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THE ROLE OF ROAD QUALITY DEVELOPMENT IN DRIVING THE GROWTH OF INFORMAL TRANSPORT SERVICES (IMT) AND NON-FARM EMPLOYMENT IN RURAL MURSHIDABAD OF WEST BENGAL, INDIA

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***Abstract*:** The transportation system acts as a vital tool for socio-economic development, especially in rural areas, where remoteness and unavailability hamper habitat development. In this research paper, it is tried to focus on the impacts of all-season bitumen roads on the new modes of transportation, along with job generation, specifically in rural Murshidabad, West Bengal, India, a rural area characterised by high-isolation conditions. In this research, it is assumed that a primary survey involving 855 households in 57 rural villages, along with the data provided by the transportation syndicate, spanning the period from 2005 to 2020, is used to filter out the impact created by the development in transportation. The study uses a qualitative comparative approach to determine the impact created by the nature of transportation infrastructure in this study.

The key findings reveal a 245% increase in the service providers of informal transport (IMT), thereby offering 158 direct jobs, with 58 jobs indirectly. The service delivery offered by the old transport mode of bullock/ horse carts decreased by 74%, thereby making it insignificant. The findings are in support of the fact that infrastructure, particularly the road, plays a role beyond supportive service interventions. It plays the role of a basic economic recasting methodology, which possesses the capability to modify the basic paradigms of the entire occupational structure and offer uninterrupted non-farm employment to the rural folk.

Keywords: Road Infrastructure, Intermediate Transport Services, Non-farm Employment, Rural Livelihoods, Economic Transformation, Motorisation, India

I. INTRODUCTION AND RATIONALE OF THE STUDY

Rural areas in developing countries have traditionally remained less connected and using traditional transport modes these areas remain highly constrained in terms of mobility and market access (Tarafder and Jana, 2016). In the Indian context, where about 65% of the Indian population lives in rural areas, rural transport infrastructure is highly relevant for rural poverty alleviation, rural diversification of employment, and rural development success (Tiwary et al, 2003). The measurement of all-weather roads has been long established in the international arena as an indispensable infrastructure, and considerable investments in this objective have come through the *Pradhan Mantri Gram Sadak Yojna* (PMGSY) scheme, which began in the Indian context in the year 2000 (Tarafder and Jana, 2021). However, surprisingly,

not many studies have closely investigated in how the changed nature of roads can bring about transitions in transport, and consequently, non-farm employment.

Murshidabad district in West Bengal provides an interesting case study on these aspects. The district with its 80.3 percent rural population (Tarafder and Das 2020) saw systematic bitumen road development under the PMGSY from the year 2000 on, yet considerable variations in the condition of roads in the villages were observed. The villages of the district were mostly using the conventional transport modes like bullock and horse-carts along with vans, and autos prior to the period from 2000-2010. Buses and trekkers were operated on the major roads. Just like the situation in the other districts in West Bengal, the establishment of the all-weather bitumen roads started the transition process from the conventional transport modes even in this district too. The motor vans, autos, and most preferably the "*Totos*," the battery-powered three-wheelers, now have taken over the conventional modes on the new roads. This happened with hardly any official intervention in the matter (Tarafder, 2022).

The significance of the economic dimension of the modal shift is not limited by the requirement of modal shifts but the entire structure of the economy of the rural areas. For instance, the effect of the modal shift creates new employment opportunities outside farming, and the entire livelihood patterns of families in rural areas are changed. However, the extent of the employment generation process is not well documented in the literature of the academic world.

II. OBJECTIVES

The study aims at evaluating the effect of improved road infrastructure on non-farm job opportunities. The main research objectives are:

1. To quantify change of the transport mode in the intermediate transport service level (IMT) from traditional (bullock/horse) to motorized (van/auto/toto) transport services offered within villages, depending upon road conditions.
2. Estimate the number of both direct and indirect employment in the transport services industry triggered by the introduction of bitumen roads, and the income multiplier effects.

III. SIGNIFICANCE OF THE STUDY

This research is a novel work towards understanding infrastructure investment-triggered occupational shift and employment creation processes at the micro-level. The impact of infrastructure typically is measured in aggregate terms, such as reduction in poverty levels, increases in incomes, and so on, but this study traces the occupational transition as a spontaneous response to road infrastructure investment.

