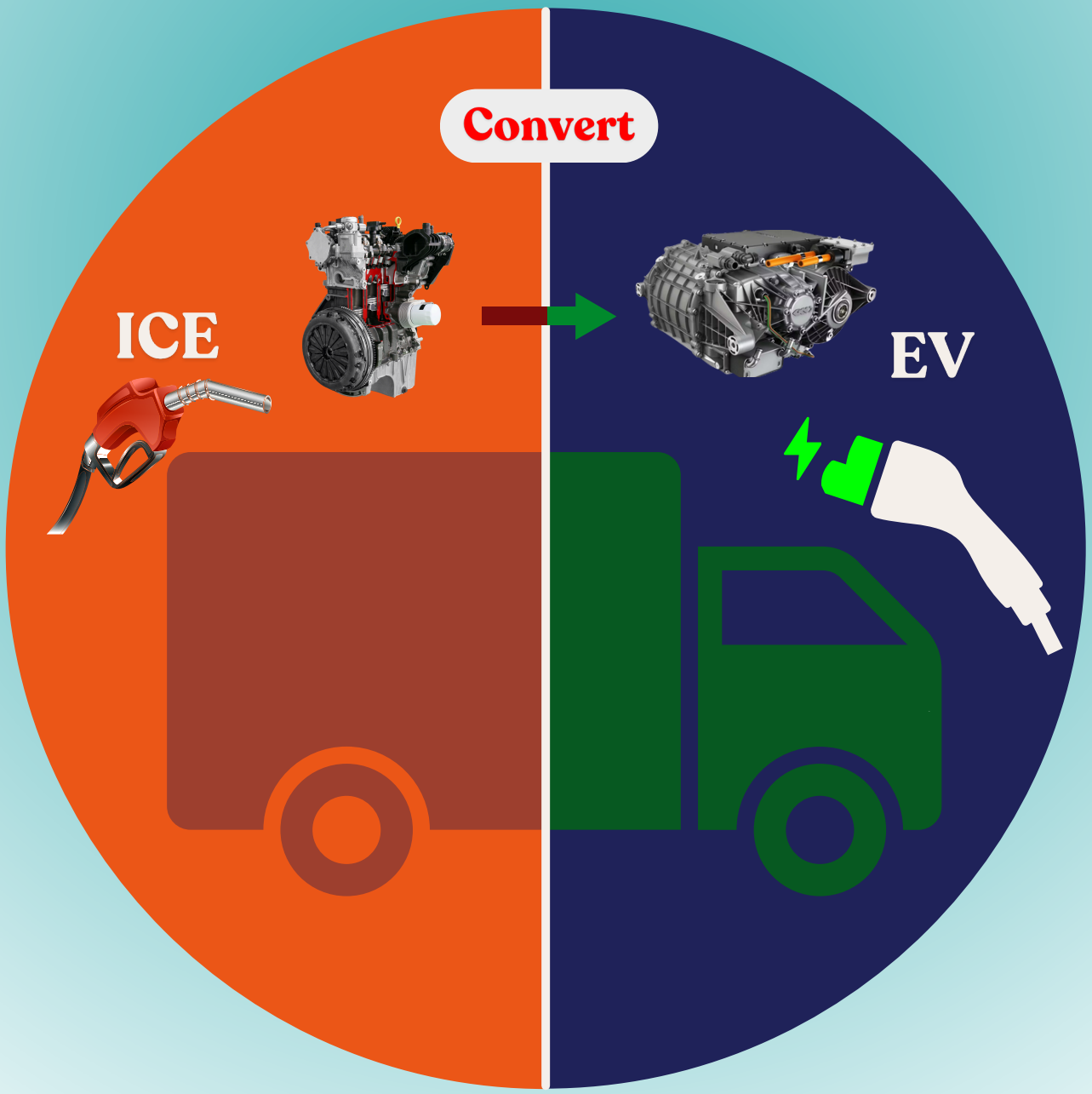
Exploring Viability: Transitioning to Electric Light Commercial Vehicles (eLCVs) in Jharkhand



Exploring Viability: Transitioning to Electric Light Commercial Vehicles (eLCVs) in Jharkhand

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Guidance
Dr. Ashmita Gupta, Member Secretary, Asian Development Research Institute
Dr. Leeza Malik, Assistant Professor, Indian Institute of Technology (Indian School of Mines), Dhanbad

Editorial Team
Dr. Leeza Malik, Assistant Professor, IIT (ISM) Dhanbad
Dr. Sunil Kumar Gupta, Research Lead, CSEC-ADRI
Ms. Pooja Kumari, CSEC-ADRI

Authors
Dr. Sunil Kumar Gupta, Research Lead, CSEC-ADRI
Mr. Anshuman Kumar, Programme Coordinator, CSEC-ADRI
Mr. Gulshan Patel, Project Assistant, CSEC-ADRI

Design & Compilation
Mr. Sanjeev Kumar

Publisher
Centre for Studies on Environment and Climate
Asian Development Research Institute
ADRI Lane, BSIDC Colony, Off Boring-Patliputra Road, Patna, Bihar 800 013, India
Phone: +91-612-2575649 | Email: adripatna@adriindia.org, csec@adriindia.org

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MESSAGE

The transition to electric light commercial vehicles (eLCVs) in Jharkhand presents a promising opportunity to reduce greenhouse gas emissions and improve air quality. The study's analysis of freight vehicle operations in Ranchi, Jamshedpur, and Dhanbad highlights key challenges, including high operational costs, a lack of organized parking infrastructure, and limited awareness of electric vehicle (EV) benefits among commercial vehicle operators. While the adoption of cleaner vehicle standards, such as BS IV and BS VI, has been uneven, the growing interest in electrification underscores the need for strategic policy interventions. The data indicates that pick-up trucks and mini-trucks, primarily used for transporting vegetables and construction materials, are the main freight carriers and are largely operated under third-party ownership. However, they also experience a substantial number of empty return trips. To promote eLCV adoption, targeted subsidies, tax incentives, and low-interest loans can provide financial support, while digital freight management solutions can help minimize empty return trips by better connecting operators with freight opportunities. Successful eLCV deployment in these cities heavily relies on strategically placed charging infrastructure to address real-world range constraints influenced by factors such as load weight, road conditions, and weather. Integrating charging stations within designated EV parking zones and incorporating them into loading and unloading areas can enhance operational flexibility, reduce downtime, and improve the overall feasibility of electrification.

This report presents the initiatives undertaken by the Centre for Studies on Environment and Climate (CSEC) at the Asian Development Research Institute (ADRI), Patna in collaboration with Indian Institute of Technology (Indian School of Mines) Dhanbad to enhance the potential and strategies for electrification of LCVs using a comprehensive field data collection approach. The findings emphasize that electrification must be accompanied by supportive policies and infrastructure development to ensure a smooth and sustainable transition. Future research should prioritise on refining EV adoption strategies, improving freight logistics efficiency, and addressing infrastructure gaps to accelerate the shift toward eLCVs in Jharkhand.

Prof. Leeza Malik

Assistant Professor
IIT (ISM) Dhanbad

Contents

1. Background

Aligned with the national policy on the electrification of freight vehicles and considering the crucial role that the transportation sector plays in reducing local air pollution and heat-trapping carbon emissions, the Government of Jharkhand published its Electric Vehicle Policy in October 2022 (Government of Jharkhand, 2022). GHG emissions in Jharkhand grew from 60.47 MtCO2e in 2005 to 115.20 MtCO2 in 2018, at a CAGR of 5.08% (Jharkhand State Pollution Control Board, 2019). The transport sector contributes to 4.60 MtCO2 in Jharkhand, with a percentage share of 5% in 2018 (Ministry of Environment, Forest and Climate Change, 2019). When considering emissions from urban centres such as Ranchi, Jamshedpur, Hazaribagh, and Dhanbad, the transport sector contributes 20-25% of total emissions (National Clean Air Programme, 2020).

While the rise in vehicle registration of private vehicles is one factor that is being focused on all over research areas, another reason and the most important factor contributing to emissions is commercial vehicles. According to study in India, commercial vehicles travel around 250-300 km per day, whereas private vehicles only cover an average of 35 km per day (Sharma et al., 2021). This shows that although commercial vehicles are less in terms of registration, the distance traveled per day is higher and results in more emissions than private vehicles.

As a mitigation approach, the Jharkhand State Government prepared a Clean Air Action Plan for eight cities, including Ranchi, Jamshedpur, Hazaribagh, Ramgarh, Chaibasa, Dumka, Sahibganj and Pakur, which don't fall under non-attainment cities as per NCAP. The clean air action plan of Ranchi, Jamshedpur, and Dhanbad indicated that the major source of emission is from the transport sector, contributing 20-25%, especially from freight traffic because of the longer run time and old age profile of commercial vehicles (Central Pollution Control Board, 2020). The clean air action plan comprises a short- and long-term implementation plan, which includes inception maintenance of BSII & BSIII commercial vehicles, prohibition in the entry of heavy commercial vehicles during a specific time, banning of old commercial vehicles, freight traffic management and promotion of battery-operated vehicle (Jharkhand State Government, 2021). Nonetheless, although serving as a significant contributor, the available data concerning freight volume and its operational characteristics remains insufficient, hindering the ability to reform policies and anticipate transition scenarios (Kumar et. al., 2020).

Therefore, the development of baseline data is of utmost importance to understand the infrastructure gaps and possible solutions for the transition to electric vehicles.
Understanding and forecasting freight movement is critical to plan for future transportation in terms of capacity augmentation, operation, prevention, safety, security, energy, and economic investment (Mohan et al., 2020). While most of the studies conducted in transportation are focused on demand modelling for private and public vehicles rather than freight movement and understanding freight travel behavior (Singh et al., 2021). Establishing base data will enable planners and policymakers to predict freight movement accurately and design better-informed policies for the transition to electric vehicles.

2. Objectives

- To develop baseline data on commercial vehicle travel characteristics in urban centers of Jharkhand.
- Examining policy, technological, and infrastructural reforms in alignment with the goals and objectives of the current Jharkhand's EV Policy

3. Description of the study areas

Jharkhand is a mineral-rich state and one of the leading mineral-producing states in India. The cities have access to various minerals and are in proximity to several heavy industries. The rapid pace of industrialization and urbanization, along with the movement of heavy traffic, contributes to an increase in the levels of ambient air pollution in the cities of Jharkhand (Jharkhand State Pollution Control Board, 2019). Though from Jharkhand, only Dhanbad was initially mentioned in the list of non-attainment cities, but Ranchi and Jamshedpur were later added in the list as a part of Million Plus Cities (National Clean Air Programme, 2020). The Comprehensive Clean Air Action Plan prepared by the Jharkhand State Pollution Control Board (JSPCB) for Ranchi, Dhanbad, and Jamshedpur stated that the transport sector is the major contributor of PM2.5 for 23% for Jamshedpur and Ranchi respectively. In contrast, the contribution of PM2.5 emissions from the transport sector in Dhanbad is only 6% (Central Pollution Control Board, 2020).

Jamshedpur, Dhanbad and Ranchi are major industrial centers of Jharkhand. Ranchi, the capital city, is an important administrative and industrial center in the state. Jamshedpur is one of the largest urban centers and commercial capital of the state, having industrial settlements of leading companies such as TISCO, TELCO, and Adani Thermal Power Plant with various small and medium scale industries (Kumar, Reddy, & Yadav, 2021). Dhanbad is an important resource region in Jharkhand due to the availability of coal reserves. It has influenced the settlements of many coal-oriented industries, such as fertilizers, coal washeries, coke plants, steel industries, and numerous others (Mehta, Sharma, & Yadav, 2020). The presence of such large industries impacts the overall emission share in Ranchi,

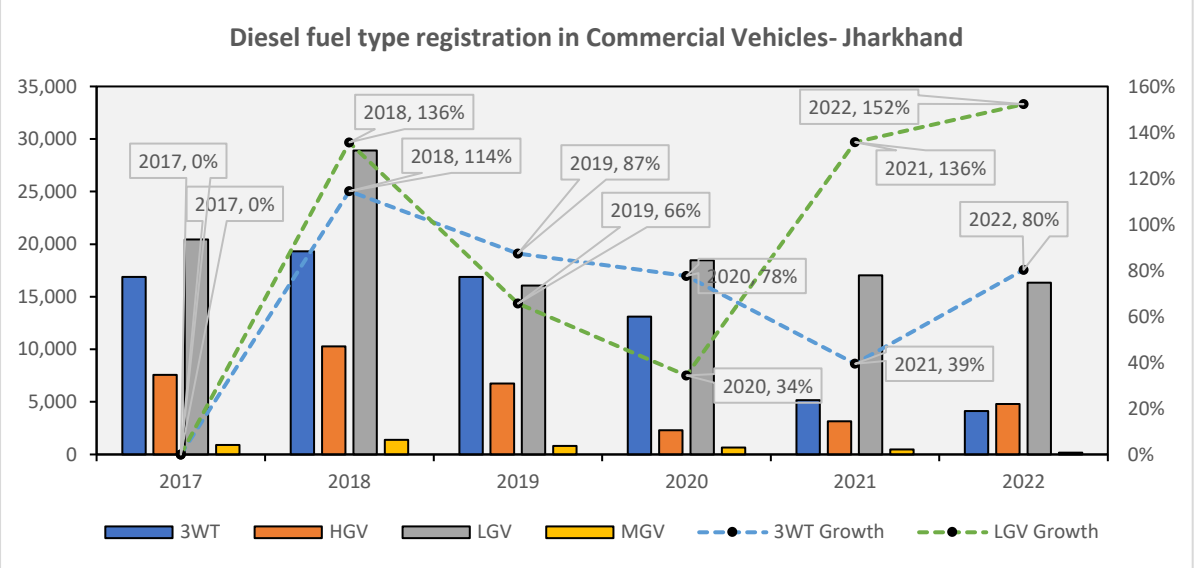


Figure 1: Diesel fuel type registration in commercial vehicles in Jharkhand

Jamshedpur, and Dhanbad. Figure 1 shows the registration trends for commercial vehicles using diesel fuel in Jharkhand.

The commercial goods vehicle segment is further divided into four vehicle categories i.e. 3-Wheeler (3WT), Light Good Vehicle (LGV), Medium Goods Vehicle (MGV), Heavy Goods Vehicle (HGV). It can be observed from the figure that the registration trend for 3WT diesel vehicles has significantly declined from 2017 to 2021, while diesel vehicle registrations in light and heavy goods categories have increased (Jharkhand Transport Department, 2021). Therefore, developing baseline data on commercial vehicle travel characteristics in Jharkhand is crucial for a successful transition to electric vehicles, given the trends in vehicle registration. As light and heavy goods vehicle registrations increase while 3W diesel registrations decline, understanding travel patterns and operational characteristics becomes essential. Such baseline data enables informed decisions on

charging infrastructure placement, policy design, and electrification strategies, ensuring a smoother and more sustainable shift in the commercial transport sector.

4. Survey procedure

The survey was conducted in Ranchi, Jamshedpur and Dhanbad from 28th September 2023 to 25 January 2024. Existing land-use maps of selected urban areas were used to identify the significant commercial and industrial hubs for survey locations. The survey locations were focused on wholesale markets, mandis, FCI godowns, rail yards, and industrial areas (Jharkhand State Government, 2023).

The survey was conducted from 8 am to 7 pm. The interview was taken from the truck drivers. The overall interview took 20 minutes per vehicle. Data on freight has been obtained from the randomly chosen trucks at the survey locations in the three selected cities. The surveyor noted the registration number and the type of the vehicle surveyed. Questions were asked about the vehicle's fuel usage, annual distance covered, and average payload carried by the truck. Travel diaries of the freight vehicles have been collected to collect information about the trip details committed by the freight vehicles. Information about the origin and destination of the trips, start and end times, and loads carried by the vehicle have been collected using travel diaries. The average daily distance covered by the vehicle can be estimated from the trip dairy. Please refer to Appendix I for the questionnaire. The survey questionnaire was set based on vehicle characteristics, trip characteristics, awareness of electric vehicles, and intention to purchase electric vehicles. The detailed description of variables is mentioned in Table 1.

