to build the network density that makes a ride-hailing platform viable.

This paper does not claim that BharatTaxi will succeed. The global track record of ride-hailing cooperatives — from Denver's Green Taxi Co-op to New York's The Drivers Cooperative — is mixed at best, and the structural advantages enjoyed by incumbent platforms are formidable. This paper claims that the cooperative logic applied in BharatTaxi is analytically sound, historically grounded in Amul's demonstrated outcomes, and structurally superior to the corporate platform model on the criterion of equitable surplus distribution. Whether that analytical soundness translates into organisational durability in the face of billion-dollar competition is a question that only time, governance quality, and policy commitment can answer.

Policy Implications and Recommendations

India is at a critical juncture in developing a cooperative digital economy. Three developments between 2021 and 2025 have created this opportunity: the establishment of the Ministry of Cooperation, the launch of the National Cooperation Policy 2025 with its *Sahkar se Samriddhi* vision linked to *Viksit Bharat 2047*, and the implementation of the Code on Social Security 2020, which formally recognises gig and platform workers within a statutory welfare framework. The National Cooperation Policy 2025 also promotes cooperative expansion into sectors such as transport, technology, and clean energy; however, translating this vision into reality requires targeted institutional reforms.

1. Create a Dedicated Legal Framework for Platform Cooperatives

India currently lacks a legal framework specifically designed for digital platform cooperatives. BharatTaxi remains registered under the Multi-State Cooperative Societies Act, 2002, which was designed primarily for agricultural and credit cooperatives. Existing laws continue to suffer from definitional ambiguities around gig and platform workers, weak implementation mechanisms, and exclusion from core labour protections (International Journal of Labour Law and Industrial Relations, 2026). Parliament should therefore enact a dedicated

Platform Cooperative Act establishing clear rules for membership rights, governance standards, surplus distribution, and accountability. Existing recommendations under the National Cooperation Policy 2025 regarding transparency, autonomy, and access to finance should also be made mandatory rather than merely advisory.

2. Establish a Platform Cooperative Development Fund

Limited access to capital remains one of the greatest barriers facing platform cooperatives. Although BharatTaxi's ₹ 300 crore institutional backing is significant, it remains modest compared to the heavily subsidised expansion of Ola and Uber. The government should establish a *Platform Cooperative Development Fund*, administered through NABARD and NCDC, to provide concessional finance, technology grants, and working capital support for cooperative platforms in transport and services. Such a fund would align directly with the inclusive-growth goals of *Viksit Bharat 2047* and the National Cooperation Policy 2025.

3. Ensure Portable Social Security for Cooperative Platform Workers

The Code on Social Security 2020 introduced important protections for platform workers, including insurance, health, and old-age benefits, but implementation remains limited (International Journal of Labour Law and Industrial Relations, 2026). For platform cooperatives, social security should be guaranteed as a membership right. All cooperatives registered under the proposed Platform Cooperative Act should therefore automatically enrol members into a national social security framework, with contributions shared between members and the cooperative. Portability is especially important in a sector where workers frequently operate across multiple platforms.

4. Integrate Cooperatives into Urban Mobility and Public Procurement

One major lesson from Amul is that state procurement and institutional demand were crucial to achieving scale. A similar strategy can support BharatTaxi and future platform cooperatives. Government encouragement of BharatTaxi through ministries and public institutions (BusinessToday, 2026) should evolve into a formal procurement-preference policy. Platform cooperatives should receive priority access to airport taxi services, railway station pools, and government transport contracts, creating the demand density necessary for operational sustainability.

5. Strengthen Governance and Democratic Accountability

The greatest long-term threat to cooperative platforms is governance failure caused by political or bureaucratic interference (Amul, n.d.). To preserve democratic integrity, three safeguards are essential: fixed tenure limits for elected board members, mandatory independent audits accessible to all members, and a

Cooperative Governance Index measuring democratic participation, transparency, and equitable surplus distribution. Access to government funding and procurement support should be conditional upon meeting these governance standards.

Taken together, these recommendations form a coherent strategy for building a cooperative digital economy aligned with Viksit Bharat 2047's goals. Platform cooperatives promote inclusive growth by generating worker ownership, retaining surplus within local communities, and reducing dependence on extractive corporate platforms. If India seeks economic expansion alongside social equity, the cooperative digital economy is not merely an alternative model — it is a structural necessity.