IV. REVIEW OF THE EXISTING LITERATURE

The relationship between transport infrastructure and development outcomes has long been captured in theoretical papers. The rural areas of the developing world tend to be less developed in transport, and communication infrastructure, and therefore less developed in agriculture, and agricultural marketing, and the rainy seasons render many villages inaccessible, and bullock carts are the only modes of communication during this period (Mokua, 2000). With the establishment of effective transport networks, the rural areas would be able to develop quickly by connecting the rural economy to commercialization. Public spending in road construction shapes rural poverty in relation to improved agricultural production associated with better agricultural productivity, non-farm employment opportunities, and rural wages (Mahapatra et al., 2007).

The motor transport services create a great scope, especially for rural areas, by reducing the problem of isolation created by the rural villages and increasing the social and economic interaction between the rural villages and the towns (Rahman, 2002). The study conducted by Asher & Novosad, (2020), showed considerable heterogeneity existing in road outcomes, where the jobs created are mainly seen in areas having adequate market density.

The coming of motorized transport from the use of animals is an important milestone for rural development. Starkey et al. (2002), in their World Bank study on rural transport in developing countries, observed that the motorization process for rural transport usually passes through three stages: (1) "primitive forms of motorized transport," mainly involving the use of motorized transport on main roads; (2) "a period of very rapid growth for intermediate transport," mostly due to improvements in the condition of roads; and (3) "an expansion phase whereby transport is consolidated on larger vehicles," an aspect being witnessed in Murshidabad and nearer to the final stage. This intermediate stage is somewhat an era where 'maximum entrepreneurship and employment generation take place with minimal capital outlays.' Bhat (1987) observed that 'light transport vehicles owned and operated by low-income people provide substantial rural employment once road improvement is made.' Light transport vehicles like 'passenger motor cars,' 'auto rickshaws,' and 'motorised three-wheelers' act as 'vehicles for entrepreneurship' with 'multiple journeys per day to varied destinations' involving 'substantially less capital than bus transport.' Moreover, it is observed in the case of India that 'growth of auto-rickshaws and three-wheelers is an important source of employment generation,' although 'it is yet an unexplored aspect in rural transport with improvements in road connectivity.'

Induced employment effects resulting from expansion in the transportation sector work through various mechanisms. According to Starkey et al. (2002), these mechanisms include (1) maintenance and supply of spare parts for vehicles, (2) fuel distribution, (3) services (food, accommodation for transportation sector employees), and (4) increased accessibility appropriate for employment in other industries. The value of the employment multiplier, expressed as the ratio of indirect employment to direct employment, is generally in the band 1.5-3.0. For the Indian situation, NRRDA (2009) found in their study on rural road development as government expenditures in rural areas that this creates a "productive effect" representing 55% of overall non-rural farm employment effects. Clearly, this is indicative of quite high values attributable to indirect employment.

The reduction of traditional modes of transport follows a predictable trajectory. Horse carts and bullockcarts, which are well-entrenched in villages, follow suit drastically as more modern means of transport become available. Devaraja suggests that this is a result of rational decision-making by the operators to move to faster, more reliable, and more lucrative transport.

V. IDENTIFIED RESEARCH GAP

Existing literature identifies road infrastructure as an important part for employment, but the specific mechanisms, like how road infrastructure quality drives modal transition in transport service provision in the intermediate operation level (IMT) receive limited empirical attention. Most studies measure aggregate employment changes without documenting the transport sector dynamics underlying these changes. This research addresses this gap by quantifying modal shifts empirically, analysing the road quality impacts on motorisation, and measuring employment growth across multiple occupational categories.

