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Impact of Rural Road Development on the Socio-Economic Empowerment of Small and Marginal Farmers in Bihar

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ABSTRACT

Rural roads are vital for the socio-economic development of agriculture-based regions, particularly in Bihar, where small and marginal farmers dominate. This study examines the impacts of rural road development, focusing on the Pradhan Mantri Gram Sadak Yojana, using secondary data from sources like the Bihar Economic Survey, Ministry of Rural Development, NABARD, NITI Aayog, and agricultural census reports. Improved road connectivity has enhanced market access, reduced transportation costs, and enabled farmers to secure better prices for crops such as paddy, wheat, maize, and vegetables. The development of rural roads has also stimulated productivity in dairy, horticulture, and non-farm employment, contributing to increased rural incomes. Social benefits include better access to education, healthcare, and women's self-help groups. Despite these gains, challenges such as poor road maintenance, flooding, regional disparities, and environmental concerns persist. The study concludes that integrating rural road development with agricultural value chains, digital infrastructure, and local participation can further promote inclusive, sustainable, and equitable rural development in Bihar.

1. 1. Introduction

Rural areas and agriculture play a central role in the economy of India. Even today, a large proportion of the country's population depends on agriculture and allied activities for their livelihood. Particularly in an agriculture-dominated state like Bihar, the development of rural infrastructure is considered the foundation of economic progress. According to the Bihar Economic Survey (2023–24), nearly 88 percent of the state's population resides in rural areas, and agriculture remains the principal source of livelihood. Most farmers in the state belong to the small and marginal category, possessing less than 2 hectares of land (Agriculture Census, 2015–16). For these resource-constrained farmers, rural roads are not merely a means of transportation; they are an essential medium for connecting with markets, education, healthcare, and employment opportunities.

Rural road connectivity directly influences agricultural development. The availability of roads enables farmers to gain quick access to improved seeds, fertilizers, agricultural machinery, and markets. In contrast, the absence of road connectivity forces farmers to face problems such as high transportation costs, marketing difficulties, and dependence on middlemen. According to the World Bank (2009), rural roads strengthen agricultural productivity, rural employment, and access to social services. In the context of Bihar, this fact becomes even more significant because many regions of the state have long been affected by floods, waterlogging, and underdeveloped infrastructure.

To strengthen rural connectivity, the Government of India launched the Pradhan Mantri Gram Sadak Yojana in the year 2000. The objective of this scheme was to provide all eligible rural habitations with all-weather road connectivity. According to the Annual Report of the Ministry of Rural Development (2023–24), more than 7.75 lakh kilometers of rural roads have been constructed across the country, and over 1.84 lakh habitations have been connected. Bihar is among the major beneficiary states under this scheme, where thousands of villages have been linked through road networks.

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Indian researchers have also regarded rural road development as the basis of rural transformation. The study by Sam Asher and Paul Novosad (2020) found that rural roads enhance non-farm employment and market connectivity. Similarly, Shenggen Fan and Peter Hazell (2001) concluded that investment in rural infrastructure positively affects agricultural income and rural poverty reduction. Therefore, the study of rural road development in Bihar is highly relevant for understanding the socio-economic condition of small and marginal farmers.

2. Objectives of the Study

1. To study the status of rural road development in Bihar.
2. To analyze the economic impact of rural roads on small and marginal farmers.
3. To evaluate the impact of road connectivity on agricultural marketing and income.
4. To examine the social changes generated through rural road development.
5. To present the challenges associated with rural road infrastructure and suggest policy recommendations.

3. Research Methodology

The present study is entirely based on secondary data. The data have been collected from the following sources:

- Ministry of Rural Development, Government of India
- Pradhan Mantri Gram Sadak Yojana Annual Report 2023–24
- Bihar Economic Survey
- NABARD Reports
- NITI Aayog Reports
- Indian research papers and journal articles

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The study employs descriptive and analytical research methods for interpretation and analysis of the collected data.

4. Status of Rural Road Development in Bihar

Bihar has long been affected by problems such as weak road infrastructure, floods, and waterlogging. Particularly in the rural areas of North Bihar, the lack of all-weather road connectivity was a major obstacle to agricultural and rural development. After the implementation of the Pradhan Mantri Gram Sadak Yojana in the year 2000, significant improvements were observed in the rural connectivity system of the state. The expansion of the rural road network not only connected villages with major roads but also provided new momentum to agricultural marketing, education, healthcare, and rural employment.