Conclusion

India's journey toward Viksit Bharat will ultimately be judged not only by the scale of its economic growth, but by the structure of that growth — who owns wealth, who benefits from technological change, and whether development deepens democracy or concentrates power. This paper has argued that the cooperative model offers more than a nostalgic reminder of India's developmental past; it represents a structurally viable alternative to the extractive tendencies of contemporary platform capitalism. Through the comparative study of Amul and BharatTaxi, the analysis demonstrates that the logic of cooperative organisation remains remarkably consistent across sectors and historical periods: where intermediaries monopolise exchange and capture disproportionate surplus, democratic collective ownership emerges as a mechanism for restoring economic justice and local accountability.

The central argument of this paper is not that cooperatives should replace markets, but that markets themselves must be democratised. In an era when algorithms increasingly mediate labour, mobility, and consumption, the question of ownership becomes fundamental. The cooperative model offers a way of reconciling technological modernity with social justice by ensuring that innovation does not sever workers from the value they create. If India's digital future is to be genuinely inclusive, the cooperative economy cannot remain confined to the dairy sector or rural credit societies; it must become a central pillar of the country's technological and developmental imagination. In that sense, the transition "from dairy to digital" is not simply a sectoral shift — it is a broader struggle over the future architecture of economic democracy in India.

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17

An Assessment of the Ayushman Bharat Digital Mission in the Digital Transformation of Healthcare in India

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Abstract: *The Ayushman Bharat Digital Mission (ABDM) is a transformative program for developing an integrated digital health ecosystem in India. The present study uses a descriptive technique to evaluate progress, growth patterns, and inter-state variances in important ABDM indicators, such as ABHA ID generation, registration of healthcare facilities, and linking of health records, using secondary data from official sources. The findings indicate a significant increase in digital health infrastructure, notably in the implementation phase, with signs of stabilisation in recent years. The distribution across genders seems balanced, but the distribution across age categories shows a stronger uptake by economically active groups. The analysis of health professional registration demonstrates the presence of the public sector, underscoring the importance of government-led implementation. However, there are considerable inter-state variances in terms of enrolment as well as effective utilisation, especially in health record linking. The report indicates that ABDM has made significant strides in increasing digital health coverage, but difficulties related to inclusivity, geographical inequities and depth of adoption remain important to building a fully integrated and efficient digital health ecosystem.*

Keywords*: Digital health, Ayushman Bharat Digital Mission, Digital health transformation, ABHA ID, Health record linkages*

Introduction

Health is a key input to economic and human growth. Health is both an end and a method of economic and human development. A healthy population is not only a social success, it is a necessity for sustainable economic productivity, innovation and inclusive growth. From the economic point of view, health is a direct determinant of human capital formation.

The same is demonstrated in the key work of Finlay (2007). The World Health Organization predicts that each additional year of healthy life expectancy may raise per capita GDP by as much as 4%, which suggests the macroeconomic benefits to health investment. In developing countries like India, high burden of disease leads to tremendous expenditures both directly, in terms of medical expenses, and indirectly, in terms of lost workdays, diminished cognitive capacity, and premature death. As per National Health Account Estimates for India 2021-22, out-of-pocket expenditure alone constitutes 45.11% of current health expenditure, 39.4% of total health expenditure and 1.51% of GDP remaining a primary driver of medical impoverishment and a critical barrier in achieving Universal Health Coverage (UHC) . India is a major country in the South East Asia region with more than 1.4 billion people and a such as high prevalence of infectious diseases, non-communicable diseases (NCDs), and maternity and child health issues. Communicable and non-communicable diseases have added a double load to the healthcare infrastructure, which is under considerable strain. India's healthcare system is further burdened by uneven distribution of healthcare personnel, a weak foundation in primary healthcare, a vast and unregulated private sector, insufficient public health funding, and fragmented health data systems. The COVID-19 epidemic has further exposed the fragility of under-resourced health systems and their ripple implications on economic stability, employment and social cohesion.

In order to increase healthcare delivery and reduce the budgetary burden, the government of India launched Ayushman Bharat Yojna and Pradhan Mantri Jan Arogya Yojana (ABPMJAY) to extend insurance coverage and establish an integrated digital health ecosystem. This scheme will act as the milestone in achieving the vision of Universal Health Coverage (UHC) articulated in the National Health Policy (2017) and Sustainable Development Goals (SDGs). SDG target 3.8 aligns with the vision of PM-JAY, which is to "ensure financial protection against catastrophic health expenditure and access to affordable and quality healthcare for all". They are part of a larger trend towards using digital technologies and reforms in public health finance to attain universal health coverage and improve efficiency, transparency and accessibility in health care delivery.