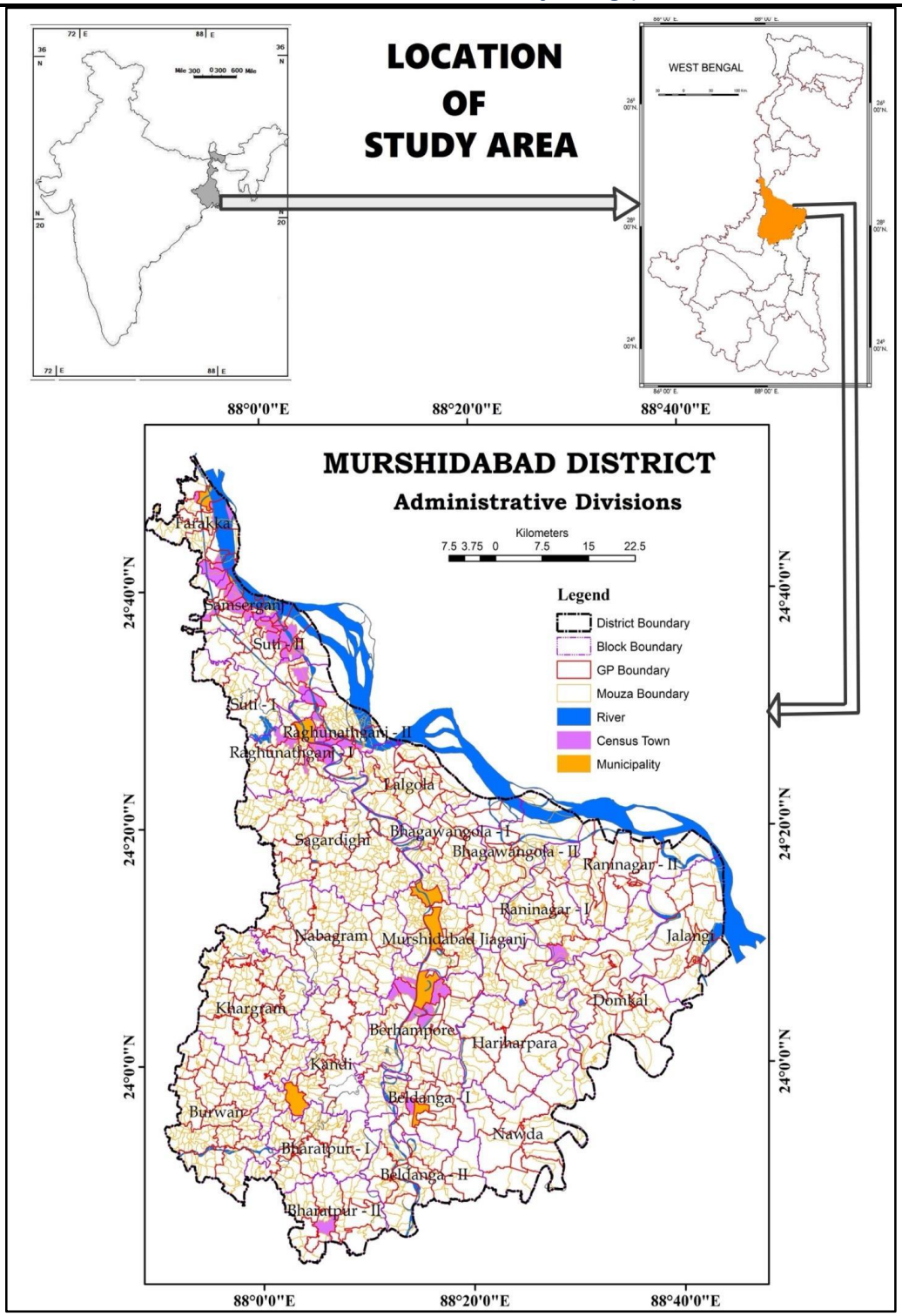

Fig. 1 Study Area (Tarafder, 2022)

VI. STUDY AREA AND RATIONALE BEHIND THE CHOICE

For the present study Murshidabad district of West Bengal has been selected as a study area. The rationale behind the selection of the study area is its rural background as about 80.3% of the population lives in rural areas (Census of India, 2011). The district has a third highest decadal growth rate (from 2001 to 2011) and is much higher than the state's average of 13.8%. The literacy rate is 66.6% and ranks 16th position within the state. The work participation rate is only 36.5% in the census year 2011 and ranks 15th within the state. The literacy rate of Murshidabad is always lower than the State's average and ranks 16th since 2001. Female literacy was 47.6% in 2001, and in 2011 it was raised to 63.1%. The district is lagging in terms of development as it ranked 15th out of 19 districts of West Bengal in human development (Human Development Report, 2004). The situation has not improved much in due course, and in terms of rural development, the situation remains the same (Tarafder and Jana, 2021).