Table 1: Description of variables

Characteristics	***Variable***	***Type of Variable***	***Description***
Vehicle	Vehicle Type	Independent	Freight vehicle classification was done by grouping freight vehicles into 8 classes. They are three-wheeler goods carriers, E-Rickshaw, mini-trucks, pick-up-trucks, six-wheeler trucks, tractors, jugaad, and two-wheelers
	Make Year	Independent	Year of purchasing
	Commodity Type	Independent	The type of goods was classified into 17 categories as per NIC

			classification. They were Crops, Fruits, Vegetables, Livestock, Diary, Packed Food, Textile, Plastic & Rubber, Metal Fabrication, Sugar, Brick, Stone Chip, Logistics, Cement, Oil and Gas
	Odometer Reading	Independent	The last odometer reading of the vehicle
	Ownership	Independent	Ownership was categorised into three categories. Personal, Leased & Third-Party Ownership
	Fuel	Independent	Fuel technologies for freight vehicles were Petrol, Diesel, CNG, and Electric.
	Mileage	Independent	Average Km traveled by vehicle with 1 liter of fuel/charge.
	Origin	Independent	The beginning points of the trip
	Destination	Independent	The final endpoint of the trip
Trip	Movement Type	Independent	The movement type of vehicle was classified into fixed and flexible movement types.
	Trips per day	Independent	Number of trips made by vehicle per day. The classification was divided into 6 types: 1-2, 3-6, 7-10, 11-20, 21-50, and >50 trips
	Commodity Weight	Independent	Weight of commodity carried by vehicle irrespective of passing load by a different vehicle.
	Time Taken per trip	Independent	Time is taken to reach the final endpoint of the trip. They are grouped into 1-2 Hrs, 3-4 Hrs, 5-10 Hrs, 11-15 Hrs, 16-24 Hrs, 2 Days, 3 Days
	Average Distance per day	Independent	Distance traveled by vehicle in one day combining all the trips. The distance range from 1-2 Km, 3-5 Km, 6-10 Km, 11-30 Km, 31-50 Km, 51-80 Km, 81-120 Km, 121-200 Km, 201-300 Km, 301-500 Km, and >500 Km
	Parking Location	Independent	Location where the vehicle is parked in the middle of the day or night. It is categorised into three categories i.e., Roadside, Private Parking, Common Parking

	Parking Time	Independent	The total time vehicles are in parking not doing any activity. The range is 0-1 Hr, 2-3 Hr, 4-5 Hr, 6-8 Hr, 9-12 Hr, and >12 Hr
Awareness	Subsidy Awareness	Independent	Are vehicle drivers aware of government subsidies for electric vehicles? Yes or No
	Retrofitting Awareness	Independent	Are vehicle drivers aware their vehicle can be retrofitted into CNG? Yes or No
Intention to shift to electric vehicle	Subsidy from Govt.	Dependent	Rank the eagerness to buy the next vehicle if the government provides a subsidy. Rank 1- Lowest and Rank 5- Highest
	Finance by Bank	Dependent	Rank the eagerness to buy the next vehicle if the bank would finance the vehicle at a lower interest rate. Rank 1- Lowest and Rank 5- Highest
	Operation & Maintenance	Dependent	Rank the eagerness to buy the next vehicle if the electric vehicle has similar operational characteristics to ICE vehicles. Rank 1- Lowest and Rank 5- Highest
	Same Range	Dependent	Rank the eagerness to buy the next vehicle if the electric vehicle has a similar travel range to ICE vehicles. Rank 1- Lowest and Rank 5- Highest
	Same Speed	Dependent	Rank the eagerness to buy the next vehicle if the electric vehicle has a similar speed to ICE vehicles. Rank 1- Lowest and Rank 5- Highest
	Same Payload	Dependent	Rank the eagerness to buy the next vehicle if an electric vehicle has a similar carrying capacity as ICE vehicles. Rank 1- Lowest and Rank 5- Highest
	Higher Refueling Time	Dependent	Rank the eagerness to buy the next vehicle if an electric vehicle has a longer refueling time than ICE vehicles. Rank 1- Lowest and Rank 5- Highest

4.1 Calculation of the sample size

The formula used for sample size calculation for the trajectory of the vehicle is as follows:

$$n = \frac{CV^2[Z(\alpha)]^2}{E^2}$$

Where n is the sample size; CV is the coefficient of variation; Z(α) is the standard normal distribution quantile value for the confidence level (α), and E is the level of accuracy (the margin of error for the estimate of the mean of the population). The calculation of sample size is based on a 90% confidence level. In that case, $Z(\alpha)$ is 1.96, and E is 0.01. This formula is based on Cochran's (1977) methodology for sample size calculation in survey sampling.

The average daily distance covered is an important factor contributing to greenhouse gas emissions and energy consumption by vehicles (Cen et al., 2017). Hence, the average daily distance covered has been taken as the key variable. The means and the standard deviation of the average daily distance covered have been used to calculate the required sample size (Rao, 2018). The data about the mean and standard deviation of the average distance covered by the freight vehicles was unavailable. Hence, to calculate the sample size, initially, some data about the average daily distance travelled was collected, and the mean and standard deviation of the sample were calculated. The process was repeated until the number of samples collected is more than the sample size calculated by the mean and standard deviation of the collected data.

The sample size required for each city is shown in Table 2.

Table 2: Sample size

	Mean Distance	Standard deviation of Distance traveled	Required sample size at 90% confidence level	Sample collected
Ranchi	67	99.5	603	754
Jamshedpur	39	51.8	489	692
Dhanbad	40	38.6	252	676

5. Descriptive Statistics of the Data Collected

5.1 Ranchi

5.1.1 Age Distribution:

Figure 2 shows a clear shift in vehicle utilization patterns across the different emission standard phases. There was a significant increase in the use of Mini-Trucks, Pick-Up Trucks, and 3-W Goods Carriers during the BS IV phase, with Pick-Up Trucks peaking at 78%. However, their usage declined in the BS VI phase. The increased use of Two-Wheelers in the BS VI phase suggests their growing transition to more stringent emission norms or alternative vehicles. This shift in usage patterns aligns with trends observed in similar studies, where emission standard changes led to shifts in the fleet composition and usage patterns in different regions (Gupta et al., 2018; Patil & Sharma, 2020).

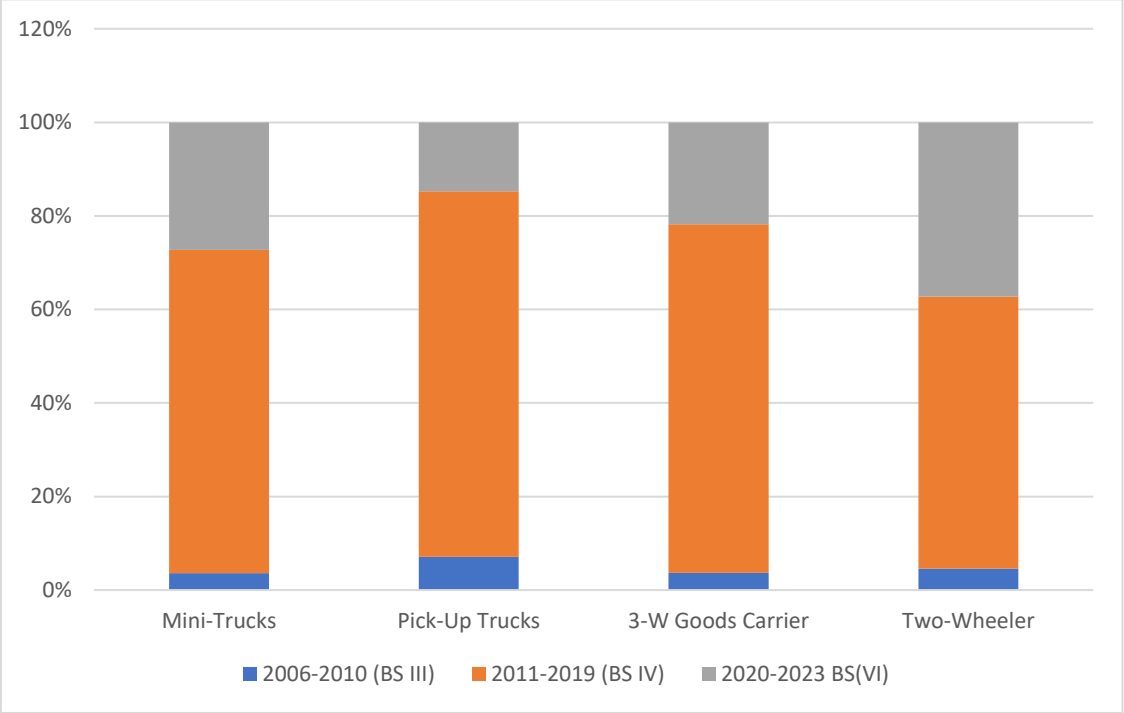
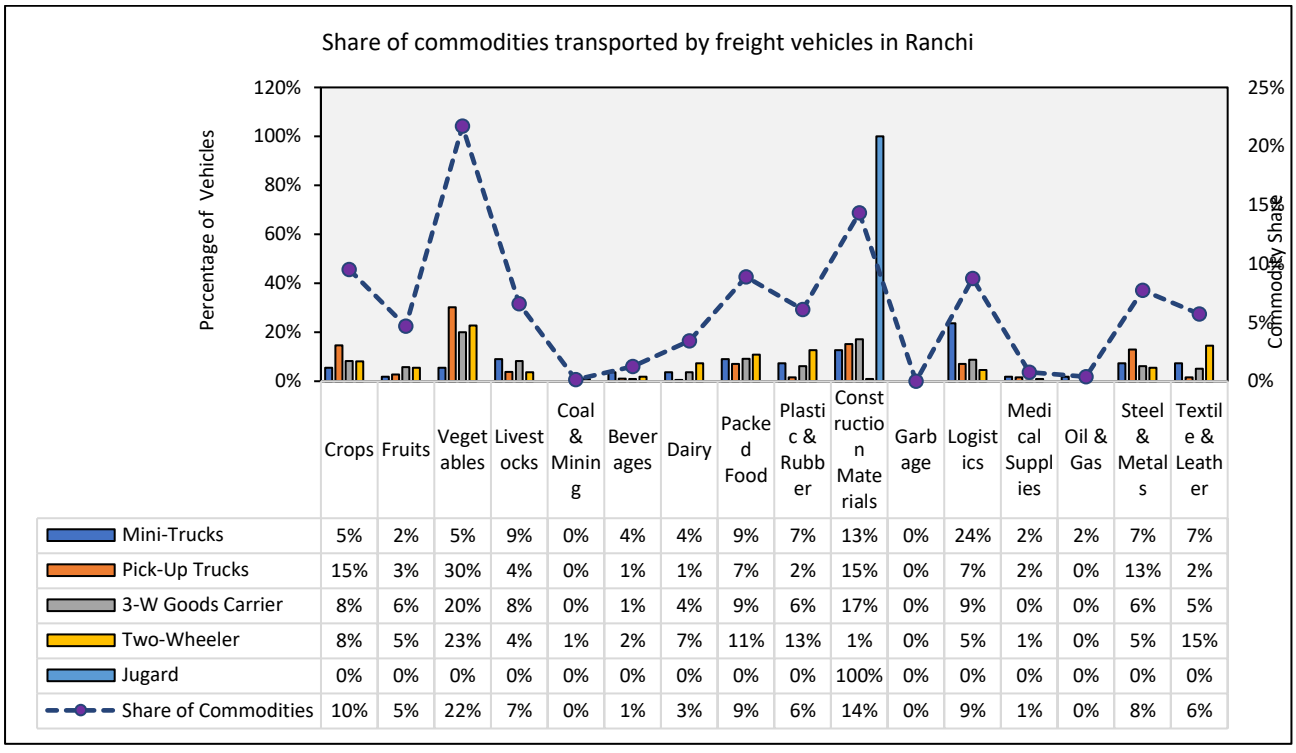


Figure 2: Age distribution of vehicles in Ranchi

5.1.2 Commodity Characteristics Transported in Freight Vehicles

Figure 3 reveals that mini trucks are primarily used for logistics (24%) and construction materials (13%), while pickup trucks are heavily utilized for vegetables (30%) and construction materials (15%). Jugard vehicles are exclusively used for construction materials, occupying 100% of that category. Vegetables stand out as the most commonly transported commodity, with a significant share of 22%, especially using pickup trucks

(30%) and Two-Wheelers (23%). Additionally, construction materials represent 14% of the total commodity share, highlighting their importance in the dataset. This analysis underscores the versatility of Mini-Trucks and Pick-Up Trucks, as well as the specialization of Jugard vehicles in the construction sector. The data indicates a strong correlation between vehicle type and the specific needs of certain industries, with Pick-Up Trucks and Mini-Trucks being more versatile across different commodities. In contrast, Jugard vehicles are specialized solely for construction materials. The dominance of vegetable transport suggests a high demand for fresh produce, requiring frequent and diverse transportation methods. These findings are consistent with previous research that emphasizes the specific applications of freight vehicles in urban logistics, particularly the role of small commercial vehicles in urban transportation (Sahu & Singhal, 2019; Shamsuddin et al., 2020).



	Crops	Fruits	Vegetables	Livestocks	Coal & Mining	Beverages	Dairy	Packed Food	Plastic & Rubber	Construction Materials	Garbage	Logistics	Medical Supplies	Oil & Gas	Steel & Metals	Textile & Leather
Mini-Trucks	5%	2%	5%	9%	0%	4%	4%	9%	7%	13%	0%	24%	2%	2%	7%	7%
Pick-Up Trucks	15%	3%	30%	4%	0%	1%	1%	7%	2%	15%	0%	7%	2%	0%	13%	2%
3-W Goods Carrier	8%	6%	20%	8%	0%	1%	4%	9%	6%	17%	0%	9%	0%	0%	6%	5%
Two-Wheeler	8%	5%	23%	4%	1%	2%	7%	11%	13%	1%	0%	5%	1%	0%	5%	15%
Jugard	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
Share of Commodities	10%	5%	22%	7%	0%	1%	3%	9%	6%	14%	0%	9%	1%	0%	8%	6%

Figure 3: Commodities transported by freight vehicle in Ranchi

5.1.3 Vehicle Ownership

Figure 4 shows the ownership distribution of different vehicle types among third-party, leased, and personal categories. Mini-Trucks and Pick-Up Trucks are predominantly operated by third parties, with 67% and 77% respectively, while 3-W Goods Carriers are

more evenly split, with 41% under third-party ownership and 59% personally owned. Two-Wheelers and Jugard vehicles, on the other hand, are almost exclusively personally owned, at 99% and 100% respectively. There is no leasing activity reported across any of the vehicle types, highlighting a clear preference for either third-party operation or personal ownership depending on the vehicle type.

Similar research has shown similar trends in vehicle ownership in urban areas. For example, Gupta et al. (2019) found that smaller vehicles, like Two-Wheelers and auto-rickshaws, are mostly privately owned because they are cheaper and more flexible for the owner. Larger vehicles, like Mini-Trucks and Pick-Up Trucks, are often used by third-party logistics companies because they are more expensive and need specialized drivers (Gupta et al., 2019). Patil and Sharma (2020) also observed that third-party ownership is common for larger freight vehicles due to the high cost, while smaller vehicles tend to be privately owned because they are easier to manage and operate, especially in busy city areas. Similarly, Yadav et al. (2018) found that 3-W Goods Carriers have more diverse ownership, with many owned personally by small business owners because of the low investment required. These findings are similar to the trends seen in this study, where third-party ownership is more common for bigger vehicles, and smaller ones are more likely to be privately owned, especially for people working in local businesses.

