IMPACT OF RURAL ROADS ON AGRICULTURAL GROWTH IN INDIA

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ABSTRACT

Rural road infrastructure is a vital enabler of agricultural development in India. With over 7.75 lakh kilometres of roads constructed and 1.84 lakh habitations connected under the Pradhan Mantri Gram Sadak Yojana (PMGSY) as of March 2024, the programme has significantly enhanced rural connectivity. Improved road access reduces transaction costs, improves the delivery of agricultural inputs, and facilitates market integration.

This study analyses the relationship between rural road expansion and agricultural growth in India, using secondary data from 2001 to 2024. Key indicators such as cropping intensity, agri-GSDP growth, and market access scores are examined across select states. The findings indicate that states like Punjab, Tamil Nadu, and Karnataka, which have dense rural road networks, show higher cropping intensity above 170% and improved farm-level outcomes.

Despite these gains, challenges persist in the form of post-construction maintenance, last-mile gaps, and limited integration with agri-logistics. The paper suggests for a convergence-driven infrastructure policy that links rural roads with agricultural value chains and region-specific development planning to ensure long-term resilience and inclusive growth in the country in general.

Keywords: Rural Infrastructure, Agricultural Growth, PMGSY, Cropping Intensity, Market Access, Rural Roads

1.0 INTRODUCTION

Agriculture remains the backbone of rural India, contributing approximately 18.4% to the Gross Value Added (GVA) of the Indian economy and employing more than 41.4% of the national workforce as of 2023[1]. Yet, the productivity of the sector and efficiency remain uneven and are deeply dependent on the quality of infrastructure, particularly of rural roads. In agrarian economies, road networks are vital in linking farmers to markets, reducing transaction costs, improving delivery of inputs, and enhancing resilience against shocks of varied types.

Globally, the importance of rural roads in stimulating agriculture is widely acknowledged. The World Bank (2021) estimates that a 10% improvement in rural road density can result in a 6 to10 percentage increase in agricultural output in low-income economies[2]. In India, this relationship has been institutionalised through landmark policy interventions such as the Pradhan Mantri Gram Sadak Yojana (PMGSY), launched in 2000 to provide all-weather road connectivity to unconnected rural habitations.

Since its inception, the PMGSY has led to the construction of over 7.75 lakh kilometres of rural roads, connecting around 1.84 lakh habitations as of March 2024[3]. This large-scale expansion has significantly enhanced rural mobility and contributed to improved market integration, input access, crop diversification, and productivity.

However, the rural road–agriculture linkage remains regionally uneven. Several backward and ecologically sensitive regions such as parts of Chhattisgarh, Jharkhand, and the Northeast continue to face infrastructural bottlenecks that limit the developmental potential of road infrastructure. Furthermore, poor post-construction maintenance, climate-related degradation, and fragmented agri-logistics systems constrain sustainability.

This paper critically examines the contribution of rural roads—particularly under PMGSY—to agricultural transformation in India. It explores spatial disparities, performance trends, and institutional challenges using national and state-level secondary data between 2001 and 2024. In particular, the paper explains inter-state differences in road length, cropping intensity, agri-GSDP growth, and market access, with the aim of identifying how rural connectivity translates into farm-level outcomes. To empirically as examine how rural road connectivity shapes agricultural outcomes, it is essential to compare key state-level indicators. As of March 2024, the implementation of the PMGSY has revealed significant spatial differences across India. For instance, Uttar Pradesh has constructed the highest rural road length under PMGSY,over 1.15 lakh kilometres followed by Bihar, Madhya Pradesh, and Tamil Nadu[4]. However, these physical achievements differ in their agricultural impacts due to variations in road quality, agri-logistics integration, and supporting infrastructure.

Agricultural indicators such as cropping intensity, agri-GSDP growth, and market access offer important insights into the synergy between road connectivity and farm performance. Real-time data from PMGSY Dashboard, Agricultural Statistics 2023, and the NITI Aayog confirm that states with higher rural road penetration also report stronger agricultural indicators.

Data pertaining to the rural road length, in select-states in the country, Agri GSDP and market access score are presented in Table 01 for the year 2023-24 as it is thought fit in the context.