The rural connectivity by all-weather roads was not good (about 35% of rural habitation was unconnected as of 2001), and slow growth of road development has been observed in public sector road construction (PWD and PW (Roads), 2018) although considerable progress has been noticed since the initiation of PMGSY in the year 2000. Thus a district with a high rural base along with a low level of development struck me to pursue this research to understand the modal shift and occupational growth. Besides, there is a lack of inefficient goods and passenger transportation in the intermediate operation level.

VII. DATABASE AND RESEARCH DESIGN

The study is primarily based on primary data collected through structured questionnaires to collect information on occupational history (current and previous occupations, timing of transitions), access to transport mode (available pre-road construction and currently), frequency of use of (pre-road construction and currently), income dynamics (monthly income by source, employment type), transport service details from IMT operators (vehicle type owned/operated, annual investment, monthly revenue, operating costs, profits, constraints to expansion etc.). Respondents asked to recall approximate income 10-15 years prior.

In addition to the above, the secondary data regarding the informal transport service has been gathered from the administrative records of transport syndicate offices at Berhampore, Kandi, and Raghunathgunj. No of Vehicles by type of vehicle (Van, *Toto,* Auto, Bus) by Block and Year has been collected to test the authenticity of the primary data. The primary data has been complemented by conducting structured/paper-and-pencil interviews with a semi-structured approach among the 48 IMT operators/mechanics and syndicate officers.

This paper applies a comparative research design to investigate variation in the timing and quality of improvement in roads in villages. 57 villages in 14 blocks in the Murshidabad district have been chosen using stratified random sample for this survey. There are two groups of villages:

- **The treatment Group (n=37)-** Villages with bitumen (metalled) roads by 2018, surveyed in 2019- 2020 to estimate the effect during 10+ years after the roads were made
- **Control Group (n = 20) -** Villages not having the road connected by Bitumen within the 2 km radius, up to the year 2018.

The framework of difference-in-differences has been used by comparing villages before/after road improvement and comparing treated villages with control villages at similar points in time.

A total of 855 households were chosen to provide good representation of villages. Stratified sampling within villages was conducted to provide representative samples of households according to the occupations of people within the village, oversampling transport workers (finding all households within the village that had an IMT operator).

7.1 Measurement of Key Variables

- **Road Quality:** 1. Bitumen Roads (all-weather metalled surfaces (National Highways, State Highways, PMGSY-constructed roads), 2. Moram/Metalled Roads (gravel/brick-surfaced roads, seasonal maintenance issues), 3. Earthen Roads (soil tracks, impassable during monsoon, unsuitable for motorised vehicles).
- **Transport Modes:** 1. Traditional (Non-motorised- bullock carts, horse carts, vans and Rickshaw (Manual), 2. Intermediate (motorised vans, battery-driven three-wheelers/Totos (informal sector), 3. Commercial (auto-rickshaws, small trucks, trekkers, small passenger cars, and buses (formal sector).
- **Employment**: 1. Direct Employment (primary occupational income derived from transport services), 2. Indirect Employment (secondary occupations created through transport sector growth (mechanics, spare parts dealers, fuel station workers, food vendors serving transport workers etc).

VIII. RESULTS AND DISCUSSION

8.1 Modal Shift: From Traditional to Motorized Transport

Villages connected by bitumen roads experienced a considerable shift of traditional modes with motorised alternatives within the last 10 years.

Table-1 Modal Shift (Treatment Village)

Mode	Pre-Road (2005-10)	Post-Road (2015-20)	Net Change	Percent Change
Bullock Carts	47	12	35	74
Motorised Van/ Auto	13	38	25	192
Toto (Battery operated tricycle)	0	42	42	4200

Source: Field Survey by the Authors

Table 1 presents the aggregate modal composition in treatment villages before (2005-2010) and after (2015-2020) bitumen road introduction. Bullock Carts declined from 47 to 12 units across sampled villages (-74%). Now these are used only to collect crops from fields connected by earthen or *moram* roads. Horse Carts too decreased in similar ways. Motorised Vans and Autos increased from 13 to 38 units (+192%) replacing the horse and bull driven carts. Battery *Totos* emerged as an entirely new service (0 to 42 units) in the treatment villages. This transition was near-universal across treatment villages, with all villages shifting from bullock/horse carts as primary transport to motorized vans and *totos* as primary mode by 2018.