Building upon the foundational pillars of Ayushman Bharat, the Government of India recognised that achieving the twin objectives of the National Health Policy 2017, equitable access and financial protection, would require an equally ambitious digital transformation of the health system. This recognition culminated in the launch of the Ayushman Bharat Digital Mission (ABDM) in September 2021, to create a unified digital health ecosystem by linking patients, providers, payers, and

policymakers through a common interoperable infrastructure. knowledge and practice associated with the development and use of digital technologies to improve health" given by World Health Organization (WHO). This study will assess the progress and spatial distribution of digital health infrastructure under Ayushman Bharat Digital Mission by studying the inter-state variations and year-on-year growth trends of key indicators such as generation of ABHA IDs, registration of healthcare facilities and linking of health records.

Literature Review

Evolution and Architectural Framework of Digital Health

India's digital health trajectory is not an isolated incident but a culmination of multi-decade evolution, from 1970s health telematics (disease-centric) to 2000s eHealth (health-centric) and 2010s mHealth (access-centric) (Rana et al., 2024). The current era of "Digital Health" integrates a broader array of technologies, including Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT), to create a proactive rather than reactive care model (Rana et.al, 2024). The Ayushman Bharat Digital Mission marks a landmark step in improve the accessibility, efficiency and quality of healthcare services nationally (Narayan et al., 2025).

This mission is a part of the National Digital Health Mission and aims to transform healthcare delivery by linking patients, providers, and other stakeholders through a strong digital infrastructure (Inampudi et al., 2024). In particular, it aims to digitise health records and build an integrated digital health infrastructure to tackle the current issues in the healthcare system by providing a strong information backbone for healthcare professionals (Inamdar et al., 2025). Architecturally, the ABDM is built as a modular and interoperable stack (Kadambi et.al, 2025). It leverages existing Digital Public Infrastructure (DPI), such as the "JAM" trinity (Jan Dhan-Aadhaar-Mobile), to enable a "data follows the patient" model through open APIs and federated registries. This federated design is a key differentiator for India, allowing states and private entities to innovate while adhering to national standards like HL7 FHIR (Kadambi et.al, 2025).

Implementation Progress and State Variation

Implementation data from ABDM website shows strong fundamental expansion, but considerable functional differences. Till April, 2026 the registrations crossed 880 million ABHA IDs and 970 million linked health records. Over 8,61,643 healthcare professionals has been verified. However, the verification of supply-side building blocks remains a bottleneck; for instance, only about 8% of healthcare professionals (HPR) and 20% of facilities (HFR) were verified as of 2023 (Mishra et al, 2024). The geographic variation is stark: Union Territories like Andaman and

Nicobar Islands and Lakshadweep have achieved near 100% ABHA coverage, whereas major states like Tamil Nadu (7.3%) and Bihar (13.9%) show significantly lower adoption rates (Mishra et al, 2024). The geographic variation is showing starking differences while Union Territories like Andaman and Nicobar Islands and Lakshadweep have achieved near 100% ABHA coverage, whereas major states like Tamil Nadu (7.3%) and Bihar (13.9%) show significantly lower adoption rates. But the Health Facility Registry which is around 74.3%, dominated by the public sector and the private sector's participation remains low as 25.7%, hence restricting the mission's capacity to impact the wider health ecosystem (Mishra et al, 2024).

Impact on Access, Affordability and Utilization

There has been ample literature highlighting a consistenct dichotomy of access and affordability. The systematic reviews of public-funded health insurance (PFHI) schemes, such as RSBY and the precursor to ABDM, PM-JAY, show that while these programs successfully increase hospitalization rates and service utilization, they have no conclusive impact on reducing Out-of-Pocket Expenditure (OOPE) or protecting families from catastrophic health spending (Reshmi et al, 2021). Conversely, empirical surveys among reduce costs through telemedicine and access to generic drugs (Arya, 2024).