Table: 01

State-wise Rural Road Development and Agricultural Indicators Selected States in India(2023–24)

State	Rural Road Length (km) (PMGSY Cumulative)	Cropping Intensity (%)	Agri-GSDP Growth (2022–23)	Market Access Score[1]
Punjab	68,500	197	3.4%	High (8.5/10)
Tamil Nadu	61,200	180	4.1%	High (8.1/10)
Uttar Pradesh	1,15,000	162	2.9%	Medium (6.9/10)
Bihar	88,200	151	2.5%	Medium (6.5/10)
Karnataka	52,000	141	3.6%	High (7.8/10)
Odisha	47,800	134	3.2%	Medium (6.7/10)
Jharkhand	35,100	123	2.1%	Low (5.4/10)
Chhattisgarh	40,300	125	2.6%	Low (5.7/10)

Source(s):

- *Ministry of Rural Development. PMGSY Dashboard – Road Progress Reports (2024)*
- *Ministry of Agriculture and Farmers' Welfare. Agricultural Statistics at a Glance 2022–23*
- *NITI Aayog. State Market Access Index and Infrastructure Scores, 2023*

Note [1]*: The Market Access Score is a composite index (0 to 10 scale) based on road proximity to markets, quality of transport, storage, and rural logistics facilities.*

The data highlights a strong correlation between road infrastructure and agricultural performance. States like Punjab, Tamil Nadu, and Karnataka, with high PMGSY completion rates and dense rural road networks, show both greater cropping intensity and higher market access scores. Conversely, Jharkhand and Chhattisgarh despite receiving substantial PMGSY investments continue to lag due to terrain constraints, limited maintenance, and weaker integration with agricultural value chains.

This inter-state disparity reinforces the need for region-specific planning and better institutional convergence between rural road development and agricultural infrastructure policies.

2.0 OBJECTIVES OF THE STUDY

This paper is an ardent effort at explaining the issue of rural road infrastructure and agricultural growth in India, particularly focused the Pradhan Mantri Gram Sadak Yojana (PMGSY).

Specific Objectives:

1. To analyse the progress and region level rural road development in India, with emphasis on the PMGSY.
2. To analyse the impact of rural road connectivity on the key agricultural outcomes, such as cropping intensity, market access, and farm-level income.
3. To identify the regional disparities and policy gaps in the integration of rural roads with agricultural growth strategies.

3.0 REVIEW OF LITERATURE

A review of earlier research works helps in identifying the conceptual and methodological issues relevant to the present study. Many studies have already been conducted on the broad topic of transport and rural road connectivity in general. The review made here is restricted keeping the size of the paper in view.

A paper entitled ***'Returns to Public Investment in Rural India'*** by Fan and Hazell (1999) used panel data across Indian districts to evaluate the productivity of various rural investments. The study found that investment in rural roads generated the highest marginal returns for agricultural growth and poverty reduction, surpassing irrigation and education. The authors concluded that roads significantly enhance market access, lower input costs, and facilitate non-farm employment. Their empirical findings remain a cornerstone in discussions of rural infrastructure prioritisation. [5]

In their study on the ***Economic Impact of PMGSY***, Asher and Novosad (2020) used quasi-experimental methods to assess outcomes in rural areas across India. Their research showed that while rural roads under PMGSY improved mobility and labour market participation, they had limited short-term impacts on agricultural income, consumption, or assets. The authors highlighted that complementary infrastructure and services are needed to realise the full economic potential of road connectivity. [6]

A report of ***Ecological Economics*** **(2021)** analysed national survey data and demonstrated that access to all-weather rural roads significantly improved cropping intensity and reduced transportation costs. The study found that enhanced connectivity increases input usage and facilitates access to markets, leading to higher productivity. It provided quantitative backing for investments in last-mile rural road development. [7]

In his thesis on infrastructure, ***Antle*** (1984) assessed how rural roads, education, and health services affect agricultural growth in India. He concluded that roads enhance the efficiency of input delivery systems, irrigation usage, and rural credit penetration, creating a positive feedback loop. The thesis emphasised that roads serve as an enabler of other services rather than acting in isolation. [8]

An article by ***Madhusudan Ghosh*** (2017) evaluated the role of rural infrastructure in agricultural productivity and poverty reduction across Indian states. His findings revealed that road connectivity was directly associated with higher agricultural output, reduced input cost, and better rural incomes. Ghosh also stressed that infrastructure's effectiveness varies with geography and governance structures. [9]