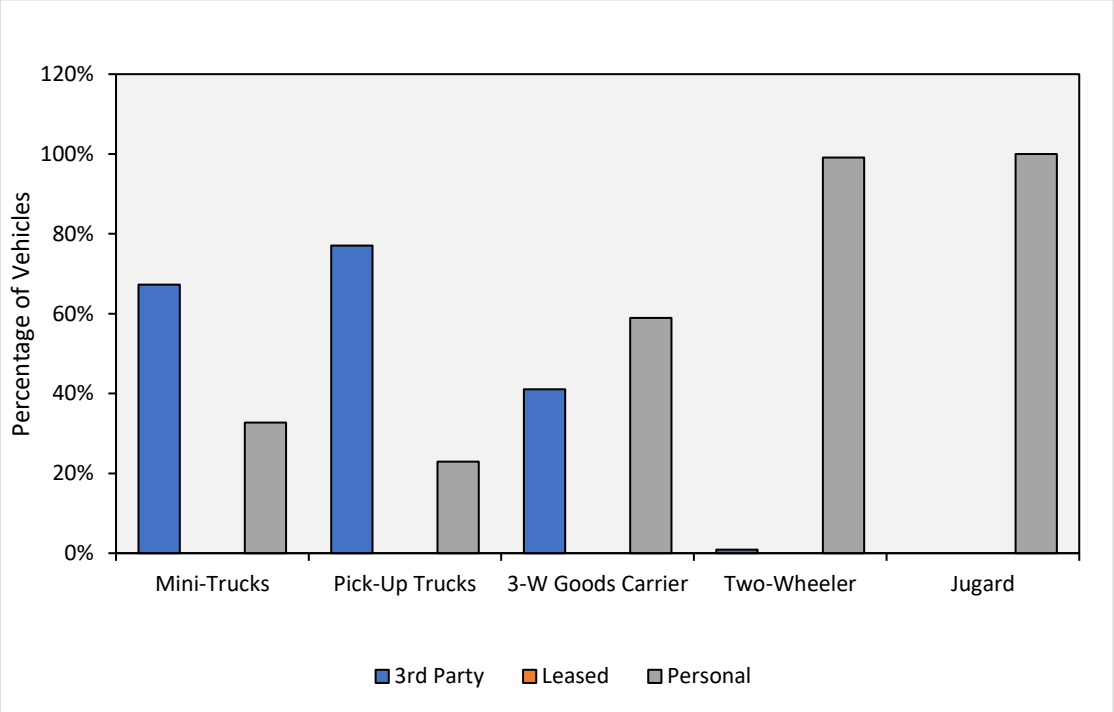


Figure 4: Vehicle Ownership of Freight Vehicles in Ranchi

5.1.4 Income Structure

Figure 5 provides insights into the income structure for different vehicle types, split between "charge per trip" and salaried roles. Mini-Trucks and Pick-Up Trucks are primarily salaried (95% and 84% respectively), with Mini-Truck drivers earning an average salary of ₹24,740 per month and generating an additional ₹192,000 from per-trip charges. Pick-up trucks have the highest overall earnings, with an average salary of ₹32,447 and a substantial ₹368,604 from per-trip charges.

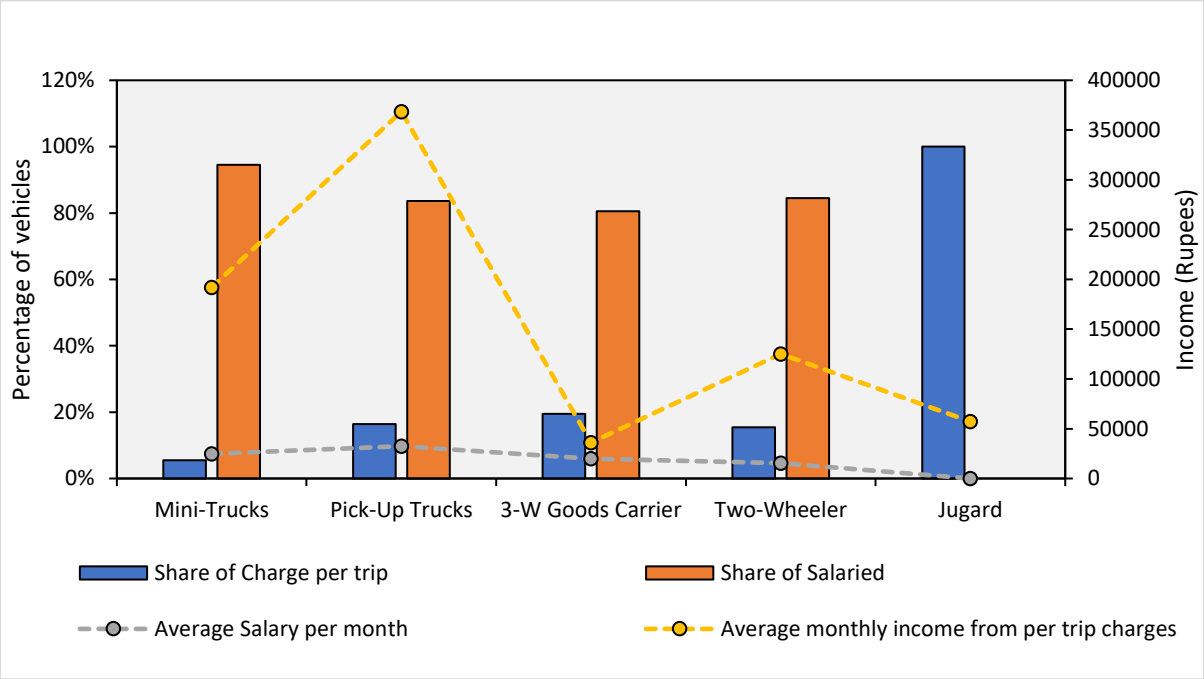


Figure 5: Average Income per Vehicle Type in Ranchi

3-W Goods Carriers also have a mix of salaried (81%) and per-trip charges (19%), with a lower average salary of ₹20,045 and additional earnings of ₹36,150 from trips. Two-Wheelers, though mostly salaried (85%), have a significant portion of their income (₹125,235) from per-trip charges, with an average salary of ₹15,532. Jugard vehicles operate exclusively on a per-trip basis, with no salaried component, and generate ₹57,375 per month solely from trips.

This data highlights the different financial models for each vehicle type, with Pick-Up Trucks standing out for their high income potential from per-trip charges, while Jugard vehicles rely entirely on this model.

5.1.5 Expenditure

Figure 6 highlights the operational costs and average monthly income for various vehicle types. Pick-up trucks have the highest fuel cost per month at ₹18,765 and the most significant monthly maintenance cost of ₹3,142, alongside other annual charges of ₹14,613. Despite these high costs, they also boast the highest average monthly income at ₹200,525.5. Mini-trucks follow with a monthly fuel cost of ₹9,087, maintenance cost of ₹2,459, and other annual charges of ₹5,551, resulting in an average monthly income of ₹108,370.

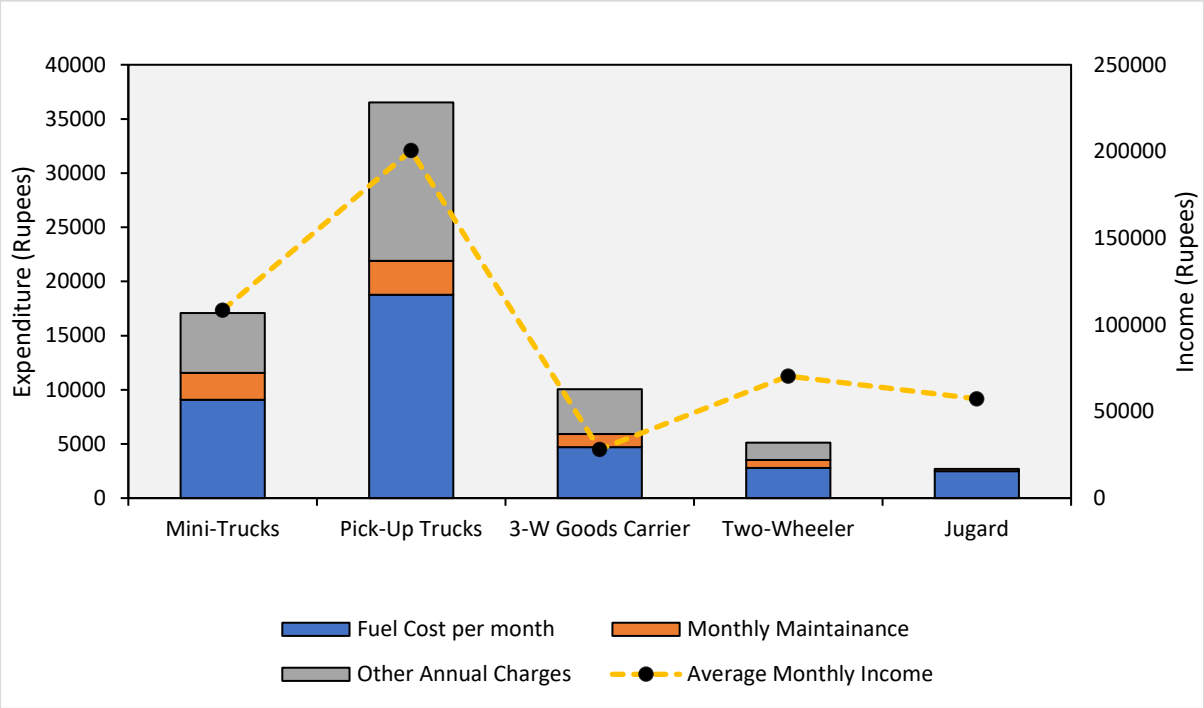


Figure 6: Monthly and annual expenditure per Vehicle Type in Ranchi

3-W Goods Carriers incur a relatively lower monthly fuel cost of ₹4,694 and maintenance cost of ₹1,233, with other annual charges of ₹4,136, leading to a modest average monthly income of ₹28,097.5. Two-wheelers have minimal operational costs, with fuel at ₹2,794, maintenance at ₹736, and annual charges at ₹1,582, yielding an average monthly income of ₹70,383.5. Jugard vehicles have the lowest costs, with a fuel expense of ₹2,500, maintenance at ₹200, and no other annual charges, resulting in an average monthly income of ₹57,375.

This data highlights that despite higher operational costs, vehicles like Pick-Up Trucks and Mini-Trucks generate significantly higher income, while Jugard vehicles maintain a steady income with minimal expenses.

5.1.6 Vehicle Movement

The vehicle movement pattern data reveals that most vehicles (Figure 7), especially Pick-Up Trucks (84%) and 3-W Goods Carriers (83%), predominantly operate with empty returns after delivery, indicating a focus on direct point-to-point logistics. Mini trucks exhibit a more varied usage, with 25% of their operations involving multi-drop deliveries but still showing a high rate of empty returns (69%). Two-wheelers almost exclusively return empty (97%), underscoring their role in quick, direct deliveries. In contrast, Jugard vehicles are solely used for multi-drop deliveries, highlighting their specialization in complex delivery routes. This suggests that while most vehicles focus on direct delivery, there is niche specialization in multi-drop routes. Similar studies have shown that many vehicles, like Pick-Up Trucks and 3-W Goods Carriers, mainly travel empty after making deliveries (Bhatia et al., 2018). This trend was also observed where 84% of Pick-Up Trucks and 83% of 3-W Goods Carriers operate with empty returns. Additionally, some vehicles, such as mini trucks and Two-Wheelers, are often used for direct deliveries, with very few multi-drop routes (Singh & Soni, 2020).

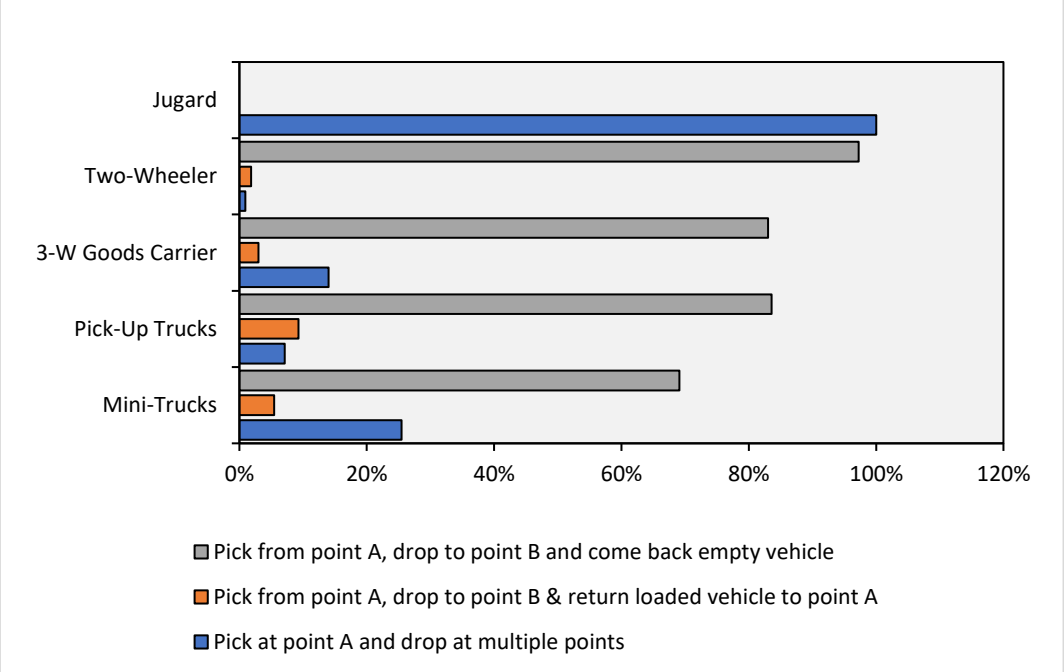


Figure 7: Movement Characteristic of Freight in Ranchi

5.1.7 Trip Frequency

Figure 8 shows the trip frequency across vehicle types. The analysis of trip frequency across vehicle types reveals that vehicles covering longer distances, particularly between 121-200 km, tend to operate with high frequency, often making more than 10 trips. In contrast, shorter distance trips (1-2 km) and moderate distances (11-30 km) are generally completed in just 1-2 trips, indicating their role in quick, local deliveries. Moderate distances like 31-50 km often require 3-6 trips, reflecting a balanced use in regional distribution. Overall, vehicles on longer routes are engaged in more frequent operations, while shorter routes see fewer trips, aligning with their specific delivery needs.

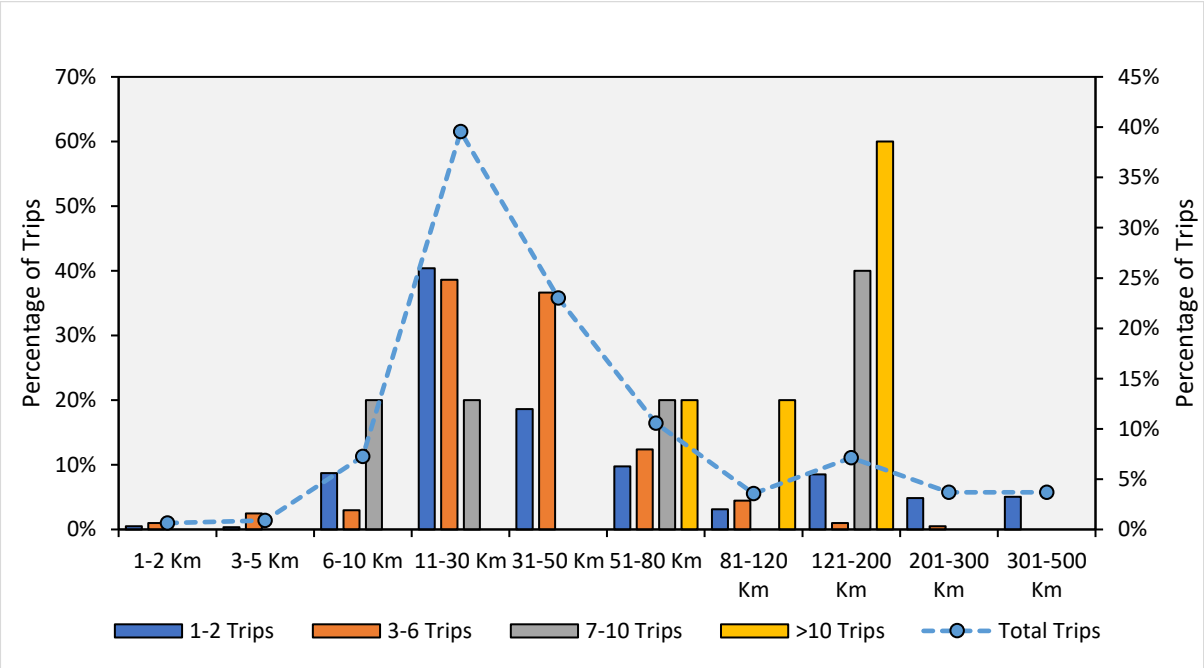


Figure 8: Trip Length Distribution of Freight in Ranchi

5.1.8 Payload Carried

Figure 9 shows the distribution of vehicles across different payload capacities and distances traveled. Vehicles carrying payload between 0-1 tonnes predominantly travel between 11-30 km (52%) and 31-50 km (22%), with a notable drop in distance traveled beyond 50 km. For vehicles carrying payloads from 1.1-2 tonnes, travel distances are more varied, with a significant proportion covering 121-200 km (17%) and 31-50 km (28%). Heavier vehicles (2.1-5 tonnes) show a preference for mid-range distances, especially between 121-200 km (23%) and 51-80 km (20%). Vehicles in the 5.1-10 tonnes category travel most frequently between 31-50 km (26%) and 11-30 km (16%). Overall,

the data suggests that vehicles with lighter payloads tend to travel shorter distances, while vehicles with higher payloads are more likely to cover longer distances. This trend is consistent with findings from other studies. For example, Sharma et al. (2019) observed that lighter vehicles typically operate within local or regional delivery zones, while heavy vehicles are used for longer-distance hauls. A similar study by Gupta and Bansal (2018) also found that vehicle payload is closely related to travel distance, with vehicles carrying heavier loads covering greater distances.