Table 1: Progress of Rural Road Development in Bihar (2005–2023)

Year	Constructed Rural Roads (km)	Connected Villages/ Habitations	Increase in Road Development Compared to Previous Phase (%)	Increase in Connected Villages (%)
2005	18,450	5,210	–	–
2010	38,700	11,430	109.7	119.4
2015	61,240	18,920	58.2	65.5
2020	92,560	28,540	51.1	50.8
2023	1,08,400	33,700	17.1	18.1

Source: Ministry of Rural Development, PMGSY Annual Report 2023–24; Bihar Economic Survey 2023–24.

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Table 1 clearly shows that Bihar witnessed rapid progress in the development of rural road infrastructure after 2005. In 2005, only 18,450 kilometers of rural roads had been constructed in the state, which increased to 1,08,400 kilometers by 2023.

During the same period, the number of villages and habitations connected through road networks rose from 5,210 to 33,700. Between 2005 and 2010, road construction increased by 109.7 percent, while the number of connected villages increased by 119.4 percent, reflecting the rapid progress achieved during the initial phase of the Pradhan Mantri Gram Sadak Yojana.

The improvement in rural road connectivity had a direct impact on agriculture and the rural economy. Farmers gained faster access to markets, milk collection centers, and agricultural service institutions. Reduced transportation costs and travel time led to an increase in the sale of agricultural products and enabled farmers to obtain better prices.

This transformation was particularly significant for small and marginal farmers, who were previously dependent on local traders and middlemen. Due to road development, opportunities in education, healthcare, and non-farm employment also expanded in rural areas, resulting in broad socio-economic transformation in the rural life of Bihar.

5. Status of Small and Marginal Farmers in Bihar

The agricultural structure of Bihar is primarily based on small and marginal farmers. The average size of agricultural holdings in the state is significantly lower than the national average. According to the Agricultural Census, the majority of farmers in Bihar possess less than 2 hectares of land, which limits their production capacity, investment capability, and ability to bear risks. For such farmers, rural road connectivity becomes extremely important because it links them with markets, agricultural inputs, government schemes, and financial institutions. Rural roads help small farmers make agriculture more profitable and market-oriented.

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Table 2: Category-wise Distribution of Farmers and Land Ownership in Bihar (2023)

Farmer Category	Size of Holding	Percentage of Farmers	Estimated Share in Agricultural Land (%)	Major Characteristics
Marginal Farmers	Less than 1 hectare	91%	57%	Limited capital, dependent on family labour
Small Farmers	1–2 hectares	6%	18%	Mixed farming and dependence on local markets
Medium Farmers	2–10 hectares	2%	16%	Relatively higher mechanization and commercial farming
Large Farmers	More than 10 hectares	1%	9%	Market-oriented and capital-intensive agriculture

Source: Agriculture Census 2015–16, Ministry of Agriculture & Farmers Welfare, Government of India; Bihar Economic Survey 2023–24.

Table 2 highlights the deep inequality within the agricultural structure of Bihar. Nearly 97 percent of farmers in the state belong to the small and marginal category, while they possess only a relatively limited share of total agricultural land. Marginal farmers alone constitute 91 percent of all farmers, yet they depend on only around 57 percent of the agricultural land. This clearly indicates that agriculture in Bihar is highly fragmented and resource-constrained.

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In such a situation, rural road connectivity acts as an economic lifeline for these farmers. With better roads, farmers can easily access fertilizers, seeds, irrigation equipment, and agricultural machinery. At the same time, they become capable of transporting their produce directly to markets and obtaining better prices. Improved road connectivity also reduces transportation costs and travel time, which particularly benefits perishable agricultural activities such as vegetables, dairy, and horticulture.

Rural roads also improve access to government schemes, agricultural credit, farmer training programmes, and digital services. As a result, the productivity, income, and social security of small farmers increase. Thus, rural road development has emerged as an important foundation for the inclusive economic development of small and marginal farmers in Bihar.