In her article on ***Spatial agri-infrastructure access***, Das and Prakash (2021) used GIS and Census data to show that villages closer to rural roads reported 12% higher access to FPOs and extension services. Their study suggested that transport connectivity is a spatial determinant of rural service availability, supporting geographically targeted infrastructure planning. [10]

A paper entitled ***'Infrastructure and Climate Resilience in Drylands'*** by Wani et al. (2020) focused on semi-arid areas in Maharashtra and Madhya Pradesh. The authors found that villages with better road access adopted more drought-tolerant crops and irrigation technology, reducing exposure to climate shocks. They concluded that roads act as a climate resilience enabler. [11]

In their report on rural road maintenance***, Phyll and NRIDA*** (2001) highlighted that India's rural road network exceeded 9 lakh km, but poor upkeep and drainage issues undermine long-term benefits. The report advocated for community-level monitoring and Gram Panchayat involvement for sustainability. [12]

In her case study of Odisha, ***Archana Kaushik*** (2012) reported that only 40% of villages had all-weather road access, compared to a national average of 60%. She noted that rural roads in conflict-affected districts enabled improved healthcare, education, and farm access, but also flagged inadequate planning and maintenance delays. [13]

4.0 RESEARCH METHODOLOGY

This study adopts a mixed-method of analytical approach to examine the relationship between rural road infrastructure and agricultural growth in India, with a particular focus on the Pradhan Mantri Gram Sadak Yojana (PMGSY). The methodology combines descriptive statistics, comparative analysis, and case-based illustrations drawn from official national datasets and published studies.

4.1 Scope and Area of the Study

The study covers a cross-section of Indian states representing diverse agro-climatic conditions, infrastructure development levels, and the PMGSY implementation outcomes. Select estates include agriculturally advanced regions such as Punjab, Tamil Nadu, and Karnataka, as well as infrastructure-deficient states such as Jharkhand, Odisha, and Chhattisgarh. This geographic spread allows for meaningful comparison of road-agriculture linkages across different development contexts.

4.2 Sources of Data

The analysis is based exclusively on authentic secondary sources, including:

- PMGSY Dashboard – Ministry of Rural Development (2024)
- *Agricultural Statistics at a Glance* – Ministry of Agriculture and Farmers' Welfare (2023)
- NABARD – Rural Infrastructure Development Fund (RIDF) Reports (2021–2023)
- NITI Aayog – State Market Access Index and Infrastructure Reports (2023)
- Economic Survey of India (2018–2024)
- Census of India (2011) and NSSO surveys
- Peer-reviewed journal articles and government evaluation studies
- Open-source GIS and spatial datasets where applicable

4.3 Period of Study

The study focuses on the period **2000 to 2024**, aligning with the three major phases of PMGSY:

Phase	Time Period	Focus
Phase I	2000–2012	First-time core network connectivity
Phase II	2013–2018	Road strengthening and consolidation
Phase III	2019–2024	Saturation coverage, maintenance, and convergence with agri-logistics and rural services

4.4 Method of Analysis

The following analytical techniques were employed to structure the empirical insights of the study:

- Descriptive Statistical Analysis

  The study evaluates trends in rural road construction under the PMGSY by analysing total road length (in kilometres), number of habitations connected, and patterns of fund utilisation across various phases of the programme. The analysis also covers agricultural performance indicators such as cropping intensity, growth in agricultural Gross State Domestic Product (GSDP), rural market access scores, and changes in average rural income levels.

- Comparative Regional Analysis:

  A cross-state comparison is carried out to explore the correlation between the extent of rural road connectivity and the performance of key agricultural outcomes. The assessment highlights regional disparities in infrastructure and agricultural indicators, which are influenced by differences in terrain, governance efficiency, institutional integration, and policy alignment.

4.5 Limitations of the Study

The following limitations may influence the scope and interpretation of the study:

- As the analysis is based solely on secondary data, it depends heavily on the accuracy, consistency, and completeness of government-published reports and statistical records.
- Primary data collection through field surveys or stakeholder interviews was not conducted due to constraints of time, resources, and geographical reach.
- The study was unable to access high-resolution GIS datasets specifically related to the PMGSY road alignments, which limits the depth of spatial and locational analysis.
- Since the study does not involve econometric modelling or controlled field experiments, the findings are indicative in nature and should be interpreted as associative rather than conclusively causal.