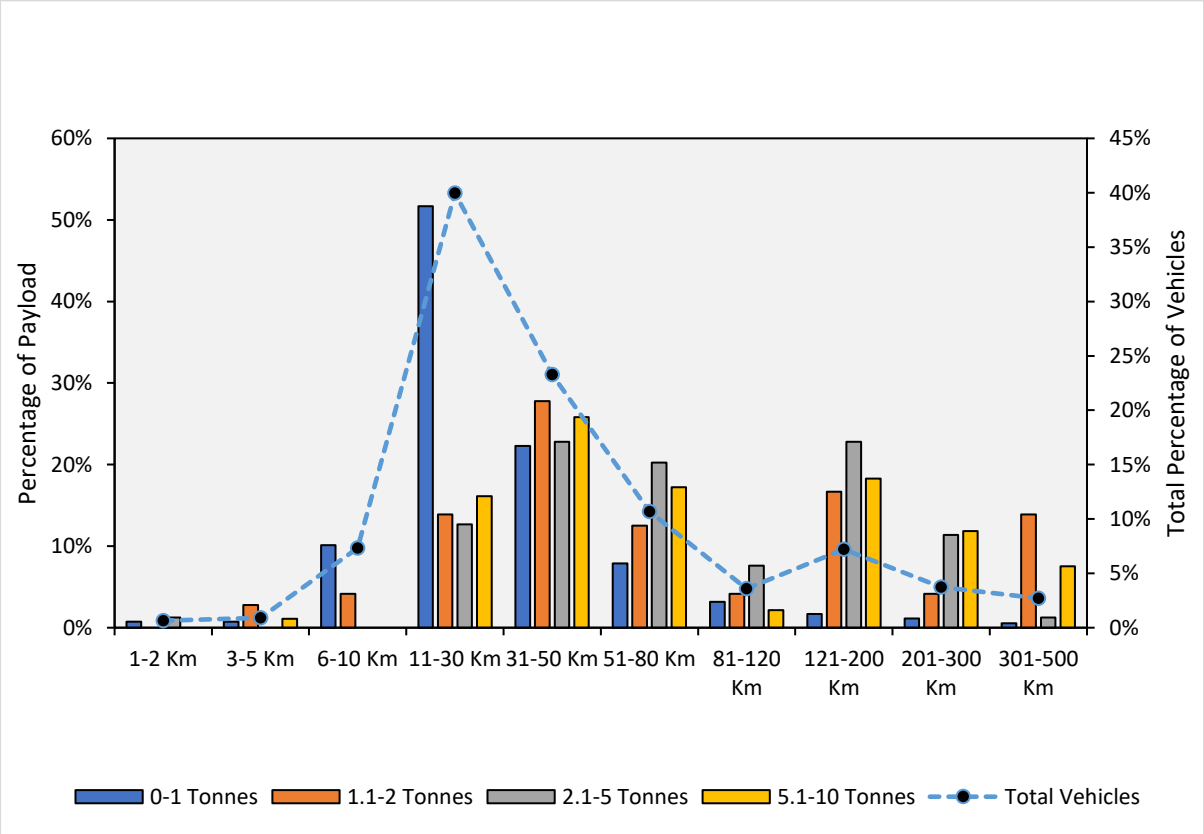


Figure 9: Payload and Distance distribution of freight vehicles in Ranchi

5.1.9 Parking Characteristics

Figure 10 reveals distinct parking duration patterns by location. Common parking areas see the longest stays, with 49% of vehicles parked for 4-5 hours. Private parking is used primarily for shorter durations, especially 2-3 hours (65%). Roadside parking shows a mix of durations, with significant portions parked for 0-1 hours (33%) and 2-3 hours (44%). Home parking also exhibits a range, with the most common durations being 2-3 hours (36%) and 0-1 hours (23%). In general, common parking is associated with longer stays, while private parking is geared towards shorter durations. Other studies have

shown similar findings. For example, Kumar et al. (2020) found that vehicles in common parking areas were parked for longer durations, just like in our study. Their research also found that private parking areas were used mostly for short stays of 1-3 hours. Raj et al. (2019) found that roadside parking often had a mix of short and medium stays, similar to our data, with most vehicles parked for 1-3 hours.

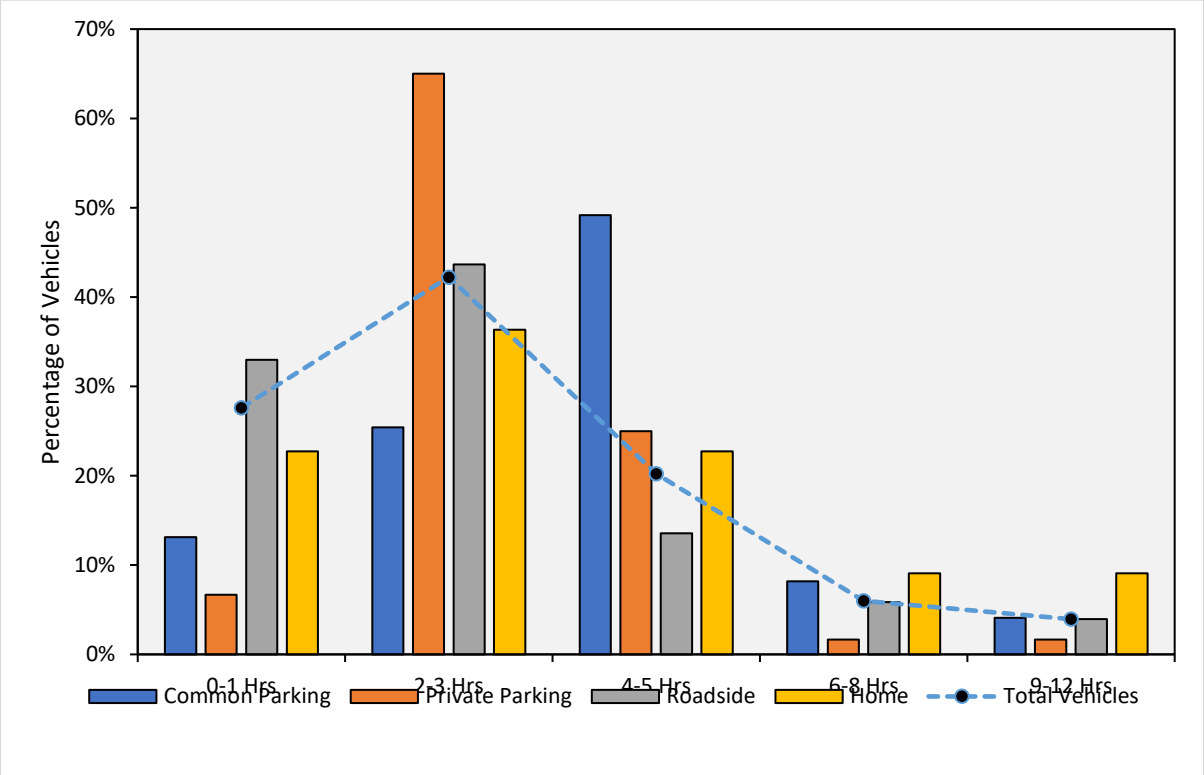


Figure 10: Parking Characteristics of Freight Vehicles in Ranchi

5.2 Jamshedpur

5.2.1 Age Distribution

Mini-trucks are predominantly from the BS IV category (54%) and BS VI category (35%), with fewer from the BS III category (11%). Pick-up trucks follow a similar pattern, with 49% in BS IV and 39% in BS VI, and 12% in BS III. For 3-wheel goods carriers, the majority are in the BS IV category (60%), while 29% are in the BS VI category and 12% in BS III. Notably, all 3-wheelers are from the BS VI category (100%), indicating a shift towards newer, more environmentally friendly models. Overall, there is a clear transition from older BS III to newer BS IV and BS VI standards, particularly for mini-trucks and pick-up trucks.

5.2.2 Commodity Characteristics Transported in Freight Vehicles

Figure 11 highlights the distribution of different types of vehicles across various commodity categories. Mini-trucks are most commonly used for transporting construction materials (18%) and steel & metals (26%), with a notable presence in vegetables (13%) and logistics (14%). Pick-up trucks primarily handle vegetables (25%) and steel & metals (30%), with significant use in fruits (8%) and dairy (4%). 3-wheel goods carriers are frequently employed for vegetables (21%) and packed food (16%), as well as some transportation of fruits (11%) and construction materials (16%). E-3-wheelers are notably utilized for packed food (43%) and beverages (14%), but have minimal representation in other categories. Overall, mini-trucks and pick-up trucks are versatile across a broad range of commodities, while 3-wheel goods carriers and E-3-wheelers are more specialized in specific sectors (Sharma et al., 2019).

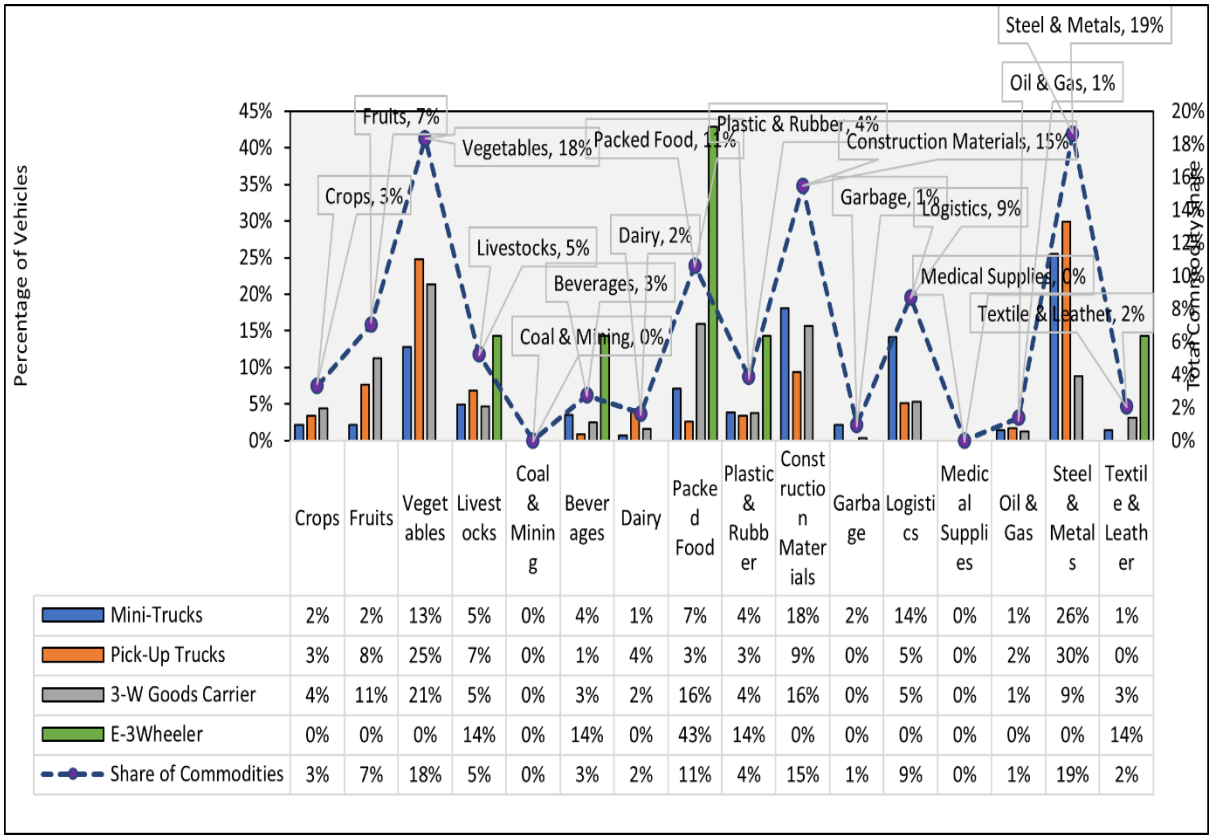


Figure 11: Share of commodities transported by freight vehicles in Jamshedpur

5.2.3 Vehicle Ownership

Figure 12 indicates that personal ownership is predominant across all vehicle types in Jamshedpur, especially for E-3 Wheelers (86%) and Pick-Up Trucks (78%). Third-party

operations play a notable secondary role, particularly for Mini-Trucks (26%) and 3-W Goods Carriers (23%). Leasing is minimal across all categories, with the highest being just 3% for Mini-Trucks. Overall, vehicles are primarily owned personally, with third-party management as a common alternative and leasing being rare. Similar patterns were observed in a study by Srinivas et al. (2020), which found that personal ownership dominates vehicle fleets in Indian cities, with ownership rates for two-wheelers and small freight vehicles like mini-trucks being above 70%. Their study also highlighted that third-party operators were most prevalent in large vehicles (like trucks), while leasing was almost negligible in all vehicle types.

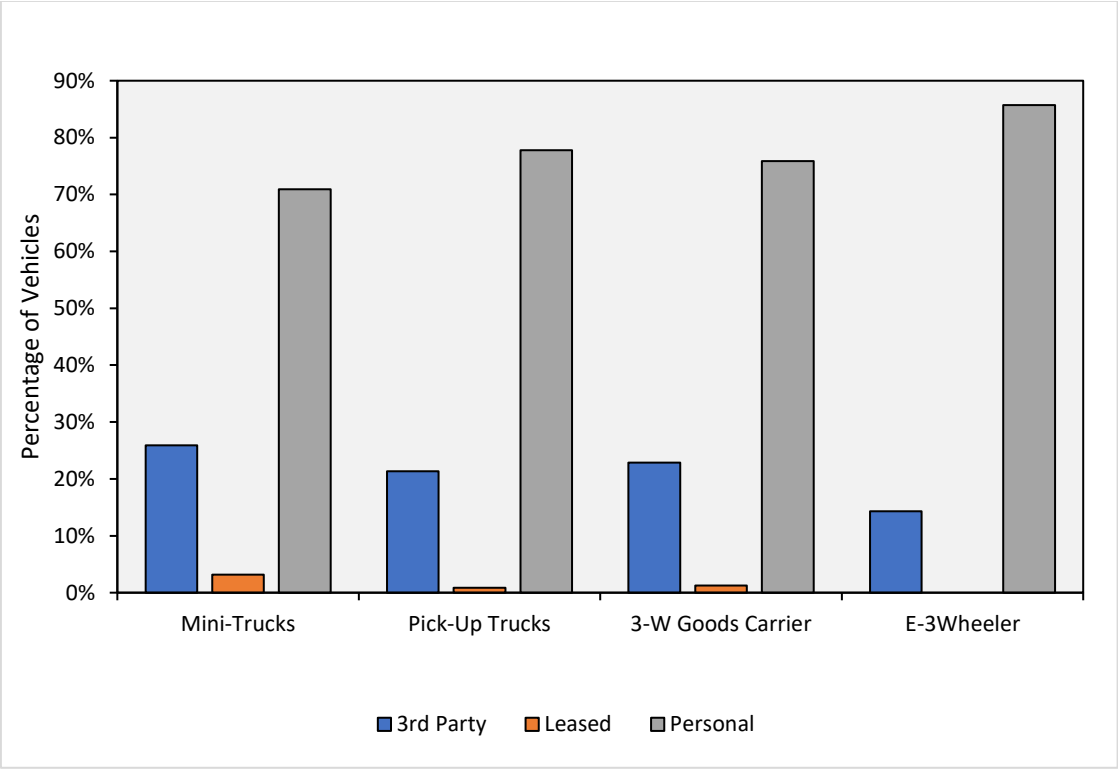


Figure 12: Vehicle Ownership in Jamshedpur

5.2.4 Income Structure

The income structure for vehicle drivers varies significantly by vehicle type (Figure 13). Pick-up truck drivers earn predominantly from per-trip charges (79%), with an impressive average monthly income of ₹203,700, making it the most lucrative category. Mini-Truck and 3-W Goods Carrier drivers also rely heavily on per-trip charges, which make up 70% and 78% of their income, respectively, with monthly averages of ₹73,111.5 and ₹71,640. Salaried income in these categories is a smaller but notable portion,

contributing around 30% and 22% of their earnings. This finding is consistent with studies by Srinivas et al. (2020) and Kumar & Singh (2019), which reported that per-trip charges constitute the majority of income for freight vehicle drivers in India, especially for small vehicles like pick-up trucks and mini-trucks.