In contrast, villages without bitumen roads showed less changes or shifts. In the control villages bullock and horse carts didn't decrease significantly (55 units to 38 units (-31%), with 3 to 7 motorised vans and few *totos* during this period. This comparison strongly suggests road quality drives modal transition rather than autonomous technological adoption or demand changes.

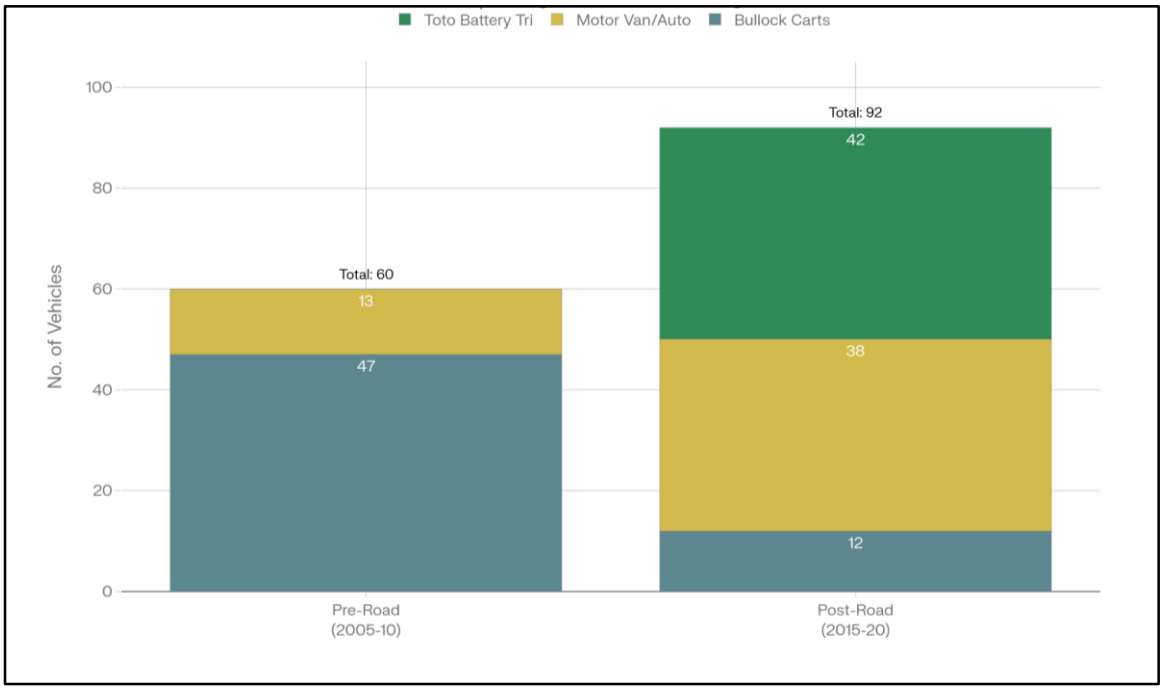

Fig.2 Modal Shift

8.2 Speed of Transition of Transport Mode

The observed transition occurred remarkably rapidly, faster than typical technology diffusion patterns. Analysis of syndicate records and household surveys reveals that, the years to first service adoption following bitumen road completion, is 3-6 months. Within 3-5 years of road completion, 60% of villages achieved regular motorized vehicle service; by year 10, service coverage exceeded 85% and bullock and horse carts became economically non-viable, with remaining units serving only specific agricultural functions (transport from fields to roadside). This rapid adoption suggested road completion creates immediate profit opportunities driving rapid entrepreneur response.

8.3 Occupational Shift: From Agriculture to Transport Services

The employment expansion occurred primarily through occupational transition rather than population increase. Among the respondents having transport occupations, 28% were from farming as primary occupation before 2010, shifted to transport as roads improved, 22% shifted from traditional vehicle operators, 16% were engaged in construction or casual labour, and 34% were new young workforce. This occupational reallocation suggests that roads enable rural economic diversification (beyond agriculture). Transport services emerged as accessible non-farm employment for those lacking desired educational qualification for formal sector jobs.