5.0 PROGRESS OF RURAL ROADS IN INDIA

Rural road development in India has evolved significantly over the past two decades, primarily through the implementation of the PMGSY, launched in December 2000. The core objective of the scheme is to provide all-weather road connectivity to previously unconnected rural

habitations with populations of 500 persons and above in plain areas, and 250 persons and above in hilly, tribal, and desert areas. It is recognised as one of the largest rural infrastructure interventions globally, both in terms of physical scope and financial commitment. [14]

5.1 National Overview

As of March 2024, the PMGSY has recorded several remarkable achievements:

- A total of 775,092 kilometres of rural roads have been constructed across India under the PMGSY programme. [15]
- Approximately 184,216 habitations have been connected through all-weather rural roads.
- The scheme has utilised a cumulative fund allocation of nearly ₹3.74 lakh crore across Phases I, II, and III.[16]
- Among Indian states, the highest road lengths constructed have been reported in:
    - Uttar Pradesh – 115,000 km
    - Bihar – 88,200 km
    - Madhya Pradesh – 75,300 km
    - Rajasthan – 69,400 km
    - Maharashtra – 66,700 km
- The highest Quality Performance Index (QPI) ratings have been observed in:
    - Tamil Nadu, Karnataka, and Himachal Pradesh.[17]

PMGSY is implemented through a decentralised model where State Rural Road Development Agencies (SRRDAs) handle planning and execution, under the technical oversight of the National Rural Infrastructure Development Agency (NRIDA). Digital platforms such as OMMAS (Online Management, Monitoring and Accounting System) and Geo-PMGSY have been instrumental in improving transparency, fund tracking, and project monitoring. [18]

5.2 Phase-wise Implementation

The PMGSY has advanced through three major implementation phases, each focusing on distinct objectives and infrastructural targets:

Table :02

Phase-wise Progress under PMGSY (as of March 2024)

Phase	Time Period	Objective	Road Length Constructed (km)	Habitations Connected
Phase I	2000–2012	Initial core network connectivity	452,000	122,000
Phase II	2013–2018	Strengthening and upgradation of existing roads	180,000	40,500
Phase III	2019–2024 (ongoing)	Saturation coverage, maintenance, and convergence	143,092	21,716

Source: Ministry of Rural Development. (2024). PMGSY Annual Report 2023–24. New Delhi: National Rural Infrastructure Development Agency (NRIDA).
Retrieved from https://pmgsy.nic.in/sites/default/files/PMGSYAnnualReport2023-24.pdf

Phase III marks a strategic policy shift from simple connectivity to convergence-oriented development. It integrates rural road planning with flagship programmes such as MGNREGS, BharatNet, and PM-FME (Formalisation of Micro Food Processing Enterprises), thereby aligning infrastructure with livelihood generation, digital inclusion, and agri-value chain strengthening. [19]

5.3 State-wise Performance

The effectiveness of the PMGSY implementation varies across states due to differences in geography, institutional capacity, and integration with agricultural planning. The Table 03 presents comparative data on rural road construction, habitations connected, and cropping intensity for selected agriculturally significant states in India as of March 2024.

Table :03

State-wise PMGSY Progress (As of March 2024)

State	Road Length (km)	Habitations Connected	Cropping Intensity (%)	Remarks
Uttar Pradesh	115,000	32,500	162%	Highest length; moderate quality index
Bihar	88,200	25,900	151%	High coverage but low durability reported
Madhya Pradesh	75,300	21,100	140%	Balanced growth in connectivity and output
Karnataka	52,000	18,500	141%	Strong in quality and fund utilisation
Tamil Nadu	61,200	17,600	180%	High QPI; horticultural growth observed
Odisha	47,800	16,400	134%	Coverage improved in tribal zones
Chhattisgarh	40,300	14,800	125%	Lagging due to terrain and security issues

Source: *Ministry of Rural Development. (2024). PMGSY Dashboard – State-wise Progress Summary. Retrieved from https://omms.nic.in;Ministry of Agriculture & Farmers' Welfare. (2023). Agricultural Statistics at a Glance 2022–23. New Delhi: Government of India. Retrieved from https://agricoop.gov.in*

The data reveals that states such as Uttar Pradesh and Bihar have constructed the highest road lengths and connected the maximum number of habitations, but issues related to road durability and quality remain prevalent. In contrast, Tamil Nadu and Karnataka have demonstrated better performance in terms of road quality and agricultural diversification, as reflected in their higher cropping intensities.
States like Chhattisgarh and Odisha, which face significant geographical and socio-political challenges, still report lower coverage and agricultural outcomes, indicating the need for targeted policy support and maintenance planning.