In contrast, E-3 Wheeler drivers have a different income structure, where the majority (57%) comes from salaried work, with an average salary of ₹15,000. Per-trip charges contribute 43% of their income, resulting in a lower average monthly income of ₹58,455 compared to the other vehicle types. This indicates a more stable but potentially less lucrative earning pattern for E-3 Wheeler drivers. Sharma (2021), who observed that drivers of electric vehicles (E-3 Wheelers) tend to have lower overall earnings but benefit from a more predictable income structure due to their salaried positions.

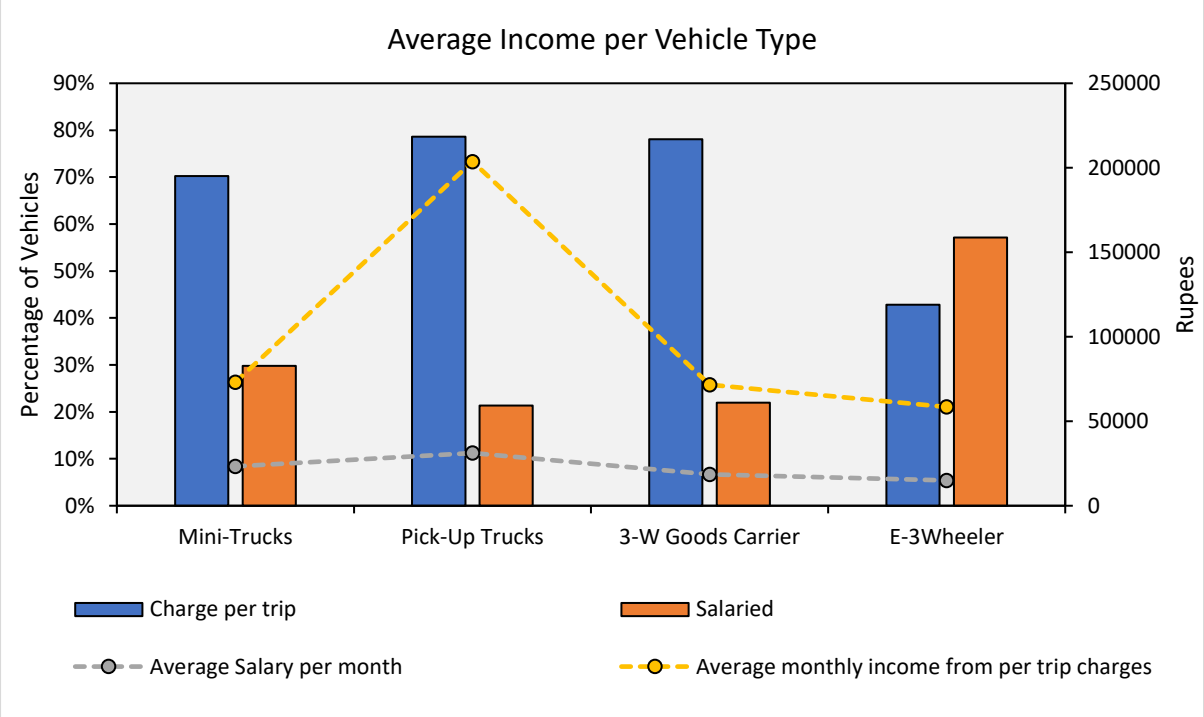


Figure 13: Average Income per Vehicle Type in Jamshedpur

5.2.5 Expenditure

Figure 14 shows that pickup trucks, despite having the highest fuel and maintenance costs, also yield the highest average monthly income at ₹117,440. Mini-Trucks and 3-W Goods Carriers have moderate costs and incomes, with Mini-Trucks earning ₹48,170.25 and 3-W Goods Carriers earning ₹45,059 on average per month. E-3 Wheelers, which have no fuel or maintenance costs, generate a lower average monthly income of ₹36,727.5.

Overall, while electric vehicles like E-3 Wheelers have minimal operational costs, they also tend to earn less compared to fuel-dependent vehicles.

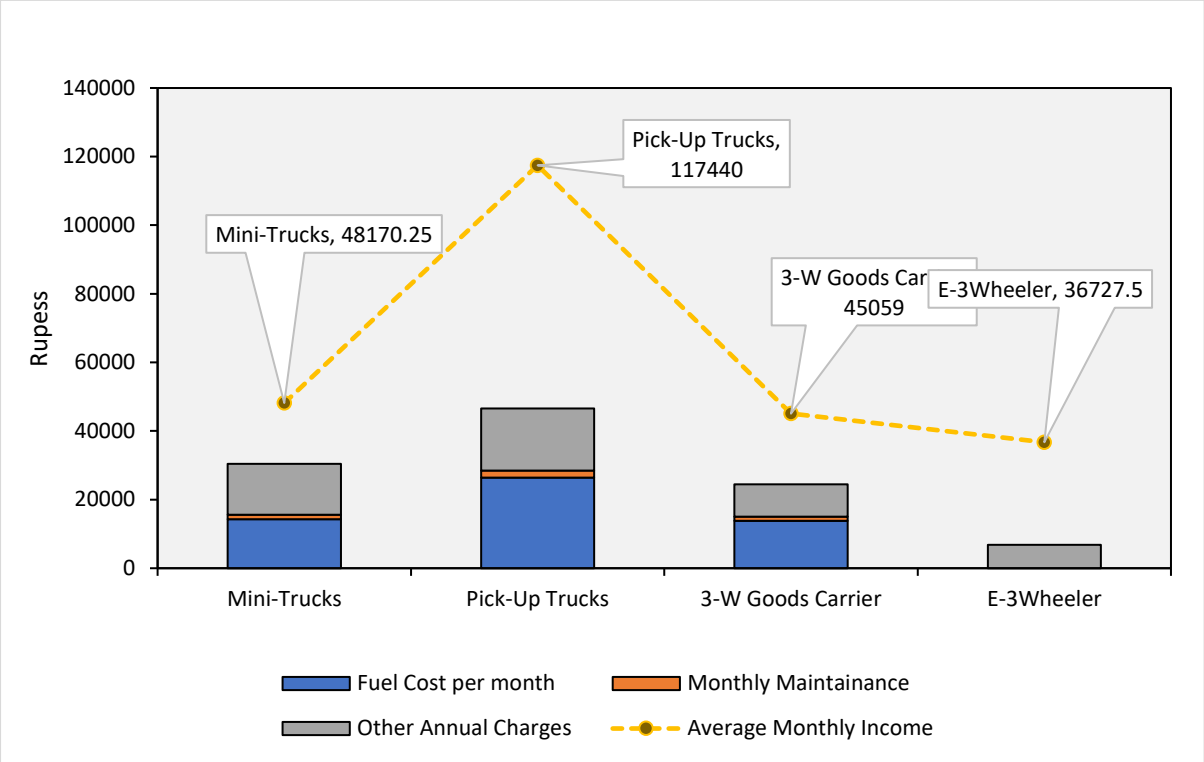


Figure 14: Monthly and Annual Expenditure in Jamshedpur

5.2.6 Vehicle Movement

Figure 15 reveals distinct vehicle movement patterns across different types. Mini-Trucks, Pick-Up Trucks, and 3-W Goods Carriers mostly follow a point-to-point delivery model, where they pick up goods at point A, deliver them to point B, and then return empty—this happens in 68-81% of cases. This indicates a less efficient use of the return journey. E-3 Wheelers, on the other hand, show a more flexible and efficient movement pattern. A majority (57%) are used for multi-point deliveries, picking up at point A and dropping off at multiple locations, reducing the frequency of empty returns (only 29% return empty). This suggests that E-3 Wheelers are better optimized for urban or short-range logistics, maximizing their operational efficiency by minimizing empty trips.

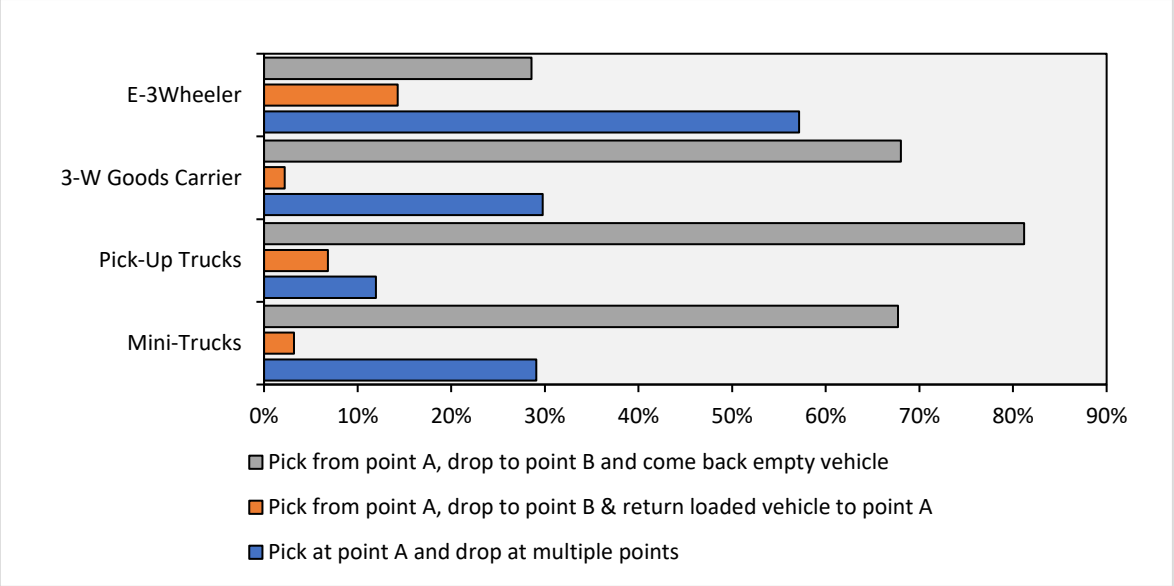


Figure 15: Movement Characteristic of Freight in Jamshedpur

5.2.7 Trip Frequency

Figure 16 shows trip frequency across various distance ranges and trip counts highlighting some distinct patterns. For trips ranging from 1-2 km and 3-5 km, there is minimal variation, with only a small percentage of trips falling into these categories. However, trips spanning 6-10 km and 11-30 km dominate the dataset, particularly for higher trip frequencies. For example, 47% of trips fall within the 11-30 km range when there are 1-2 trips, and this percentage increases to 59% for those making 7-10 trips. The distribution indicates that as the number of trips increases, the proportion of longer-distance trips (11-30 km) also rises, suggesting that individuals who travel more frequently are likely to cover greater distances.

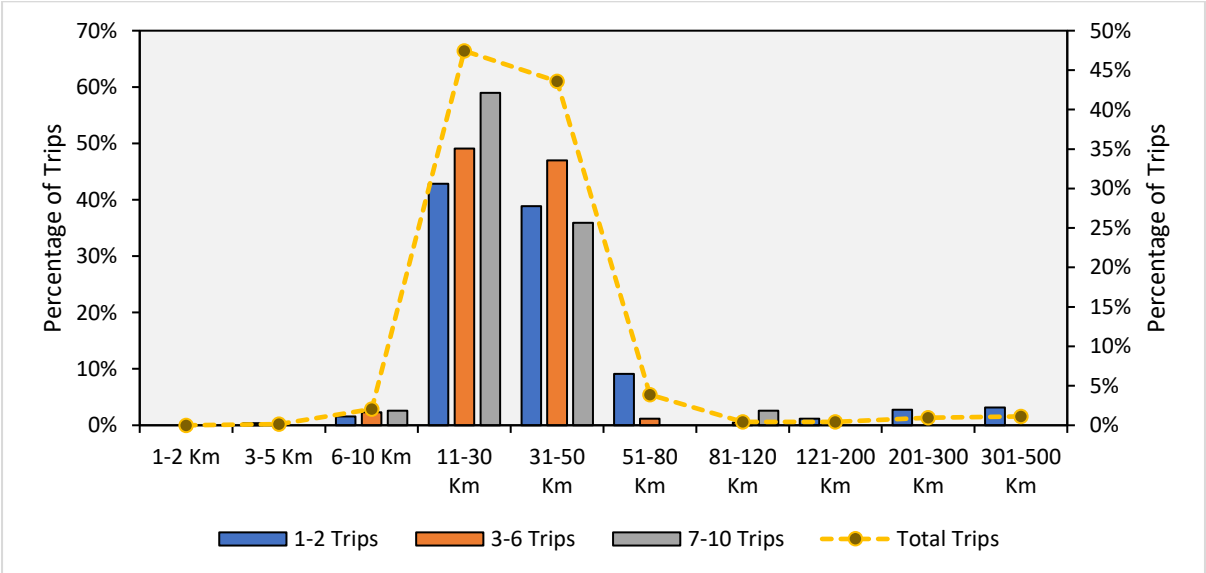


Figure 16: Trip Distribution of Freight in Jamshedpur

5.2.8 Payload Carried

Figure 17 on payload weights and the distances traveled by freight vehicles reveals that payload distribution varies significantly with distance. For distances between 6-10 km, payloads of 1.1-2 tonnes, 2.1-5 tonnes, and 5.1-10 tonnes are relatively evenly distributed, though 5.1-10 tonnes makes up a slightly larger share. As the distance increases to 11-30 km, the percentage of heavier payloads (5.1-10 tonnes) rises notably, reaching 59%, compared to 47% for the 2.1-5 tonnes range. Conversely, for longer distances such as 31-50 km, payloads in the 2.1-5 tonnes range remain predominant. This suggests that heavier payloads are more common for longer distances, likely due to the nature of freight logistics which favors larger, more efficient loads over extended routes.