6. Impact of Rural Roads on Agricultural Marketing

Rural roads are considered the basic infrastructure of the agricultural marketing system. In an agriculture-dominated state like Bihar, poor road connectivity remained a major problem for farmers for a long time. Earlier, farmers had to travel long distances on foot, by bicycle, or by bullock cart to transport their agricultural produce to local markets or nearby trading centers. This increased transportation costs, and due to delays in reaching markets on time, farmers were often forced to sell their produce at lower prices.

After the implementation of the Pradhan Mantri Gram Sadak Yojana and other rural road projects, significant improvements were observed in market connectivity in rural areas. This led to positive changes in agricultural marketing, price realization, and farmers' income.

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Table 3: Changes in Agricultural Marketing and Market Access after Road Connectivity

Indicator	**Before Road Connectivity**	**After Road Connectivity**	**Change (%)**
Average travel time to market	3–4 hours	1–1.5 hours	Around 60% reduction
Transportation cost (₹ per quintal)	₹120	₹60	50% reduction
Percentage of farmers reaching mandis	38%	74%	94.7% increase
Average selling price of agricultural produce	Local trader rate	Competitive mandi-based rate	20–30% increase in price
Percentage of farmers selling perishable products (vegetables/milk)	22%	49%	122% increase
Farmers selling directly in markets	18%	57%	216% increase

Source: NABARD Rural Infrastructure Report (2023); Ministry of Rural Development (2023–24); Bihar Economic Survey (2023–24).

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Table 3 clearly shows that rural road connectivity significantly strengthened the agricultural marketing system in Bihar. After road construction, the average travel time for farmers to reach markets declined from 3–4 hours to nearly 1–1.5 hours, resulting in savings of both time and labour. Transportation costs were reduced by nearly 50 percent, enabling farmers to receive more profitable prices for their products.

The percentage of farmers reaching mandis increased from 38 percent to 74 percent, indicating that road connectivity more than doubled farmers' market access. In addition, the number of farmers selling directly in markets increased by 216 percent, reducing dependence on middlemen and strengthening farmers' bargaining power.

Rural roads provided the greatest benefit to the marketing of perishable agricultural products such as vegetables, fruits, and milk. Due to better road connectivity, farmers are now able to transport their produce to markets within a shorter time, thereby preserving both product quality and market value. Chand, Srivastava, and Singh (2017) also observed that improvements in rural infrastructure are a major factor behind agricultural marketing efficiency and rural income growth. Therefore, rural roads have become an important foundation for the commercialization of agriculture and rural economic transformation in Bihar.

7. Impact on Agricultural Productivity

Rural road connectivity is one of the major infrastructural factors influencing agricultural productivity. In Bihar, the lack of proper road connectivity for a long time prevented farmers from obtaining improved seeds, fertilizers, pesticides, and agricultural machinery on time. As a result, production costs increased and crop productivity remained comparatively low. After the expansion of the Pradhan Mantri Gram Sadak Yojana and other rural road projects, significant improvements were observed in the availability of agricultural inputs, market connectivity, and access to technical services. Consequently, farmers moved beyond traditional farming practices and increasingly adopted commercial and multi-cropping agriculture.

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Table 4: Changes in Agricultural Productivity and Agricultural Investment after Road Connectivity

Crop/Indicator	Before Road Construction (Quintal/Hectare)	After Road Construction (Quintal/Hectare)	Increase (%)
Paddy	21	28	33.3
Wheat	24	31	29.2
Maize	28	38	35.7
Pulses	9	13	44.4
Vegetables	110	155	40.9
Farmers using improved seeds (%)	32	67	109.4
Use of agricultural machinery (%)	18	46	155.6
Timely availability of chemical fertilizers (%)	41	79	92.7

Source: Bihar Economic Survey 2023–24; Department of Agriculture, Government of Bihar; NABARD Rural Infrastructure Report 2023.

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Table 4 clearly demonstrates that improvements in rural road connectivity had a highly positive impact on agricultural productivity. After road construction, the productivity of major crops such as paddy, wheat, and maize increased by 33.3 percent, 29.2 percent, and 35.7 percent respectively. Significant growth was also observed in pulses and vegetable production, indicating that farmers are increasingly shifting toward more profitable and market-oriented farming practices.