Barriers to Adoption: Friction and Digital Divide barriers of operation (Arya, 2024). ABDM has the potential to be transformational but execution is fraught with several problems such as technological challenges and socio economic inequities (Katke, 2026). Furthermore, the mission must focus on five strategic areas: infrastructure, integration and sustainability, a skilled healthcare workforce, effective integration, and rigorous legislative guidelines to ensure ethical data use (Khatke, 2026). The ABDM is still in its introductory stage which further requires operational measures by the government. There is an increasing amount of literature on digital health programs in India, but there is inadequate understanding of the spatial and temporal dynamics of digital health adoption under the Ayushman Bharat Digital Mission. First, while current studies have mostly focused on aggregate national-level successes there has been little attention paid to inter-state variances in ABHA ID production, thus missing regional discrepancies in the adoption and accessibility of digital health infrastructure. Second, there is a lack of systematic study of year-over-year growth trends in important ABDM metrics, such as ABHA ID generation, healthcare facility registration, and health records linkage, limiting insights into the pace, consistency, and sustainability of digital expansion. Moreover, most of the existing assessments are descriptive at a moment of time and do not take into account both spatial (state-wise) and temporal (development over time)

dimensions. This creates a knowledge gap on the consistency of the growth of digital health infrastructure between areas and over time, therefore highlighting the necessity for a complete analysis that includes both inter-state comparison and trend evaluation.

Objectives

To understand the pace and pattern of digital health expansion by studying the yearon-year growth trends of key ABDM indicators, such as ABHA ID generation, healthcare facility registration and health records linking.

To examine the inter-state variation in ABHA ID generation under Ayushman Bharat Digital Mission, with a view to understand the disparity in adoption of the digital health infrastructure across states.

Methodology

The study adopts a descriptive research design, as it seeks to systematically present and analyze the growth patterns and inter-state variations in the implementation of the Ayushman Bharat Digital Mission (ABDM). This study is purely based on secondary data, collected from the official ABDM dashboard, reports of Ministry of Health and Family Welfare, National Health Accounts and National Health Authority. The analysis considers the important indicators of digital health advancement such as ABHA ID creation, Healthcare Facility Registration (HFR) and health records linking (PHR/EHR linkage) which together represent the expansion and use of digital health infrastructure across States. The study covers time period from 2021 to 2025.

Data Analysis

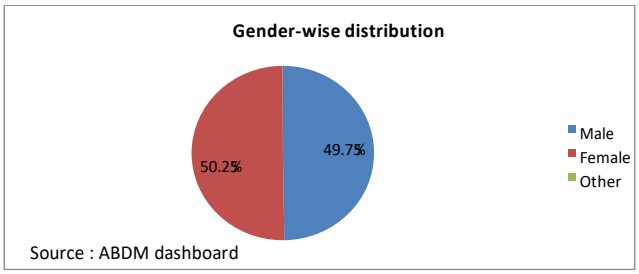
This section includes a descriptive study of important indicators under Ayushman Bharat Digital Mission (ABDM) with an emphasis on understanding the rate and pattern of digital health spread across India.

Table no.1: Key ABDM statistic (till April,2026)

Variable	Figure
Ayushman Bharat Health Account (ABHA) ID	88,12,43,230
Health Records Linked	97,45,82,599
Verified facilities on Health Facility Registry	5,04,353
Verified Healthcare Professionals	8,63,162
Source: ABDM dashboard	

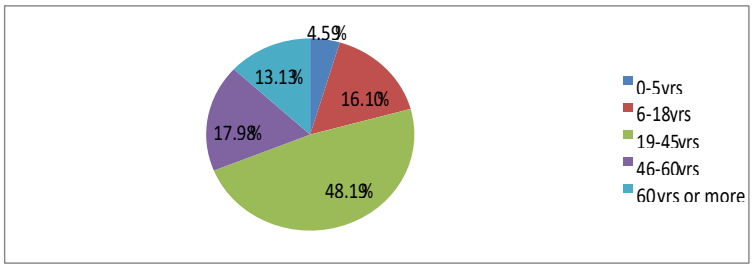
The following pie chart shows the gender-wise distribution of ABHA ids generated till April,2026.

Figure 1 : ABHA Id Gender-wise distribution



ABHA creation shows nearly equal gender distribution with most of ABHA numbers generated for those aged 19-45 years. The figure in below shows the age-wise distribution of ABHA ids generated till April, 2026.

Figure 2 : ABHA Id Age wise distribution

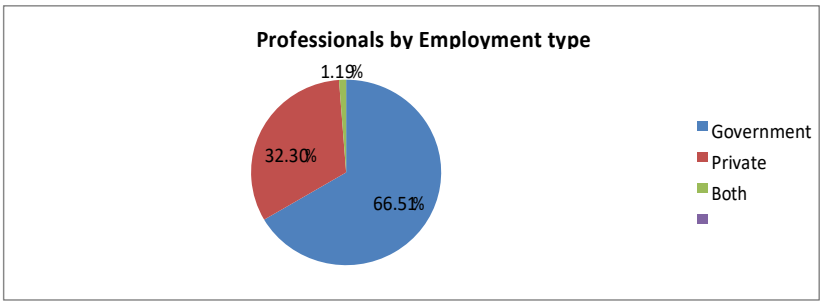


The trend suggests that the adoption of digital health under Ayushman Bharat Digital Mission is currently being led by economically productive and health-conscious sections of the population and there is a need to increase outreach among dependent and elderly populations.