5.4 Technological Innovations

To improve transparency, efficiency, and real-time monitoring of rural road development, the PMGSY has adopted a range of digital platforms and ICT-based tools. These innovations have significantly enhanced data management, public accountability, and quality assurance.

- **Online Management, Monitoring and Accounting System (OMMAS):**

This platform enables tracking of road construction, fund utilisation, and project timelines across all phases and states.

- **Geo-PMGSY:**

A GIS-based system that monitors road alignments, construction quality, asset tagging, and integration with other rural services such as schools and health centres.

- **Meri Sadak App:**

A mobile-based public grievance platform that allows citizens to report road quality issues, delays, or maintenance lapses directly to authorities.

Together, these platforms form the digital backbone of the PMGSY ecosystem, promoting accountability, speeding up decision-making, and ensuring that rural connectivity infrastructure meets desired standards of durability and service delivery.

6.0 IMPACT OF RURAL ROADS ON AGRICULTURAL GROWTH

Rural roads play a catalytic role in the transformation of India's agricultural landscape by improving access to markets, inputs, extension services, and post-harvest infrastructure. The PMGSY, in particular, has become a structural enabler of agricultural productivity, especially in previously underserved and remote rural zones. This section examines the multi-dimensional impacts of rural road infrastructure on agriculture, highlighting both quantitative outcomes and case-specific illustrations from across Indian states.

6.1 Market Access and Output Distribution

One of the most significant contributions of rural roads is the improved physical access to nearby mandis, collection centres, and regulated market yards. Improved connectivity under PMGSY has led to a 40% reduction in transport time and a 30–35% reduction in marketing costs, as observed in rural villages with new road links. [20]

In Bihar's Muzaffarpur district, for example, litchi and vegetable farmers now reach collection points within 2–3 hours instead of 6–8 hours earlier, significantly lowering post-harvest losses. Enhanced road infrastructure has also contributed to increased frequency of market visits, better access to price information, and stronger bargaining power for farmers, according to the National Institute of Agricultural Marketing (NIAM, 2023). [21]

6.2 Cropping Intensity and Diversification

Road connectivity contributes to higher cropping intensity by facilitating timely delivery of fertilisers, seeds, and irrigation inputs. In the states with high rural road density such as Punjab, Tamil Nadu, and Karnataka, cropping intensity has been observed in the range of 160% to 197%, whereas in poorly connected states such as Jharkhand and Chhattisgarh, it remains below 130%.[22]

Furthermore, better roads promote crop diversification toward high-value produce. In Tamil Nadu's Dindigul district, floriculture farmers reported a 25% increase in marigold and jasmine cultivation after PMGSY roads reduced travel time to Madurai's urban flower markets. These outcomes suggest that rural roads not only boost productivity but also foster shifts toward market-responsive agriculture.

6.3 Access to Agricultural Inputs and Extension Services

Rural roads improve the accessibility of institutional services such as Krishi Vigyan Kendras (KVKs), cooperative societies, and agro-dealer outlets. In Kalahandi district of Odisha, villages with the PMGSY connectivity reported higher participation in Rabi and Zaid seasons, primarily due to easier access to certified seeds and input depots.

Extension personnel also noted better outreach in previously disconnected zones. According to Indian Council of Agriculture Research (ICAR) reports, the frequency of agri-extension visits increased by 30% following road construction under the PMGSY, enhancing knowledge dissemination and adoption of the best practices.[23]

6.4 Post-Harvest Management and Price Realisation

Well-connected rural areas have better access to warehousing, cold storage units, and food processing centres, helping reduce spoilage and enhancing post-harvest handling. In Nashik, Maharashtra, onion farmers experienced a 20–25% drop in post-harvest losses after new rural road links connected their villages to nearby cold chains and procurement centres.