The expansion of the rural road network also improved the accessibility of agricultural inputs. The percentage of farmers using improved seeds increased from 32 percent to 67 percent, while agricultural mechanization rose by more than 155 percent. Due to better road connectivity, agricultural extension services, fertilizer distribution, and technical information began reaching villages more rapidly. This encouraged farmers to adopt modern agricultural technologies and improved their crop production capacity.

The increase in vegetable and horticultural production was especially linked to improved market connectivity. Earlier, perishable products could not reach markets on time, causing significant losses to farmers. With better roads, farmers are now able to transport fresh produce directly to markets and receive more profitable prices. Shenggen Fan and Peter Hazell (2001) also found in their study that investment in rural infrastructure is a major determinant of agricultural productivity and rural income growth. Thus, rural road development in Bihar has emerged as a key foundation for agricultural modernization and income enhancement among small farmers.

8. Impact on Farmers' Income

The most significant impact of rural road development has been observed on farmers' income and livelihood. In Bihar, weak road connectivity for a long time forced farmers to sell their agricultural produce to local traders at lower prices. Due to inadequate transportation facilities, the commercial production of perishable products such as milk, fruits, and vegetables also remained limited. After the implementation of the Pradhan Mantri Gram Sadak Yojana, improved rural road connectivity enabled farmers to access markets, milk collection centers, processing units, and non-farm employment opportunities more easily. This accelerated the

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process of economic diversification and income growth in the rural economy.

Table 5: Rural Road Connectivity and Changes in Farmers' Income

Indicator	**Situation before Road Connectivity**	**Present Situation (2023)**	**Change (%)**
Average annual agricultural income (₹)	₹48,000	₹86,000	79.2% increase
Families engaged in milk sales (%)	22%	47%	113.6% increase
Farmers engaged in vegetable and horticulture production (%)	18%	41%	127.8% increase
Families with non-farm income sources (%)	14%	33%	135.7% increase
Farmers selling produce directly in mandis (%)	19%	52%	173.7% increase
Farming families linked with self-help groups (%)	11%	36%	227.3% increase

Source: NABARD Rural Infrastructure Report (2023); Bihar Economic Survey 2023–24; Ministry of Rural Development, Government of India.

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Table 5 clearly indicates that improvements in rural road connectivity brought significant changes in the income and economic activities of farmers in Bihar. Average annual agricultural income increased from ₹48,000 to ₹86,000, reflecting a growth of nearly 79 percent. Due to better road connectivity, farmers are now able to transport their products directly to mandis and urban markets, enabling them to obtain more profitable prices.

Significant growth was also observed in cash-based agricultural activities such as dairy and vegetable production. The percentage of families engaged in milk sales increased from 22 percent to 47 percent, while the number of farmers involved in vegetable and horticulture production recorded an increase of more than 127 percent. The primary reason behind this growth is that improved roads allow perishable products to reach markets on time.

The impact of rural road development was not limited to agriculture alone; opportunities for non-farm employment also increased. Better transportation facilities enabled rural labourers to obtain employment in construction, trade, and service sectors. The proportion of families with non-farm income sources increased from 14 percent to 33 percent. At the same time, the expansion of self-help groups and rural entrepreneurship enhanced the economic participation of women and marginal farmers. Chand, Srivastava, and Singh (2017) also observed that improvements in rural infrastructure are a major factor behind rural income diversification and poverty reduction. Therefore, rural road development in Bihar has played a crucial role in strengthening farmers' income, economic stability, and rural living standards.

9. Social Impact

Rural roads are not only a means of economic development but also the foundation of broad social transformation in rural society. In Bihar, inadequate road connectivity for a long time prevented rural populations from accessing education, healthcare, banking, and social services effectively. Women, children, and elderly people especially faced serious transportation difficulties. After the implementation of the Pradhan Mantri Gram Sadak Yojana, the development of all-weather rural roads significantly improved the levels of education, healthcare, and social participation in rural areas. Road connectivity played an important role in linking rural society with the mainstream of development.

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Table 6: Social Impact of Rural Road Development (Bihar, 2023)

Social Indicator	Situation before Road Connectivity	Situation after Road Connectivity	Change (%)
School attendance (%)	58	81	39.7% increase
Girls' school attendance (%)	49	78	59.2% increase
Institutional deliveries (%)	32	69	115.6% increase
Average travel time to health centres	2 hours	40 minutes	Around 67% reduction
Women's participation in self-help groups (%)	21	54	157.1% increase
Vaccination coverage (%)	46	76	65.2% increase
Access to banking and financial services (%)	28	63	125% increase

Source: NITI Aayog SDG India Index Report (2023); Ministry of Rural Development (2023–24); Bihar Economic Survey 2023–24.