The following figure shows the employment wise distribution of healthcare professionals registry.

Source: ABDM dashboard

Figure 3 : Healthcare Professionals Registry



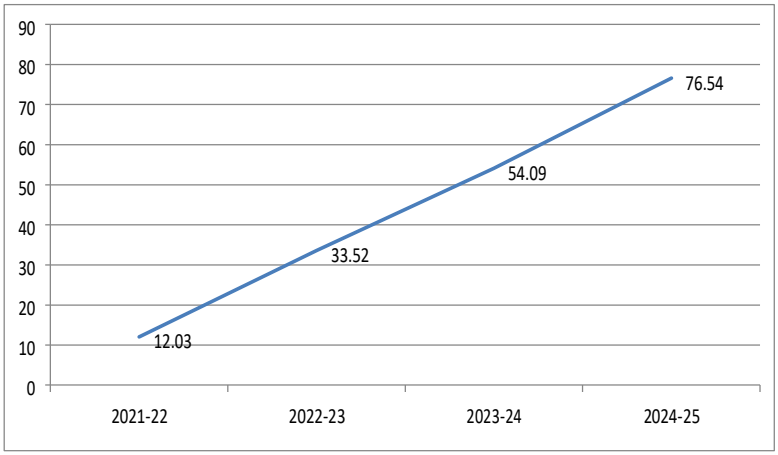
The government controls the healthcare professional registries with a 66.51% share, given its vast public infrastructure of hospitals, PHCs, CHCs, and sub-centres in urban, rural, and remote areas, and mandatory registration for every government employee, which ensures near-complete capture in official records. It is also the only employer in underdeveloped areas and operates large scale projects like NHM that formally register lakhs of temporary workers. The private sector, despite its size, seems smaller at 32.30%, mainly due to registration evasion by tiny clinics and single practitioners, fragmented ownership and an urban-only concentration which excludes the rural labour. The trivial "both" group includes just individuals in PPP models or dual practice jobs. Basically, the skewed distribution is not just indicative of employment realities, but also the difference in regulatory compliance between the two sectors government enforces registration rigidly, while the private sector does not.

Progress of Ayushman Bharat Digital Mission over the years

Element 1 : ABHA id

Under ABDM, ABHA is a unique health identity for citizens generated by ABHA portal, ABHA App, ABDM enabled PHR Apps, health programs and HMIS. By March 2025, more than 76-crore Ayushman Bharat Health Accounts (ABHA) were created, showing tremendous development every year shown in graph.

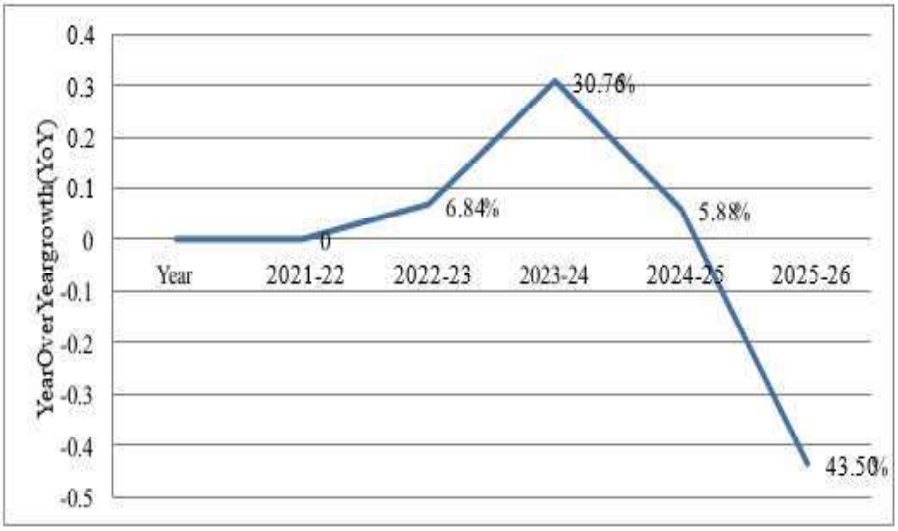
Figure 4 : Cumulative ABHA created in last 4 years (in Crores)