Table-2 Occupational Shift (Sampled Villages)

Previous Occupation	**Current**	**Percentage Shift**
Farming	Transport Service Provides (IMT)	28
Traditional Non-Motorised Operators	Transport Service Provides (IMT)	22
Casual Labours	Transport Service Provides (IMT)	16
New Workforce	Transport Service Provides (IMT)	34

Source: Field Survey by the Authors

8.4 Direct Employment Generation

The transport sector expansion generated substantial direct employment in the sample villages.

Table-3 Direct Employment Counts (Treatment Villages)

Employment Category	**Pre-Road (2005-10)**	**Post-Road (2015-20)**	**Net Change**	**Percent Change**
IMT Operators (Van/Toto)	19	100	81	+426%
Auto/Trekker Drivers	5	28	23	+460%
Motorised Vehicle Mechanics	3	18	15	+500%
Spare Parts Dealers	2	12	10	+500%
Total Transport Employment	29	158	129	+345%

Source: Field Survey by the Authors

These figures represent employment among 555 surveyed households across 37 surveyed villages. There is clear visibility of expansion of employment during the assessment period.

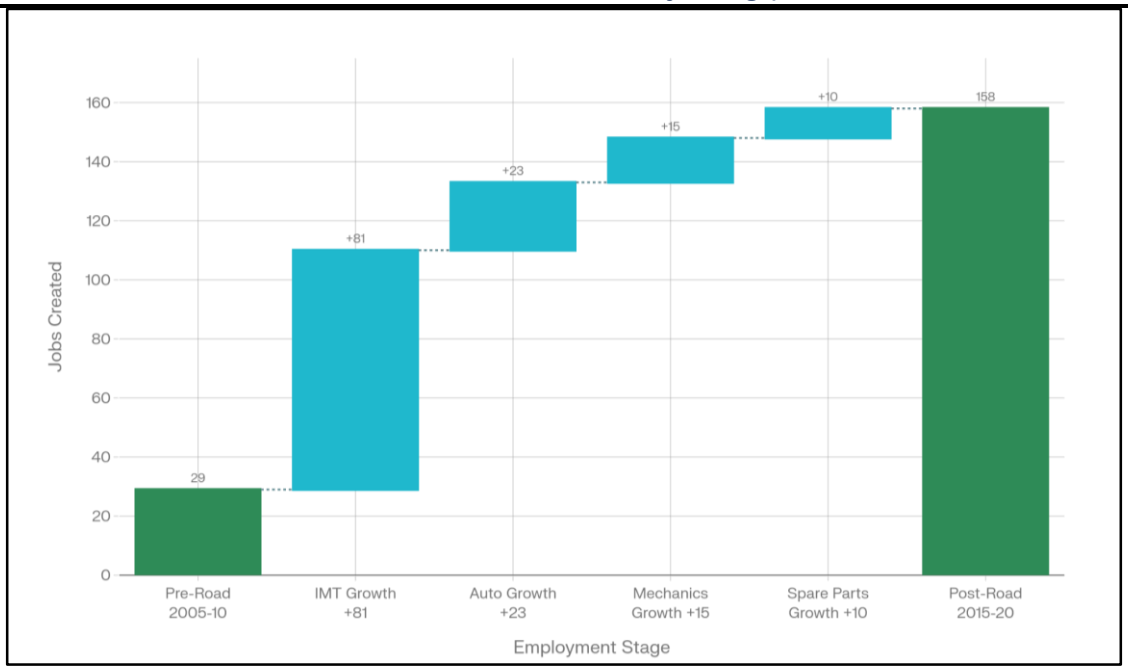

Fig. 3 Employment Growth due to Transport Service Expansion

8.5 Indirect Employment Effects

Employment creation in the transport sector triggered secondary job creation across supply chains generating indirect employment opportunities. The new not-farm employment opportunities were generated from-

- **Vehicle maintenance and supply of spare parts:** autos and motorized vans require regular maintenance and spare parts. Each van operator was estimated to spend ₹400-600 monthly on maintenance/repairs (about 5% of the revenue). The avenues where the new non-farm employment opportunities were generated are- vehicle Mechanics (18 identified), spare parts dealers (12 traders- often combined with general goods trading). The spare parts supply chain also connected to district-level spare parts wholesalers in Berhampore, Beldanga and Kandi towns, creating supply-chain employment beyond surveyed villages.
- **Employment from Supporting Services**- 28 households were identified for food and beverage services providers (tea shops, food stalls near transport hubs).