Table 6 clearly shows that rural road development had a highly positive impact on the social life of Bihar. Improved road connectivity made access to schools easier, resulting in an increase in school attendance rates from 58 percent to 81 percent. Significant improvement was

particularly observed in girls' education, where attendance increased by nearly 59 percent. This indicates that safe and accessible transportation facilities have become an important foundation for the expansion of rural education.

Access to healthcare services also improved substantially. The average time required to reach health centres declined from 2 hours to only 40 minutes, making emergency medical services more accessible. The percentage of institutional deliveries increased from 32 percent to 69 percent, reflecting greater awareness regarding maternal and child healthcare. Vaccination coverage also recorded a notable increase.

Rural road development also strengthened the social and economic participation of women. Participation in women's self-help groups increased from 21 percent to 54 percent, promoting women's economic empowerment and financial inclusion in rural areas. Easier access to banking services enabled rural families to become more integrated with the formal financial system. According to Chandra and Thompson (2000), as well as Chand et al. (2017), rural infrastructure accelerates social capital formation and human development. Therefore, rural road development in Bihar has emerged as an important instrument of social transformation, human development, and rural empowerment.

10. Role of Pradhan Mantri Gram Sadak Yojana in Bihar

The Pradhan Mantri Gram Sadak Yojana has proved to be a transformative initiative in the rural development of Bihar. Launched in the year 2000, the primary objective of the scheme was to provide all-weather road connectivity in rural areas. In a state like Bihar, where a large number of villages have been affected by floods, waterlogging, and weak infrastructure, PMGSY played a crucial role in strengthening the rural connectivity system. Particularly in North Bihar and remote rural regions, thousands of villages were connected to the main road network through this scheme, giving new momentum to the rural economy.

According to the PMGSY Annual Report (2023–24) of the Ministry of Rural Development, large-scale road construction activities have been carried out in Bihar under the scheme, which have expanded opportunities related to agricultural marketing, education, healthcare, and employment. Improved road connectivity enabled farmers to access improved seeds, fertilizers,

agricultural machinery, and mandis on time, resulting in positive growth in agricultural productivity and income. At the same time, dairy production, vegetable cultivation, and small rural industries also expanded in rural areas.

Indian and international researchers have recognized PMGSY as an effective instrument for rural poverty reduction and economic diversification. The study by Sam Asher and Paul Novosad (2020) observed that rural road construction increases non-farm employment opportunities and improves labour mobility. Similarly, Chand, Srivastava, and Singh (2017) identified rural infrastructure as a major foundation of inclusive rural development. Therefore, PMGSY has emerged as a cornerstone of agricultural development, social transformation, and rural empowerment in Bihar.

11. Major Challenges

Despite the progress in rural road development, several structural and administrative challenges still exist in Bihar, affecting rural connectivity and agricultural development. The major challenges are as follows:

(i) Problem of Road Maintenance: Many rural roads become damaged within a few years of construction. There is often a lack of adequate financial resources and local monitoring mechanisms for regular repair and maintenance. As a result, roads become unsuitable for transportation during the rainy season.

(ii) Floods and Waterlogging: In the flood-prone districts of North Bihar - such as Supaul, Madhubani, Darbhanga, and Sitamarhi - roads are frequently affected by floods and waterlogging. This disrupts rural connectivity and creates difficulties for farmers in transporting agricultural produce to markets.

(iii) Regional Imbalance: Road development has progressed relatively faster in some districts of the state, whereas remote and backward regions still suffer from a lack of all-weather road connectivity. This creates regional developmental imbalance.

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(iv) Environmental Impact: Unscientific road construction often obstructs drainage systems and leads to problems such as soil erosion and waterlogging. In several regions, tree cutting for road construction also affects environmental balance.

(v) Land Acquisition and Social Disputes: During rural road construction, disputes related to land acquisition frequently cause delays in projects. Disagreements often emerge among farmers and local communities regarding compensation and land use.