Source : NHA Annual Health Report 2024-25

After analysing the cumulative ABHA ID generation, the year-on-year growth rates are analysed to capture incremental changes and detect periods of acceleration or slowdown. The following graph shows the year-on-year growth rates :

Figure 5 : Year-on-Year growth of ABHA id

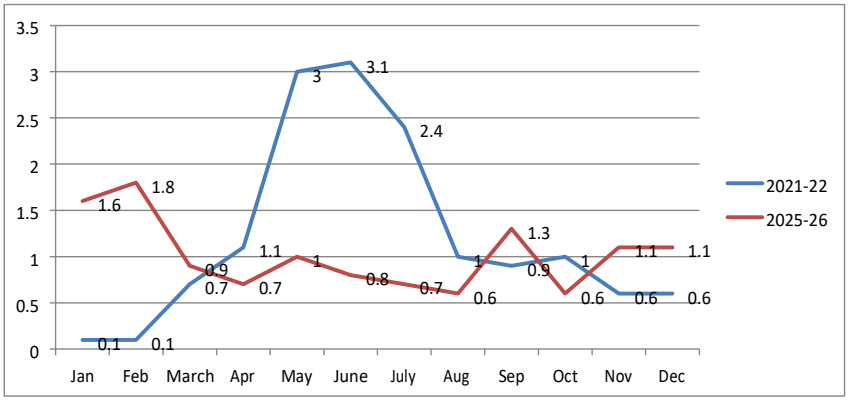


Source: Author's calculations from ABDM Dashboard data

The growth in the creation of ABHA IDs followed a typical adoption-then-saturation pattern. Limited awareness and infrastructure meant the mission was just initiated and growth was modest at 6.84% in 2022-23 from a zero baseline in 2021-22. The peak of 30.76% in 2023-24 is attributed to the vigorous push by the government, mandated integration of hospitals, multilingual app enhancements, and Digital Health awareness post-COVID. However, the rapid slowdown to 5.88% in 2024-25 suggests a substantial part of the easily accessible urban and technologically literate population has already been covered leaving behind the more difficult to reach rural and low literacy groups. The sharp fall to -43.50% in 2025-26 reflects a mix of market saturation, possible duplication of dormant accounts, waning campaign momentum and, critically, a lack of perceived everyday utility there is little incentive for people to register for or actively use an ID that most hospitals and pharmacies still do not require or fully implement on a regular basis, underscoring the core challenge of moving from passive registration to meaningful, system-wide uptake.

The month-wise analysis of ABHA ID creation for 2021-22 and 2025-26 shows how the adoption trends have transformed from early deployment to a more mature stage of the Ayushman Bharat Digital Mission.