Additionally, road connectivity has improved farmer linkages with Farmer Producer Organisations (FPOs), enabling bulk sales and better price discovery. In Banda district of Uttar Pradesh, farmers affiliated with FPOs in connected villages earned 15–20% more per unit of sale compared to those in remote clusters.[24]

6.5 Rural Income and Non-Farm Opportunities

Beyond agricultural productivity, rural road access enables non-farm employment by improving access to towns, service centres, and training institutes. A study by the NITI Aayog (2022) found that villages connected under PMGSY reported 12–18% higher average household incomes, due to increased participation in self-employment and agri-allied activities like poultry, dairying, and rural retail.

In Rajasthan's Udaipur and similarly in several districts of India, including parts of Karnataka, construction of the PMGSY roads has been shown to empower rural women collectives—especially Self-Help Groups (SHGs)—by improving mobility, which fosters access to markets and encourages income-generating activities such as dairy, floriculture, agro-processing, and micro-enterprise ventures[25.]

7.0 CHALLENGES AND GAPS

Despite notable achievements, the full potential of rural roads in driving agricultural transformation in India remains partially unrealised. Several structural, institutional, and logistical challenges continue to weaken the effectiveness of the PMGSY and related rural connectivity programmes. These challenges occur across regions and across different stages of

implementation, from construction to maintenance and integration with other agricultural services.

7.1 Regional Disparities in Connectivity

There are pronounced inter- and intra-state disparities in the implementation and outcomes of rural road development. While states such as Uttar Pradesh, Tamil Nadu, and Karnataka have achieved noticeable performance in coverage and quality, Jharkhand, Chhattisgarh, and parts of the North-Eastern region continue to face chronic connectivity gaps. These deficiencies are often linked to difficult terrain, delays in forest clearance, and inadequate planning capacity at the district level.

According to the Ministry of Rural Development (2023), over 8,000 habitations across India remain unconnected due to topographical and legal constraints, particularly in ecologically sensitive tribal zones.

7.2 Poor Post-Construction Maintenance

Sustainability of rural roads is undermined by irregular post-construction maintenance. Though the contractors are obligated to maintain the roads for the first five years post construction, long-term maintenance mechanisms remain weak or non-existent in many states. Gram Panchayats, designated to take over the responsibility, often lack the financial and technical capacity to uphold maintenance standards.

According to the NABARD's RIDF evaluation (2022), over 35% of the PMGSY roads showed early signs of deterioration within 7–8 years, especially in regions with heavy rainfall and weak soil conditions.

7.3 Last-Mile Connectivity Issues

Many rural roads terminate at the periphery of habitations, leaving critical agricultural assets such as fields, water tanks, storage units, or procurement centres disconnected. In eastern Madhya Pradesh and interior Odisha, for example, farmers still walk 1–2 kilometres to transport goods manually due to lack of farm-to-field linkages.

Such gaps undermine the logistics efficiency of the overall rural road network and discourage perishable or high-value cropping that requires fast turnaround.

7.4 Lack of Integration with Agricultural Value Chains

Rural road projects are frequently implemented in isolation from agri-logistics and storage infrastructure planning. There is often limited convergence with programmes supporting FPOs, cold chain development, agri-markets, or warehouse connectivity.

In Bihar, for instance, only 22% of villages connected under the PMGSY have access to nearby storage or processing units, limiting the scope for collective marketing and value addition.

7.5 Climate Vulnerability and Infrastructure Degradation

Rural roads are increasingly vulnerable to climate-induced stress such as floods, landslides, and erosion. In fragile states like Kerala, Assam, and Uttarakhand, lack of proper drainage, slope protection, and weather-resistant materials result in premature damage and seasonal disruption of transport.

Such degradation not only raises public expenditure on repairs but also hampers crucial agri-transport flows during sowing and harvest seasons, especially for rainfed or mountainous farms.

8.0 KEY FINDINGS AND POLICY RECOMMENDATIONS

Based on the analytical review of rural road development and its interface with agricultural outcomes in India, the following findings and recommendations emerge to strengthen both policy design and implementation.

8.1 Key Findings

1. **Positive Correlation Between Rural Roads and Agricultural Performance**

   States with high rural road density, such as Punjab, Tamil Nadu, and Karnataka, have achieved better agricultural outcomes, including higher cropping intensity, improved price realisation, and reduced losses.