8.6 Employment Multiplier

The employment multiplier (ratio of indirect to direct employment) was calculated as:

Multiplier = (Total Indirect Employment) / (Direct Transport Employment)

= 58/158 persons

= 0.37

This value of employment multiplier indicates that 0.37 indirect employment is created per 01 direct transport job. However, interviews revealed substantial additional indirect employment in other than the transport sector (local business, shop owners, who were linked to agriculture earlier).

8.7 Income Changes by Transport Mode

Transport sector employment expansion generated substantial income gains to the transport service providers. Those who have adopted motorised vans/autos immediately after the road construction had achieved substantial income generation from transport operation due to less competition but high demand.

But the scenario changed within 5-7 years due to increased competition. Thus the growth of informal transport services reached its saturation state and the income from transport operation became unattractive due to saturation of demand as a result of increased competition.

The case of the battery-driven totos produces the same scenario. These comparisons reveal that successful van operators achieved substantial income levels comparable to small service holders representing substantial rural employment opportunities. The transport operators earned 1.5 to 2x of agricultural wage labourers, making transport service significantly more.

IX. CONCLUSIONS AND FUTURE DIRECTIONS

This work uncovers a fundamental economic transformation in rural Murshidabad driven by road infrastructure improvement. The shift from traditional bullock/horse carts to motorized intermediate transport (vans, three-wheelers) represents more than simple mode substitution; it constitutes a sectoral restructuring with profound employment, income, and livelihood implications. For rural development policymakers in South Asia confronting persistent poverty and unemployment, this evidence suggests that road infrastructure investment, particularly to all-weather standards enabling motorised transport, represents a core development strategy deserving priority funding and sustained maintenance commitment. The employment benefits emerge through market-driven mechanisms requiring minimal government intervention, operate transparently through pricing mechanisms, and align private operator incentives with social employment objectives.

The transformation from bullock carts to battery rickshaws in rural Murshidabad represents not quaint technological change, but fundamental economic restructuring enabling rural populations to access livelihood opportunities and income levels previously reserved for urban centers. As such, it exemplifies how well-targeted infrastructure investment can catalyse development transformation.

9.1 Future Research Directions

The current research work unfolds few important observations in the rural transport service operations in the Murshidabad district of west Bengal which can be duplicated in other regions. With this, the research also intrigues few future research directions.

First, the sustainability of long-term employment in areas with improved road surface quality. Because the study finds saturation of income and employment after a few years of road development. The future research may direct to find the factors that enable sustained employment in the transport sector beyond the saturation point. Is there a need for fundamental improvement in the overall socio-economic scenario to increase the supply sides?

Second, does transport sector expansion influence employment in other sectors, e.g. agriculture, trade, services? What is the impact of road surface quality improvement on mobility and social service accessibility? What is the effect of poor road surface quality maintenance on IMT operators?

X. LIMITATIONS OF THE STUDY

The study has some limitations. During the study the researchers faced some limitations, accepting which work had been completed.

First, as a longitudinal study based on memory, there may be recall Bias. Income and occupational history depend on respondent recall over 10-15 years; potential for systematic bias in recalling pre-road conditions.

Second, the survey focused on villages, town-based indirect employment (spare parts wholesale, transport coordination) not fully captured and thus incomplete indirect employment capture is possible, and

Third, the study period (2005-2020) misses the earliest PMGSY roads (2000-2005), a longer time series would strengthen findings. The survey also didn’t include the observation post 2020 due to road condition changes in the control village post 2020.

Fourth, the present analysis focuses on the transport sector only, other sectors, like agriculture, trade etc may have competing explanations for employment changes, which is not covered.

Despite these limitations, the modal shifts and employment generation documented (53%+ increases in motorized operators, and 450%+ increase in employment substantially exceeds plausible bias magnitude, providing robust evidence of road-driven modal transition and employment generation.

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