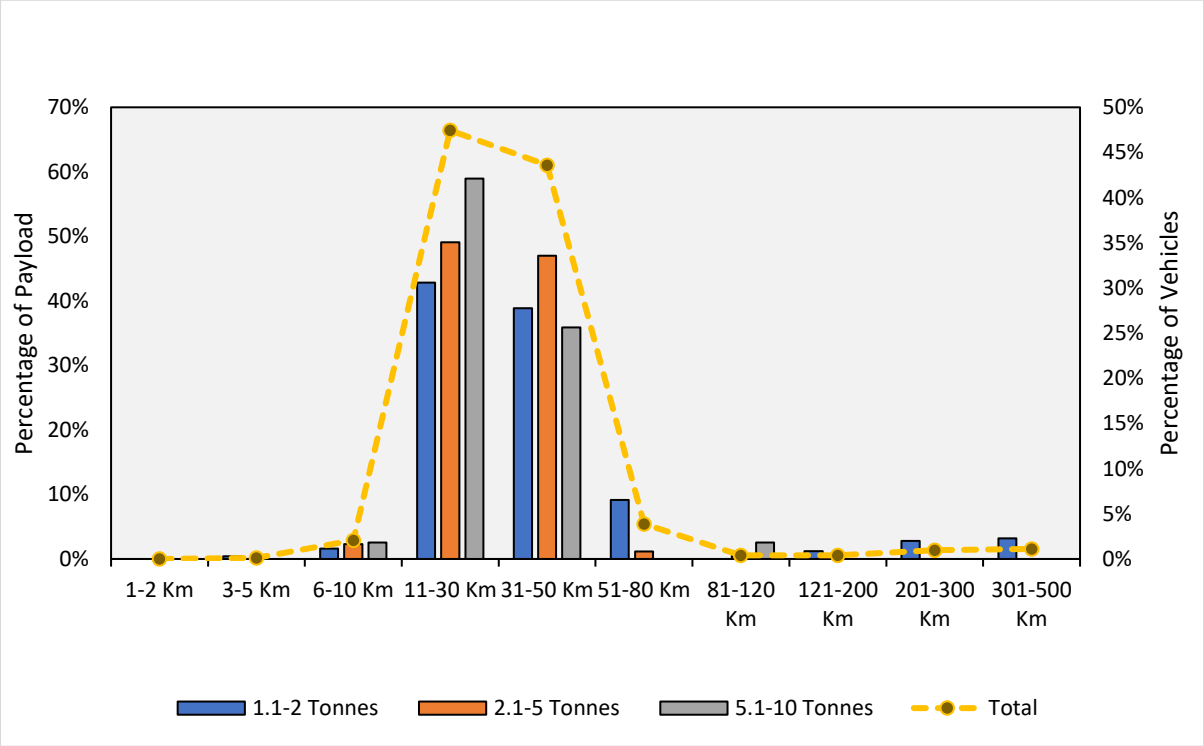


Figure 17: Payload & Distance distribution of freight vehicles in Jamshedpur

5.2.9 Parking Characteristics

The parking duration data reveals distinct preferences for parking locations based on the length of time vehicles are parked (Figure 18). For short parking durations of 0-1 hours, the majority of vehicles (88%) are parked roadside. This trend continues with a significant proportion of vehicles using roadside parking for longer durations, particularly 2-3 hours (82%) and 4-5 hours (87%). Private parking sees a lower usage rate, with only 13% of vehicles opting for this option for 0-1 hours and decreasing to 9% for 6-8 hours. The data indicates a strong reliance on roadside parking across all

durations, while private parking is less frequently utilized, suggesting potential challenges in availability or preference for roadside options. This aligns with the findings of Sharma et al. (2021), who observed that roadside parking is often more accessible and preferred by drivers for short-term parking, while private parking facilities tend to be underused, likely due to limitations in availability or cost factors.

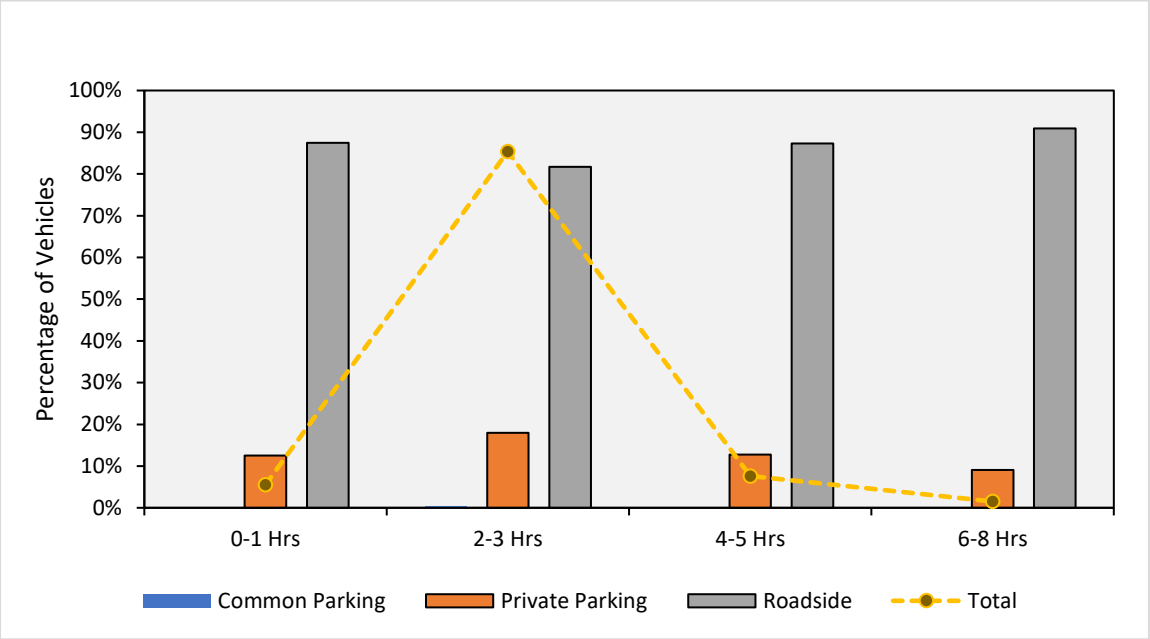


Figure 18: Parking Characteristics of Freight Vehicles in Jamshedpur

5.3 Dhanbad

5.3.1 Age Distribution

The analysis of vehicle age distribution in relation to BS emission standards reveals a clear trend towards modern compliance (Figure 19). Older vehicles from the BS III era (2006-2010) are predominantly seen in categories like Mini-Trucks and Pick-Up Trucks, though their presence has sharply declined as newer standards have been adopted. The BS IV era (2011-2019) shows a substantial increase in compliance across most vehicle types, reflecting a significant upgrade in emission technologies. However, as we transition to BS VI (2020-2023), while categories like Jugard and E-3Wheeler have embraced these stricter standards, traditional vehicles such as Pick-Up Trucks and Two-Wheelers exhibit slower adoption. This suggests that while the industry is making progress toward meeting higher emission standards, the rate of adoption varies by vehicle type and age, highlighting ongoing challenges in upgrading older fleets.

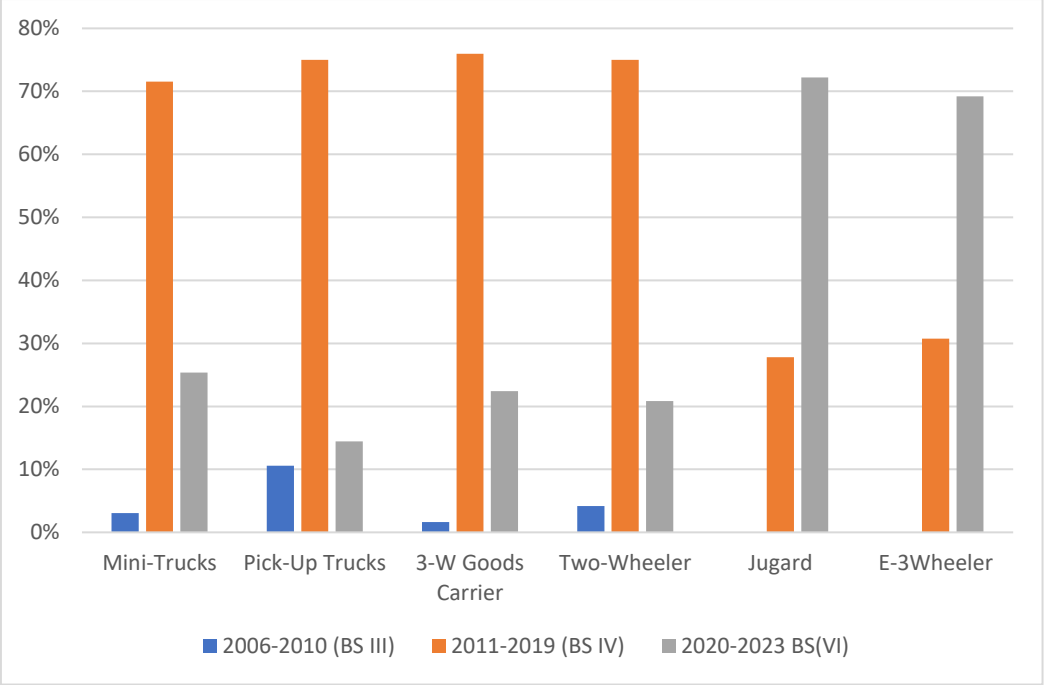


Figure 19: Age distribution of commercial vehicles in Dhanbad

5.3.2 Commodity Characteristics Transported in Freight Vehicles

Figure 20 shows the distribution of vehicle types across various commodity categories reveals distinct usage patterns. Mini-Trucks and Pick-Up Trucks are prominently used for transporting a range of goods, with Mini-Trucks showing high utilization for construction materials (23%) and packed food (13%), while Pick-Up Trucks are notably used for steel and metals (14%) and vegetables (14%). Three-wheeled goods Carriers are versatile, covering a broad spectrum of goods, especially packed food (21%) and textiles and leather (5%). Two-wheelers primarily handle vegetables (38%) and also play a role in textile and leather (13%). Jugard is heavily utilized in the construction sector (56%) and for packed food (11%). E-3Wheelers are significant for packed food (29%) and plastic and rubber (36%). Overall, while each vehicle type serves multiple categories, their specialized roles highlight their strategic importance in different sectors, from heavy construction materials to perishable goods.

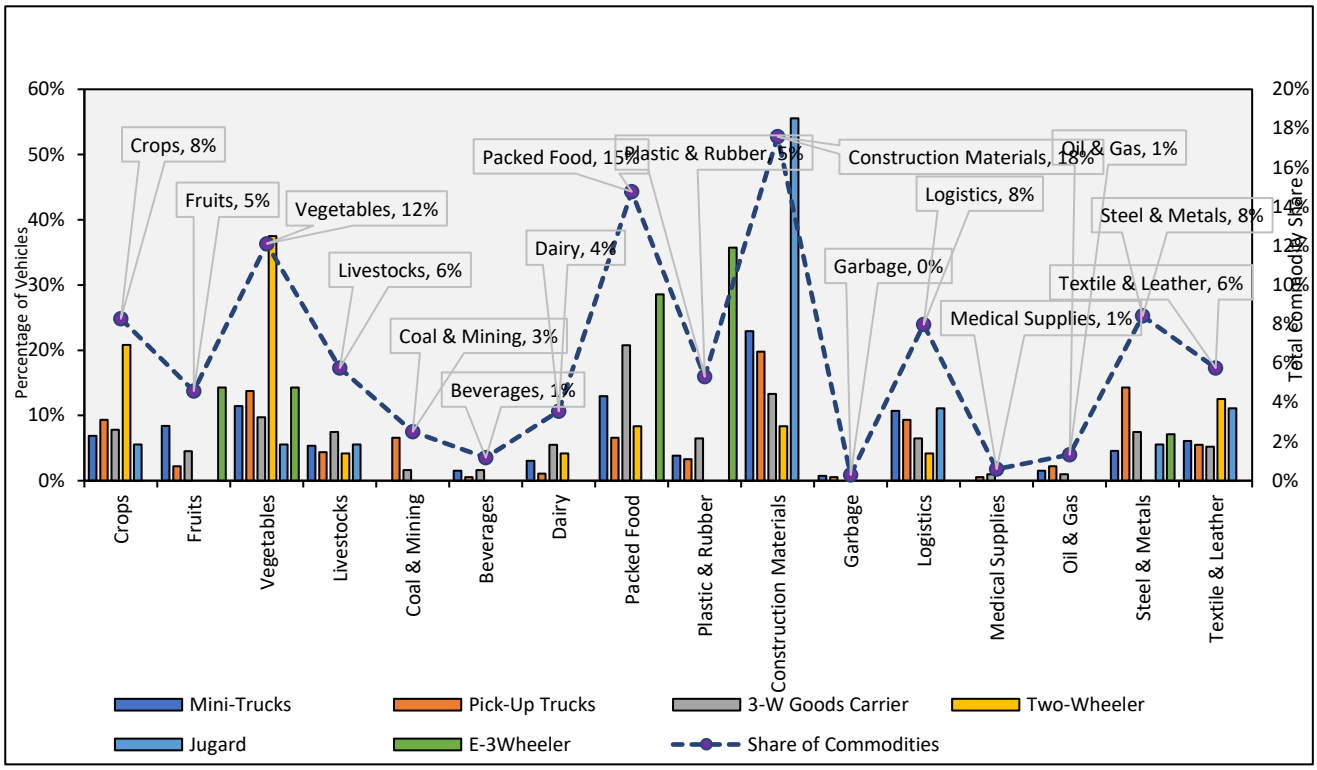


Figure 20: Commodity carried by freight vehicles in Dhanbad

5.3.3 Vehicle Ownership

Figure 21 shows the distribution of vehicle ownership across different types of vehicles shows notable patterns in vehicle management. Mini-Trucks and Pick-Up Trucks are predominantly operated under third-party arrangements, with Mini-Trucks at 82% and Pick-Up Trucks at 95%, reflecting a strong trend towards commercial fleet operations. In contrast, Two-Wheelers and Jugard are largely personally owned, with Two-Wheelers at 83% and Jugard at 78%, indicating a preference for individual ownership in these categories. Three-Wheeled Goods Carriers and E-3Wheelers exhibit a more balanced approach, with significant proportions also managed personally (37% for 3-W Goods Carriers and 64% for E-3Wheelers) while still being used in third-party operations. This distribution highlights differing usage patterns, where commercial fleets dominate for larger vehicles and personal ownership is more common for smaller, individual-use vehicles.

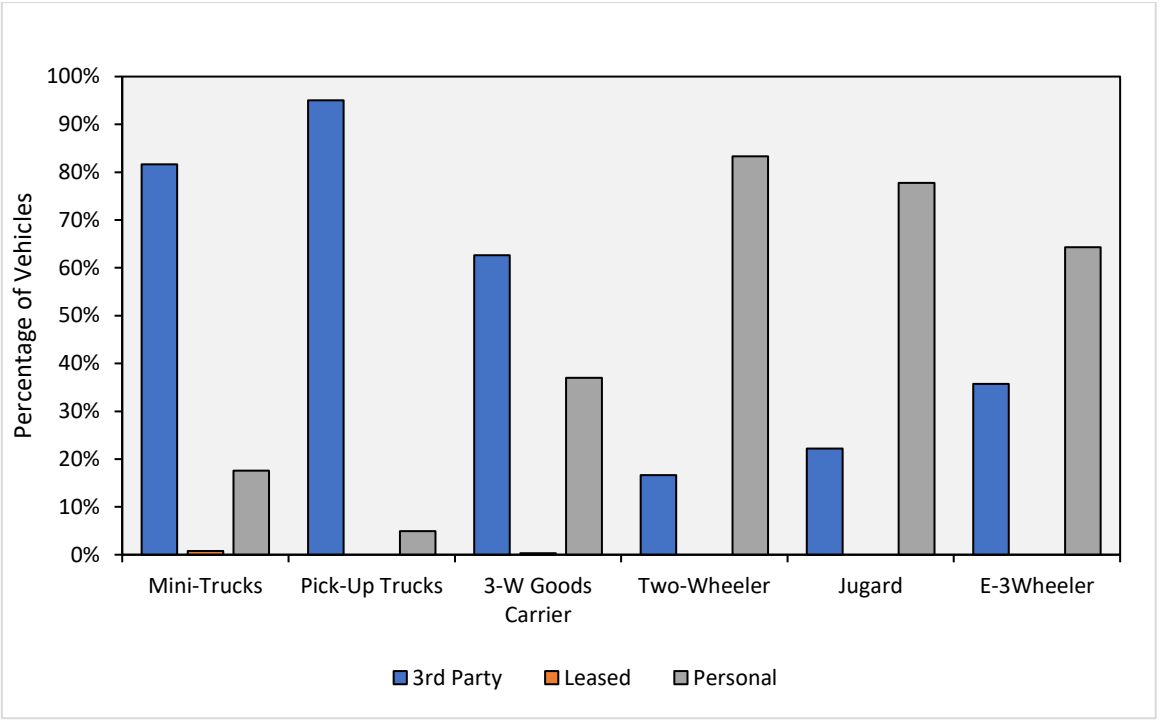


Figure 21: Vehicle ownership in Dhanbad

5.3.4 Income Structure

Figure 22 shows the income structure for vehicle drivers and owners shows distinct patterns based on vehicle type. Mini-truck drivers, predominantly salaried (93%), earn an average of ₹23,943 per month but significantly benefit from trip charges, totaling ₹97,200. With 97% being salaried, pick-up truck drivers have a higher average salary of ₹32,290, yet earn ₹27,000 from trip charges, indicating a more stable income with lower variability. Three-wheeled goods Carriers, where 87% are salaried, receive a modest average salary of ₹16,805 but earn ₹33,300 from trip charges, highlighting a reliance on trip-based income. Two-wheeler and E-3-wheeler drivers are fully salaried with no additional income from trip charges, resulting in average salaries of ₹14,409 and ₹12,785, respectively. Jugard drivers, 83% of whom are salaried, have a lower average salary of ₹11,133 but gain ₹42,000 from trip charges, showcasing a significant income boost from their trip-based earnings. This analysis underscores the varied income dynamics, where trip-based earnings are crucial for enhancing income, especially for those with lower base salaries.