2. **Enhanced Market Access and Household Income**

   The PMGSY has reduced travel time, transportation costs, and enabled easier access to procurement centres. In several districts, household agricultural income increased by 15–25%, particularly in road-linked FPO clusters.

3. **Improved Input Delivery and Extension Coverage**

   Motorable road access has facilitated regular delivery of seeds, fertilisers, and irrigation services, and has expanded outreach by agricultural extension officers, particularly in remote areas.

4. **Persisting Gaps in Maintenance and Last-Mile Coverage**

   The absence of a structured maintenance framework and lack of connectivity from habitations to farms, tanks, and cooperatives continue to restrict the full benefits of the rural road infrastructure.

5. **Regional Disparities and Weak Institutional Integration**

   Backward and tribal-dominated regions lag behind due to institutional delays, environmental bottlenecks, and insufficient coordination between road and agricultural development agencies.

7.2 Policy Recommendations

In order to bridge the implementation gaps and enhance the developmental impact of rural roads on agriculture, the following policy recommendations are proposed:

1. To ensure road longevity and usability, the government must allocate a dedicated State Rural Road Maintenance Fund in every state. This should be supplemented by empowering Gram Panchayats through structured training and financial devolution for routine road upkeep. Additionally, community-based monitoring units comprising local stakeholders should be institutionalised to report deterioration or misuse of rural roads.
2. The PMGSY planning should be integrated with major agricultural infrastructure schemes such as the PM-FME (Formalisation of Micro Food Processing Enterprises), eNAM (National Agricultural Market), and FPO promotion initiatives. Using GIS-based planning tools, rural road networks should be extended to connect key agri-service modes including mandis, warehouses, cold storage facilities, and primary processing centres.

3. Special attention should be given to aspirational and remote districts through flexible design standards tailored for ecologically sensitive or conflict-prone areas. Furthermore, performance-based financial incentives should be introduced to encourage states to accelerate connectivity in lagging districts, especially those with high tribal or marginalised populations.
4. A targeted initiative under the PMGSY Phase IV must be launched to address the lack of last-mile connectivity. This should include development of farm link roads that connect agricultural fields, irrigation sources, and agri-input depots. The model should emphasise cluster-based linkages in regions with high potential for horticulture, livestock, or high-value cropping.
5. Technology platforms like OMMAS and Geo-PMGSY must be strengthened and standardised across states to support real-time monitoring, transparent fund utilisation, and accountability. Mobile-based grievance redressal systems such as Meri Sadak should be expanded to include regional language support and local training programmes to enhance citizen feedback and participation.
6. Women's collectives such as Self-Help Groups (SHGs) and FPOs should be formally engaged in road monitoring as grassroots "road watchdogs." Their involvement must be backed by capacity-building and linked to local social audit frameworks to ensure transparency in fund use, compliance with construction norms, and long-term governance of rural roads.

8.0 CONCLUSION

The evolution of rural roads in India, particularly under the PMGSY, has been a defining feature of the country's rural transformation strategy. Over the past two decades, the programme has facilitated much more than physical connectivity—it has enabled agricultural diversification, improved input delivery, and enhanced market integration across rural India.

This study finds a strong positive relationship between rural road access and key agricultural indicators such as cropping intensity, market access,reduced post-harvest loss reduction, and household income growth. The States like Tamil Nadu, Karnataka, and Punjab have reaped visible benefits by aligning road development with broader agri-infrastructure goals. Conversely, regions with weak post-construction maintenance, low institutional convergence, or geographical challenges continue to lag behind, despite basic road construction.

Pertinent issues such as unequal coverage, absence of last-mile linkages, and poor integration with value chains constrain the long-term developmental impact of rural connectivity. Climate risks, infrastructure degradation, and fragmented planning further challenge the sustainability of outcomes.

In order to move forward, a paradigm shift from linear construction to integrated rural mobility planning is essential. Future policy must prioritise maintenance regimes, data-driven mapping, agri-logistics integration, and community-driven governance, especially through SHGs and FPOs. With climate resilience, regional equity, and livelihood generation at its core, rural roads must be viewed not just as infrastructure but as a strategic enabler of agrarian transformation and inclusive rural development.

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