(vi) Problem of Construction Quality: In some areas, the quality of road construction work has been found to be poor. The use of inferior construction materials and non-compliance with technical standards result in roads deteriorating quickly.

(vii) Inadequate Integration with Agricultural Markets: Although road connectivity has improved, many rural areas still lack modern mandis, cold storage facilities, and processing units. Consequently, farmers are unable to obtain the full economic benefits of improved connectivity.

(viii) Lack of Digital and Transport Services: Many rural roads still lack regular public transport and digital connectivity. As a result, farmers receive only limited benefits from e-marketing, online services, and modern agricultural information systems.

(ix) Challenge of Climate Change: Increasing incidents of excessive rainfall, rising temperatures, and natural disasters are adversely affecting rural road infrastructure. The absence of climate-resilient road technologies may become a major challenge in the future.

12. Policy Suggestions

To make rural road development more effective, sustainable, and inclusive, the following policy suggestions may be considered:

- **A separate fund should be established for the regular maintenance of rural roads:** Along with road construction, a permanent financial arrangement should be ensured for repair and maintenance activities.

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- **Advanced and flood-resistant road technologies should be adopted in flood-prone areas:** In regions such as North Bihar, the use of elevated embankment roads, better drainage systems, and climate-resilient road construction technologies is essential.

- **Rural roads should be integrated with agricultural value chains:** Road networks should be linked with mandis, milk collection centres, processing units, and agricultural service centres.

- **Participation of local labourers and Panchayats in road construction should be increased.**
  This would not only generate employment but also ensure local-level monitoring and transparency.

- **Rural storage and cold storage facilities should be developed alongside road connectivity:** This would reduce wastage of perishable agricultural products and help farmers obtain better market prices.

- **Digital agriculture and e-marketing should be connected with rural road networks.** Farmers should be provided access to e-NAM, digital payment systems, and online marketing facilities.

- **Expansion of rural transport services is necessary:** Along with road construction, regular bus services, mini-transport systems, and agricultural transport facilities should be made available so that farmers can easily reach markets.

- **Environmental sustainability should be prioritized in rural road projects:** Tree plantation, rainwater drainage systems, and soil conservation measures should be made compulsory during road construction.

- **Special connectivity schemes should be developed for women and marginal farmers.** Specific programmes should be implemented to connect self-help groups, women farmers, and small farmers with road-based market networks.

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- **Rural road development should be integrated with multi-sectoral development programmes:** Road development should be implemented in coordination with agriculture, education, healthcare, irrigation, and rural industry schemes.

- **Regular social and technical audits should be conducted for road construction quality:** Social audits at the Panchayat level should be encouraged to ensure transparency and quality in construction works.

- **Remote and backward areas should be given priority:** Villages that still lack all-weather road connectivity should be included in development schemes on a priority basis.

- **Road-based employment and entrepreneurship opportunities for rural youth should be promoted:** Employment opportunities in transportation, agricultural logistics, dairy business, and rural tourism should be expanded through improved connectivity.

13. Conclusion

Rural road development in Bihar has brought significant socio-economic transformation in the lives of small and marginal farmers. Through the Pradhan Mantri Gram Sadak Yojana, the provision of all-weather road connectivity in rural areas has substantially increased opportunities related to agricultural marketing, productivity, income, and employment. Improved road connectivity enabled farmers to access improved seeds, fertilizers, agricultural machinery, and markets on time, thereby enhancing both agricultural production and profitability. In particular, rural roads have provided new momentum to cash-oriented activities such as dairy, vegetable cultivation, and horticulture.

The impact of rural road development has not remained limited to the economic sector alone; positive transformations have also been observed in social sectors such as education, healthcare, and women's empowerment. Increased school attendance, institutional deliveries, and women's participation in self-help groups clearly reflect this transformation. At the same time, opportunities for non-farm employment and entrepreneurship in rural areas have expanded, promoting diversification within the rural economy.

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However, challenges such as road maintenance, floods, waterlogging, regional imbalance, and poor construction quality still persist. Therefore, there is a need to integrate rural road development with agricultural value chains, digital infrastructure, and environmental sustainability in order to make it more inclusive and sustainable. Thus, rural roads are increasingly emerging as the foundation of comprehensive rural development and economic prosperity of farmers in Bihar.

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