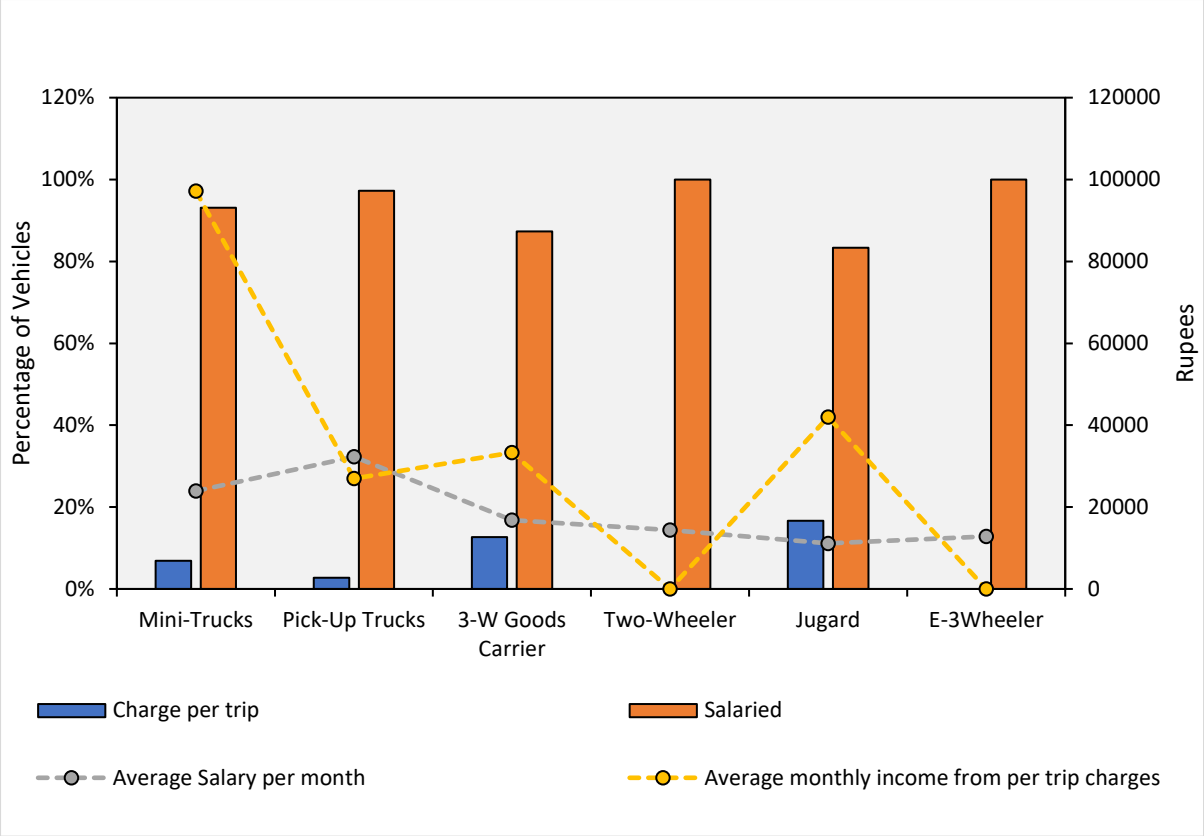


Figure 22: Average Income per vehicle type in Dhanbad

5.3.5 Expenditure

The expenditure analysis across different vehicle types reveals notable differences in operational costs is shown in Figure 23. Mini-trucks incur the highest fuel costs at ₹12,890 per month and significant annual charges of ₹21,162, yet their substantial average monthly income of ₹60,571.5 suggests a favorable income-to-expense ratio. Pick-up trucks have the highest overall costs, with fuel at ₹21,580 and annual charges of ₹28,921, resulting in a lower average monthly income of ₹29,645 relative to their expenses. Three-wheeled goods Carriers and Jugard exhibit lower operational costs, with monthly fuel and maintenance expenses significantly less than those of Mini-Trucks and Pick-Up Trucks. Despite this, Three-Wheeled Goods Carriers manage a decent average monthly income of ₹25,052.5. Two-Wheelers and E-3-wheelers, although having the lowest fuel and maintenance costs, also report lower average monthly incomes, indicating that reduced costs do not necessarily translate into higher income. While vehicle types with higher incomes tend to have higher expenses, those with lower costs often struggle with reduced income, highlighting the balance between operational costs and earning potential (Srinivas & Rathi, 2022).

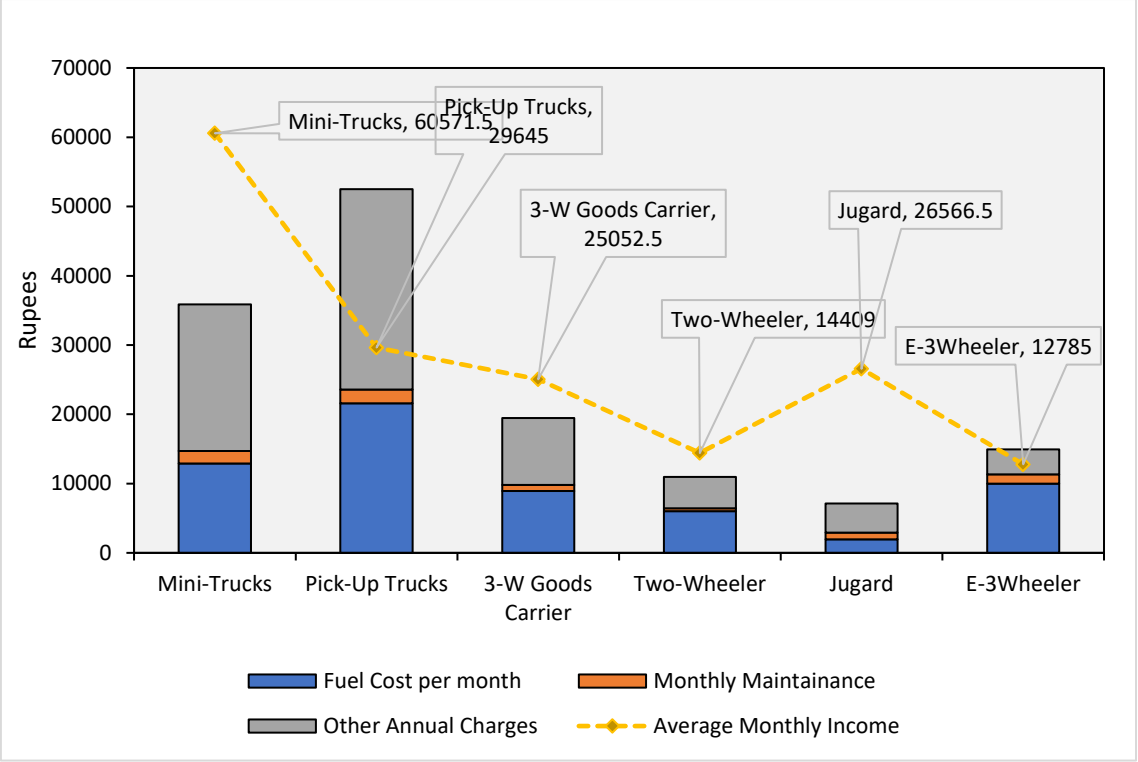


Figure 23 Monthly and Annual Expenditure in Dhanbad

5.3.6 Vehicle Movement

Figure 24 shows the movement patterns of vehicles reveal varied operational strategies tailored to different logistical needs. Mini-trucks primarily handle deliveries with multiple drop-off points (82%), demonstrating their capability for complex routing, while a small fraction is used for single drop-offs or return trips. Pick-up trucks show a preference for trips where they return to the starting point after a drop-off (84%), indicating a focus on return-load efficiency. Three-Wheeled Goods Carriers are versatile, handling both multi-drop (31%) and single-drop trips with a return (68%). Two-wheelers and Jugard predominantly engage in single-drop trips without return (92% and 83%, respectively), reflecting their suitability for simpler, more direct deliveries. E-3Wheelers are exclusively used for single-drop, no-return trips (100%), suggesting their use in straightforward delivery scenarios. Overall, the data highlights how different vehicle types are optimized for specific movement patterns, from complex multi-point deliveries to simpler, single-drop operations.

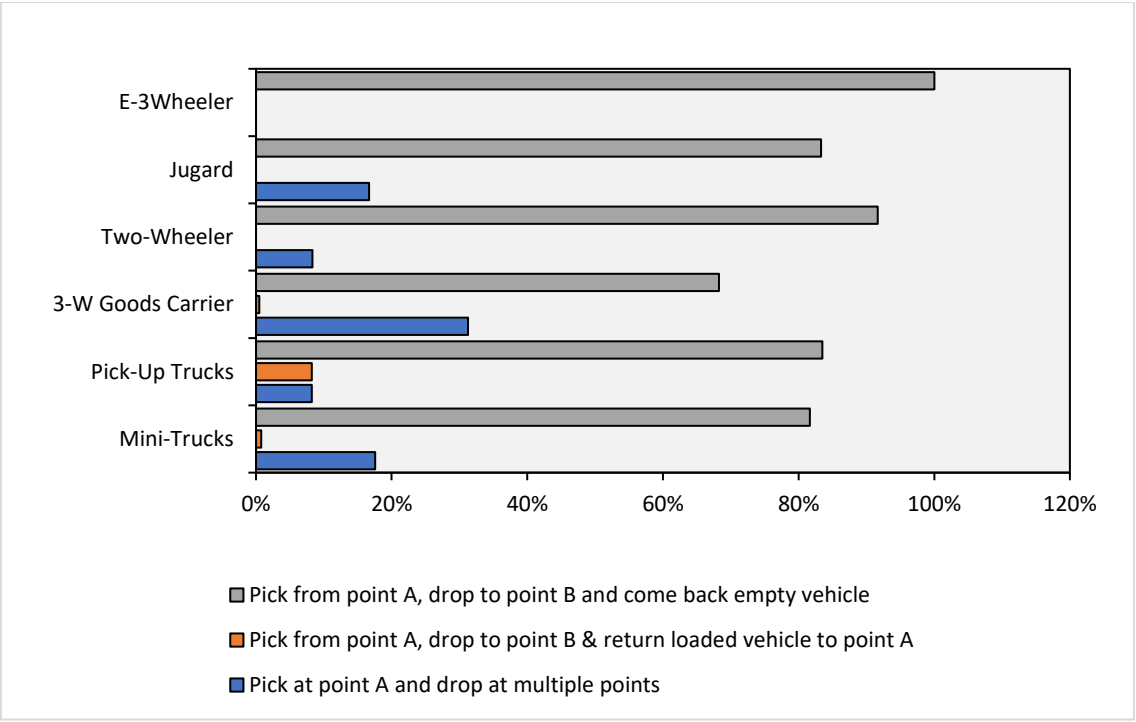


Figure 24: Movement Characteristic of Freight in Dhanbad

5.3.7 Trip Frequency

The analysis of trip distances and frequencies illustrates diverse patterns in vehicle usage (Figure 25). For trips ranging from 1-2 km, the majority of vehicles make 1-2 trips, predominantly covering distances of 11-30 km (47%). The frequency of trips decreases significantly for longer distances, with only a small percentage covering distances of 31-50 km (12%) and 51-80 km (5%). In contrast, for vehicles making 3-6 trips, the focus shifts towards medium distances, with a substantial portion covering 11-30 km (23%) and 31-50 km (48%). Vehicles making 7-10 trips are exclusively associated with distances of 6-10 km, showing a preference for consistent, medium-range trips. Overall, the data suggests that while most vehicles handle trips within the 11-30 km range, there is a clear shift towards shorter trips with increased frequency, and longer distances are less common across all trip frequencies.

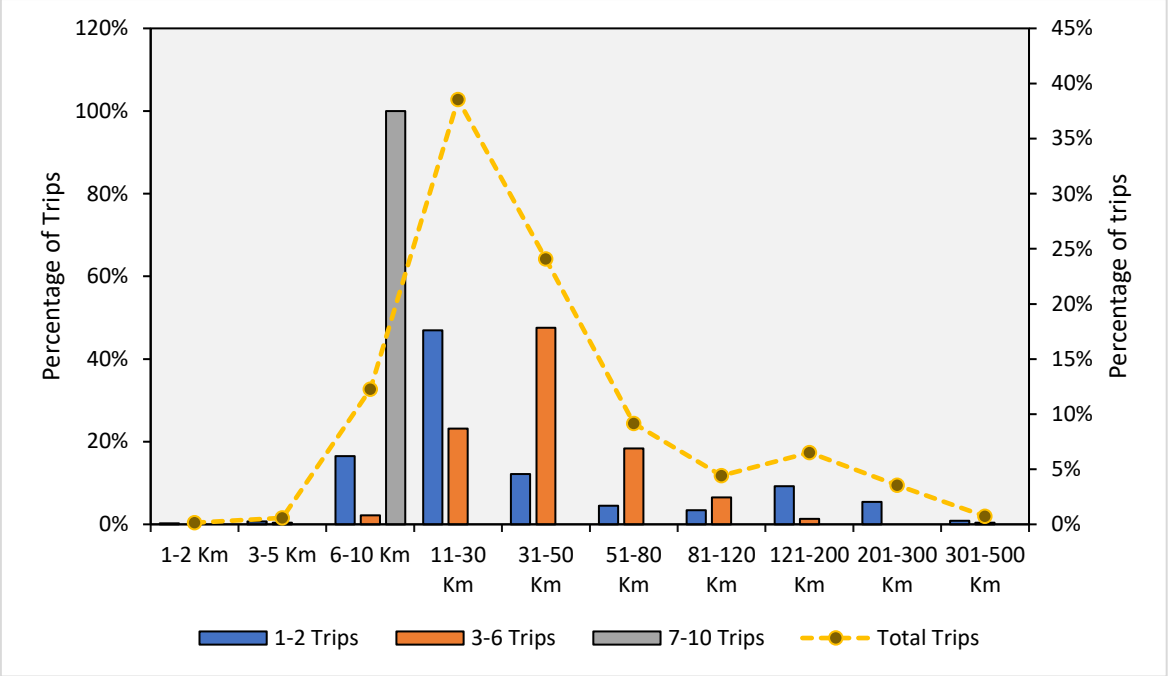


Figure 25: Trip Distribution of Trips in Dhanbad

5.3.8 Payload Carried

The analysis of payload weights across different trip distances reveals how vehicle capacity influences travel patterns (Figure 26). For short distances of 1-2 km, payloads are minimal, with negligible percentages across all weight categories. As distances increase, the distribution of payload weights becomes more varied. For trips of 6-10 km, payloads in the 0-1 tonne range are most common (18%), reflecting lighter loads for this distance. However, the most significant proportion of payloads falls into the 11-30 km range, where payloads of 1.1-2 tonnes (38%) and 2.1-5 tonnes (30%) dominate. This trend continues with a decrease in lighter payloads and an increase in heavier payloads as distances grow longer, particularly from 31-50 km to 201-300 km, where payloads of 5.1-10 tonnes become more prevalent. Overall, while lighter payloads are typical for shorter distances, heavier payloads are increasingly used for longer trips, highlighting a shift towards larger capacities for extended routes (Kumar et al., 2020; Singh & Gupta, 2019).