Figure 6 : Month-wise ABHA ID creation for FY 2021-22 and 2025-26



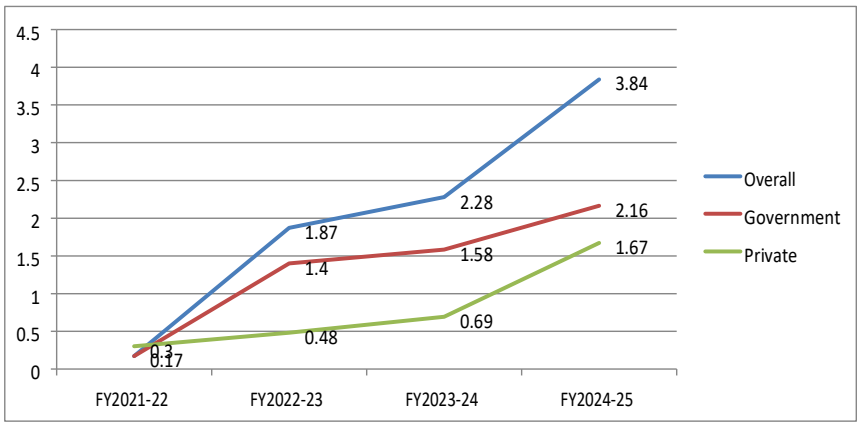
Source : ABDM dashboard

The monthly ABHA ID generation schedule for 2021-22 and 2025-26 shows two different periods of the course of the programme. In 2021-22, the numbers were close to zero in January and February, reflecting the nascent stage of the program with very little awareness and infrastructure. Then, there was a steep spike in May-June (peaking at 3.1) due to resurgence of Covid-19 pandemic and aggressive government-led enrolment campaigns at the start of the financial year 2021-22 . This was followed by a steep decline post-June in 202122 due to improvement in the pandemic situation. Finally, it settled down to a low baseline of 0.6-1.0 through the second half of 2021-22. On the other hand, 2025-26 begins at a higher relative base of 1.6-1.8 in Jan-Feb suggesting that ABHA has become more systemically entrenched driven by mandatory integration with insurance schemes, hospitals and Ayushman Bharat but gradually declines through the middle of the year indicating saturation with the more accessible urban populations, with only a marginal recovery in AugSep perhaps due to a mid-year push, before levelling off again at the year-end. In short, 202122 was campaign driven and erratic while 2025-26 is organically sustained but plateauing a natural evolution from a launch phase program to one that is approaching enrolment maturity.

Element 2 : Health Facility Registry and Health Records linked

The Healthcare Professionals Registry and Health Facility Registry have seen significant growth with continuous user interface enhancements and the addition of new features every year. In the last four years, the HPR has increased to 5,85,827 while HFR has increased to 3,84,310 167,277 are private facilities, and (216,615 are government). The graph below, Figure 7 shows the cumulative progress from 2021 to 2025 of HFR respectively

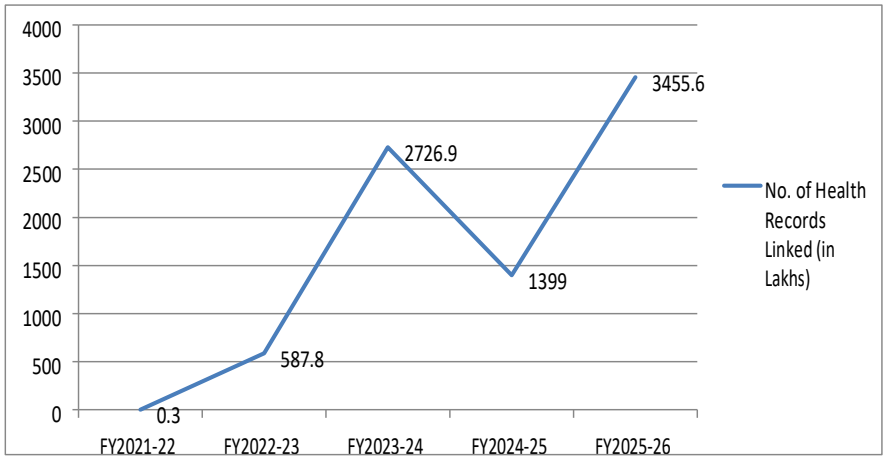
Figure 7 : Progress of Health Facility Registry from 2021 to 2025



Source : NHA Annual Health report 2024-25

Over the past year, there has been a notable increase in the number of registrations in the private sector, suggesting a rising confidence in the benefits of the program and a move towards digital health practices. The growth is linked to efforts like the Digital Health Incentive Scheme, a financial incentive for healthcare providers to adopt digital health practices.

Figure 8 : Health Records Linked from 2021 to 2025



Source : ABDM dashboard

The trajectory of health records connected to ABHA IDs from FY2021-22 to FY2025-26 is linked rose to 587.8 lakh in FY2022-23 as hospitals and diagnostic

institutes started integrating with the ABDM platform, starting with a mere 0.3 lakh in FY2021-22 when the programme was in its infancy with low facility on-boarding. The most significant spike was in FY2023-24 with records reaching 2726.9 lakh driven by obligatory compliance requirements for Ayushman Bharat empanelled establishments and tighter program integration. The FY2024-25 saw a dramatic fall to 1399 lakh, which is seen as a quality adjustment, due to duplication and a more stringent reporting technique, rather than a programme setback. FY2025-26 subsequently soared to an all-time high of 3455.6 lakh, further indicating that the digital health records ecosystem has stabilised and is now scaling sustainably across both public and private healthcare facilities.

Inter-State Variation on key ABDM indicators :

This section compares the major ABDM indicators across the states to understand the differences in the adoption and implementation of digital health infrastructure under the Ayushman Bharat Digital Mission. The following table shows the inter- state variation on key ABDM indicators:

Table no.2 : State-wise Distribution of Key ABDM Indicators under the Ayushman Bharat Digital Mission

State & UT	ABHA ID Generation	Health Facility Registry	Health Records Linked
Andaman & Nicobar Island	4,69,437	374	2,65,199
Andhra Pradesh	4,94,84,484	48,932	11,74,59,711
Arunachal Pradesh	5,81,198	774	2,02,070
Assam	2,35,09,549	16,815	38,26,037
Bihar	6,31,04,136	33,430	7,14,93,537
Chandigarh	10,06,826	931	21,48,143
Chhattisgarh	2,57,09,607	11,977	2,16,13,688
Delhi	1,03,85,094	2,757	1,35,88,929
Goa	9,89,760	1,191	4,96,665
Gujarat	5,11,01,488	18,758	4,42,91,674
Haryana	1,85,26,498	6,496	1,04,38,205
Himachal Pradesh	65,31,644	4,538	25,60,726
Jammu & Kashmir	1,11,08,027	6,890	1,22,93,570
Jharkhand	1,77,78,191	10,166	1,34,60,510
Karnataka	3,75,55,217	62,326	2,07,80,688
Kerala	2,59,06,293	10,826	3,40,52,163

Ladakh	4,13,629	398	7,37,525
Lakshadweep	1,08,716	87	86,393
Madhya Pradesh	5,75,82,079	19,072	2,48,46,724
Maharashtra	7,03,27,523	34,295	2,25,55,355
Manipur	13,86,089	806	17,56,684
Meghalaya	15,37,419	1,433	11,67,313
Mizoram	8,17,314	886	6,96,283
Nagaland	8,64,034	1,343	3,87,086
Odisha	4,20,34,181	9,137	98,01,566
Puducherry	12,11,092	501	7,85,327
Punjab	1,75,34,442	8,971	1,22,23,879
Rajasthan	6,88,72,317	52,005	6,02,26,463
Sikkim	4,68,173	525	24,659
Tamil Nadu	2,05,22,182	17,901	46,65,578
Telangana	2,88,10,958	18,676	96,68,137
Dadra & Nagar Haveli and Daman & Diu	8,58,289	616	26,55,765
Tripura	32,14,875	3,243	26,27,587
Uttarakhand	75,29,453	8,409	84,70,946
Uttar Pradesh	15,16,23,391	76,249	14,51,92,048
Source : ABDM dashboard			

A state-wise analysis of ABHA ID generation, Health Facility Registry and Health Records Linked shows a clear pattern that the number of enrolments is largely population-driven. Uttar Pradesh (15.16 crore), Maharashtra (7.03 crore) and Rajasthan (6.88 crore) are the top three in absolute ABHA creation. Smaller states and UTs such as Lakshadweep, Ladakh and Sikkim lag behind naturally due to their limited population size and geographical remoteness.

However, a more telling metric is the health records linking ratio, with Andhra Pradesh being the standout performer at about 2.4 records linked per ABHA ID, followed by Kerala and Bihar, which reflects deep and quality implementation of the ABDM ecosystem. Whereas, states like Odisha, Tamil Nadu and Assam are showing critically low linking ratios of 0.16x to 0.23x, indicating that ABHA creation was pursued as a standalone target without proportionate investment in backend health record digitisation. Karnataka and Andhra Pradesh are ahead in Health Facility Registry on per capita basis, which indicates better private healthcare ecosystem and better culture of digital compliance. North-Eastern states are structurally

disadvantaged because of poor connectivity, limited number of facilities and small population. In conclusion, the data indicates that ABHA enrolment is motivated by population and campaign intensity; however, the true sign of digital health maturity is in the linkage of health records. There is a significant gap at the state level between those who perceive ABDM as a systemic transformation and those who view it merely as an enrolment drive.

Conclusion

The Ayushman Bharat Digital Mission has become a milestone in the digital transformation of the healthcare system of India. There has been significant success in scaling up digital infrastructure and establishing a common health ecosystem. The results show that the increase of ABHA ID generation goes through a phase of rapid growth followed by a slow stabilisation, showing an increasing maturity of the system. The gender spread is reasonably even, but age trends indicates that adoption is mostly driven by economically productive populations, suggesting the need for more outreach among dependent and older groups. The dominance of the public sector in the register of healthcare professionals shows the role of government institutions in pushing the digital transition, whereas the scarcity of private sector participation points to structural and operational hindrances. Moreover, inter-state study indicates the large geographical variation where higher enrolment does not necessarily mean effective use especially in terms of health record linking. This means that increasing coverage does not, by itself, get the job done without better backend integration and use. The study suggests that while ABDM has provided a strong foundation for digital health in India, unlocking its full potential will require an increased emphasis on inclusivity, private sector engagement, data integration, and continued policy support for ensuring fair and efficient healthcare delivery.

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