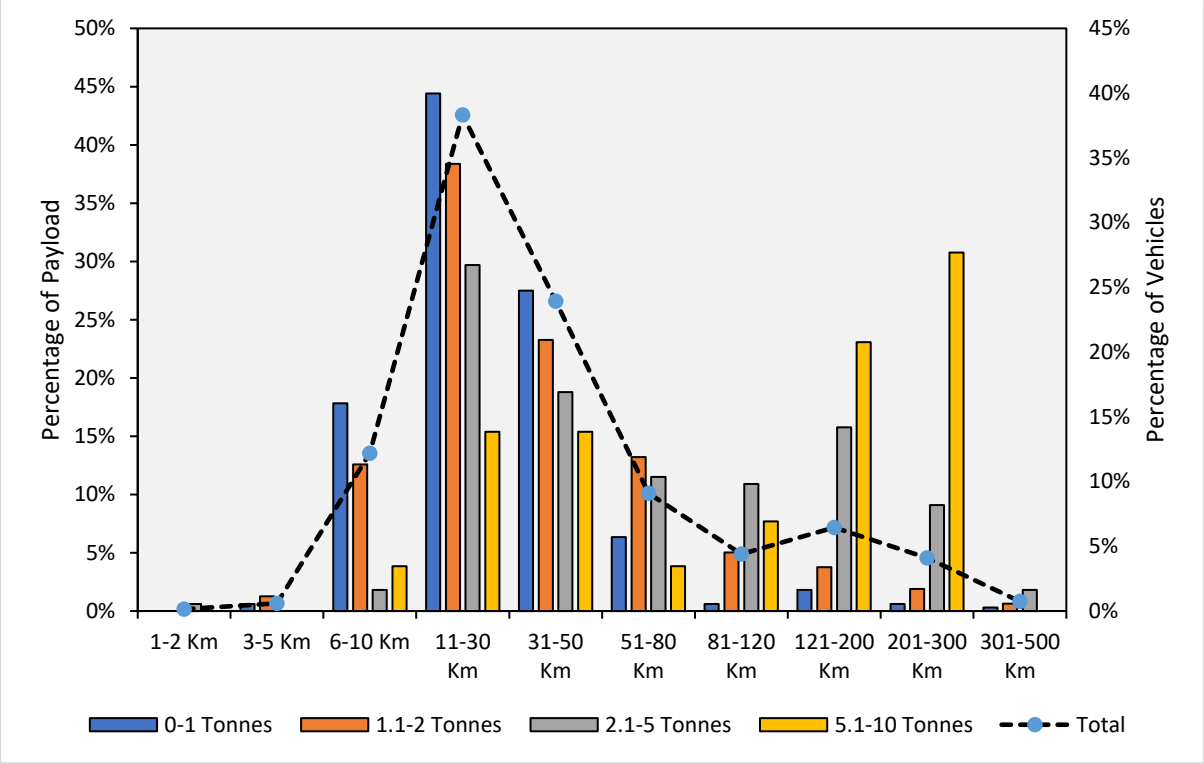


Figure 26: Payload and Distance distribution of freight vehicles in Dhanbad

5.3.9 Parking Characteristics

The parking duration data across different parking types shows clear trends in how long vehicles stay in various parking locations. For parking durations of 0-1 hours, common parking is not utilized, with only a small fraction of vehicles using private or roadside parking. As the duration increases to 2-3 hours, common parking becomes the most used option (45%), with a significant proportion also using private parking (48%) and roadside parking (47%). For 4-5 hours, common parking remains prevalent (51%), followed by private parking (39%) and roadside parking (39%). For longer durations of 6-8 hours, the use of common parking drops significantly to 2%, with roadside parking (4%) and private parking (9%) being more common. Parking for 9-12 hours is rare overall, with minimal use of all types. This distribution indicates that common parking is favored for mid-duration parking, while private and roadside options are more frequently used for longer stays.

6. Implications

6.1 Challenges and Barriers to Adoption

- From the analysis, it is found that vehicles from the BS-IV era in Ranchi, Jamshedpur and Dhanbad are more predominant in all categories. It indirectly denotes the greater readiness to cleaner technologies in these cities.
- Across all three cities, Pick-Up Trucks and Mini-Trucks transport diverse goods like vegetables and construction materials, while Jugard vehicles are specialized in carrying construction materials, especially in Dhanbad. These jugard vehicles and two-wheelers operate on a per-trip income basis. So, it is too hard for owners to save their income for transitioning to electric vehicles. Vehicle types such as Pick-Up Trucks and Mini-Trucks, are third-party operated which leads hesitation in investing in new technology due to shared ownership structures.
- Pick-Up Trucks in Ranchi and Jamshedpur generate the highest income, offsetting their high operational costs. However, Dhanbad exhibits a lower income-to-cost ratio, particularly for diesel vehicles. Due to higher maintance and fuel cost of diesel vehicles, electric vehicles can be better option. But, their initial investment is still a barrier for many operators.
- Ranchi and Jamshedpur record more frequent trips over shorter distances, while Dhanbad shows a preference for mid-range trips with heavier payloads. It indicates that all announced eLCV models can be implement for trips in Jharkhand and Ranchi as average range of these trips less than 175 km on a single charge (EVreporter, 2024). But, for Dhanbad, organized charging infrastructure is required to complete their daily trips.
- Roadside parking is the most common in all three cities, especially for shorter durations. It indicates a lack of organized parking infrastructure, which would also be a challenge for establishing EV charging stations.

6.2 Strategies for Overcoming Adoption Barriers

- As per analysis, vehicle types are highly used for diverse commodities like vegetables and construction materials. So, policy makers can target these specific sectors to replace with early electrification.

- Providing targeted subsidies as well as tax benefits to eLCVs and low-interest loans for drivers of Two-Wheelers, Jugard vehicles may encourage a shift towards electric vehicles (EVs).
- Besides, the high rate of empty return trips (84% for Pick-Up Trucks) across all cities highlights inefficiencies in logistics. So, Implementation of digital solutions that link operators with freight opportunities can diminish empty return trips.
- Consumers' awareness about electric vehicles, including their technology, government schemes, and economic benefits, play an important role in adopting electric vehicles.

7. Conclusions

The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) initiative, combined with the National Electric Mobility Mission Plan (NEMMP) by NITI Aayog, emphasizes the need for rapid adoption of electric vehicles to transform the transportation sector. So, it is essential for India to reduce CO_2 emissions by 1 billion tons by 2030 to achieve the net-zero target by 2070. This study analyzed the operational patterns of freight vehicles in three major cities of Jharkhand i.e. Ranchi, Jamshedpur and Dhanbad. The analysis of commercial vehicle dynamics in Ranchi, Jamshedpur, and Dhanbad reveals essential information about vehicle use, operating trends, and difficulties. There has been substantial but unequal progress in adhering to BS IV and BS VI emission requirements. While Dhanbad trails behind in categories like two-wheelers and pick-up trucks, Ranchi and Jamshedpur exhibit notable adoption across most vehicle types. In all three cities, pick-up trucks and minitrucks predominate and transport a variety of cargo. Due to local preferences, Jugard vehicles in Dhanbad have a particular function in transporting building supplies. While personal ownership is more common in Dhanbad, especially for smaller vehicles like two-wheelers and Jugards, ownership trends show that Ranchi and Jamshedpur have fleet-dominated operations for larger vehicles. Income and spending analysis show variations in earning patterns; trip-based income, especially in Dhanbad, is a vital supplement for drivers earning lesser salaries. Vehicle movement patterns reveal disparities in logistics tactics: Dhanbad depends on easier single-drop trips, Jamshedpur emphasizes return-load efficiency, and Ranchi

concentrates on multi-drop deliveries. Between cities, medium-range travel is more common, and loading patterns show that longer flights increasingly carry greater loads. Patterns of parking length indicate that roadside and private parking are chosen for longer visits, whereas common parking is relied upon for mid-term stays. Key findings highlight that financial barriers, challenges in charging infrastructure installation, and consumers' awareness are the most significant challenges to EV adoption.

Future research can examine commercial vehicle electrification, with an emphasis on EV integration within the logistics ecosystem. More help for the shift to sustainable urban freight might come from looking into the infrastructure needs, like charging stations, and the adoption rates of various vehicle types.

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Annexure

Quantitative Survey

Surveyor Name: _____	**Survey Location: _____**
Insert the geo-location of survey location	**Longitude: _____** **Latitude: _____**
Driver's Survey: *This survey is to understand the type of commercial vehicle used to deliver certain types of commodities at inter and intra city level. This survey will include interviewing drivers of commercial vehicles based on a predefined questionnaire. The aim of this survey is to understand the travel pattern of targeted commercial vehicles, in order to understand the flux of vehicle in specific routes.*	
Date and Time: _____	**Name of Driver: _____**
Registration Number: _____	**Make (Year) and Model:** **_____**

Type of Vehicle			
3W Goods Vehicle		Mini-Trucks	Pick-up Trucks
 ☐	 ☐	 ☐	 ☐
Two Wheeler Goods Vehicle	Jugard	If vehicle is other than above vehicle class, please describe the vehicle type:	
 ☐	 ☐		
Number of Axles:			
2 | 3 | 4 | 6			

Code	**Type of Commodity loaded**	**Code**	**Type of Commodity loaded**	**Odometer reading of Vehicle (in KMs)**		
A111	Crops	C221	Plastic & Rubber	**Ownership of Vehicle**		
A112	Fruits	C251	Metal Fabrication	Personal	Leased	3rd Party Ownership
A113	Vegetables	C106	Sugar Mill	**Fuel type of Vehicle**		
A114	Livestock	B081	Sand	1. Diesel		3. CNG
C105	Dairy	C239	Brick	2. Petrol		4. Electric
C107	Food Processing	B089	Stone Chips			
C131	Textiles	H521	Warehouse/ Storage	If Others, specify the commodity by name		
C151	Leather	H522	Logistic			
B051	Coal & Mining					

Costs & Benefit						
Type of service	**Amount**	**Monthly / Annual Cost of Operation**				
Salaried	*(Monthly lumpsum)*	Monthly Rent / EMI *(In Rs.)*	Cost of Fuel per month *(In Rs.)*	Monthly Maintenance Cost *(In Rs.)*	Monthly Parking / Other charges(permit, license, road tax etc.) *(In Rs.)*	Annual Insurance *(In Rs.)*
Charge as per trip	*(per Km)*					
Charge per Kg or tonnes	*(per Kg)*					

Trip Characteristics: To understand the pattern of transferring commodities from one place to another and to understand the flux of vehicle plying on each route.			
Specify the pick-up location of commodity	Place	District	State
Specify the drop location of commodity	Place	District	State

Which of the following driving condition suites the best for driver	Pick from point A, drop to point B & return empty vehicle to point A	
	Pick from point A, drop to point B & return loaded vehicle to point A	
	Pick at point A and drop at multiple points	
	If Other, please mention	
If Multi-stop delivery, where are the places you are going to deliver today (mention at least 5 names)?		
If Point-to-Point delivery, where are the places you generally deliver throughout the year (mention at least 5 names)?		

Please specify if the vehicle from specific point leaves loaded or unloaded with kind of commodity?

Point Name	Loaded/ Unloaded	Crops	Fruits	Vegetables	Livestock	Dairy	Food Processing	Textiles	Leather

Point Name	Loaded/ Unloaded	Plastic & Rubber	Metal Fabrication	Sugar Mill	Sand	Brick	Stone Chips	Warehouse/ Storage	Logistic Hub

Type of Movement	No. of Trips	Average Weight per trip	Time takes to deliver commodity	Total Km Covered per day (Kms)	Is the trip route repeated on a daily basis (Yes/No/Maybe)	
1. Fixed Route 2. Flexible Route	1. ≤ 2 2. ≤ 6 3. ≤10 4. ≤20 5. ≤50 6. ≥ 50 7. If More, please specify in No.	In Kg (Ex. 150-200kg)	1. 1- 2 Hrs 2. 2- 3 Hrs 3. 3- 5 Hrs 4. 5-10 Hrs 5. 10-15 Hrs 6. 15-24 Hrs 7. 1 day 8. 2 days 9. If more, please specify	1. 1-2 Km 2. 2-5 Km 3. 5-10 Km 4. 10-30 Km 5. 30-50 Km 6. 50-80 Km 7. 80-120 Km 8. 120-200 Km 9. Specify if above 200 Km	**Parking location** *1. Roadside* *2. Private Parking / in the shop* *3.Comm. Parking* *4. Home* **What is the average wait/ parking time of vehicle** 1. 0-1 Hrs. 2. 1-3 Hrs. 4. 3-5 Hrs. 5. 5-8 Hrs.	6. 8-12 Hrs. 7. ≥ 12 Hrs.

User Perception: To understand the anxiety levels in using the electric/CNG vehicle as compared to petrol/ diesel vehicle. Willingness to adopt CNG/electric vehicle for regular operations.

Q.1 Are you aware of any subsidy by government to procure electric vehicle? ◯ **Yes** ◯ **No**

Q.2 Are you aware, your current vehicle can be retrofitted with CNG kit? ◯ **Yes** ◯ **No**

Q.3 On the rank of 1-5 please rank the factors most helpful in buying electric vehicle, where 1 is least and 5 is max?

Factors	1	2	3	4	5
You get a subsidy from government					
You are financed by banks with a lower interest rate					
Operation & maintenance cost of electric vehicle less than your current vehicle					
Have a better or the same range than current vehcile					
Have the same speed as Petrol/ Diesel vehicle					
Have the same payload capacity as Petrol/ Diesel vehicle					
Have a higher refueling time/ charging time					

Survey Questionnaire- Logistic Operators

Truck Operators/ Logistic Hub Interview: *This interview is to understand the type of infrastructural/ technological needs required to plan an operation and what are the current challenges prevailing. These challenges can help to identify the transition pathway focused on specific sector. To also understand the financial challenges occurs in acquisition of electric/CNG vehicle.*

Vehicle Information and Operation							
Name of Agency	Garaging Address	Vehicle Ownership Detail	Vehicle type and number of vehicles owned				
		State Permit	Three Wheeler	Pick-Up Truck	Mini-Truck	Two Wheeler	
		National Permit					
Total loading capacity combined all vehicle							
No. of workers (Drivers and Others)							
Type of loading or commodity			Crops	Fruits	Vegetables	Livestock	Dairy	Food Processing
			Textiles	Leather	Plastic & Rubber	Metal Fabrication	Sugar Mill	Sand
			Brick	Stone Chips	Warehouse/ Storage	Logistic Hub	Coal and Mining	
Tons of each commodity								
Frequency of trips			1. Daily	2. Alternate Days	3. Weekly	4. Monthly	5. Quarterly	

Cost and Benefit						
Total Earning per month	**Service charges per vehicle**	**Monthly / Annual Cost of Operation**				
Per Month *(In Rs.)*	(Including all other expenses) Per Km *(In Rs.)*	Monthly Rent / EMI *(In Rs.)*	Cost of Fuel /Charging per Month *(In Rs.)*	Monthly Maintenance Cost *(In Rs.)*	Monthly Parking / Other charges(permit, license, road tax etc.) *(In Rs.)*	Annual Insurance *(In Rs.)*

Q.1 What are the major serviceable areas of your fleet vehicles?

Within 50 Km of radius (local level)	Within cities in Bihar	Within only Eastern region like Jharkhand, West Bengal, Odisha, Assam	All states of India	Depends on orderly basis

Interview with Logistic Owners: The interview with logistic operators will be recorded in device with introduction of dates and agency name.

Q.2 What is the current fleet size operational right now?

Not more than 10%	10-20 %	20-50 %	50-80 %	80-100 %

Q.3 Are you planning to replace your current vehicle or add a new vehicle to your fleet?

< 1 Year	1 to 3 years	4 to 5 years	6 to 10 years	Not at all soon > 10 years

Q.4 Did you require any financial aid to purchase old fleet vehicle? ◯ Yes ◯ No

Q.5 Do you have knowledge of subsidies and benefits offered by central and state governments on buying and operating electric goods vehicles in Bihar. ◯ Yes ◯ No

Q.6 Do you know of any people who have purchased electric Vehicle?

1	2	3	4	5
None	Very few	Half of the people I know	Most of them have	Everyone I know has

Q.7 Are you aware of any owners who have availed any electric vehicle related government benefits / schemes?

1	2	3	4	5
None got it	Very few got it	About half of people who bought got it	Most of them got it	All got it

Please mention (if any) the challenges/difficulties faced by the current electric vehicle owners.

_____

Q.8 Which one of these facilities/services will positively contribute to meeting your operational requirements towards electrification? Please rank in the order of preference (1 to 5)

Lower Financing - Interest Rate	Cheaper Electricity Charges - lower than Rs 5/KW/h	Availability of more options of vehicle models	Parking & Charging infrastructure	Maintenance / Service Facility
Other -				

Q.9 Explain your business briefly? (Size of operations, branches, Number of employees, Truck drivers)

Q.10 How do you plan your route? How do you ensure you vehicle and driver safety on the road?

Q.11 What are the challenges you face in day to day business related to operations?

Q.12 What infrastructure requirement you need, when planning to add new fleet vehicle in your operations?

Q.13 Do you think, electric commercial vehicle will prove more efficient then present ICE vehicles in future?

Q.14 If you were asked to shift to electric vehicles for operation, what will be major drivers and barriers to shift?