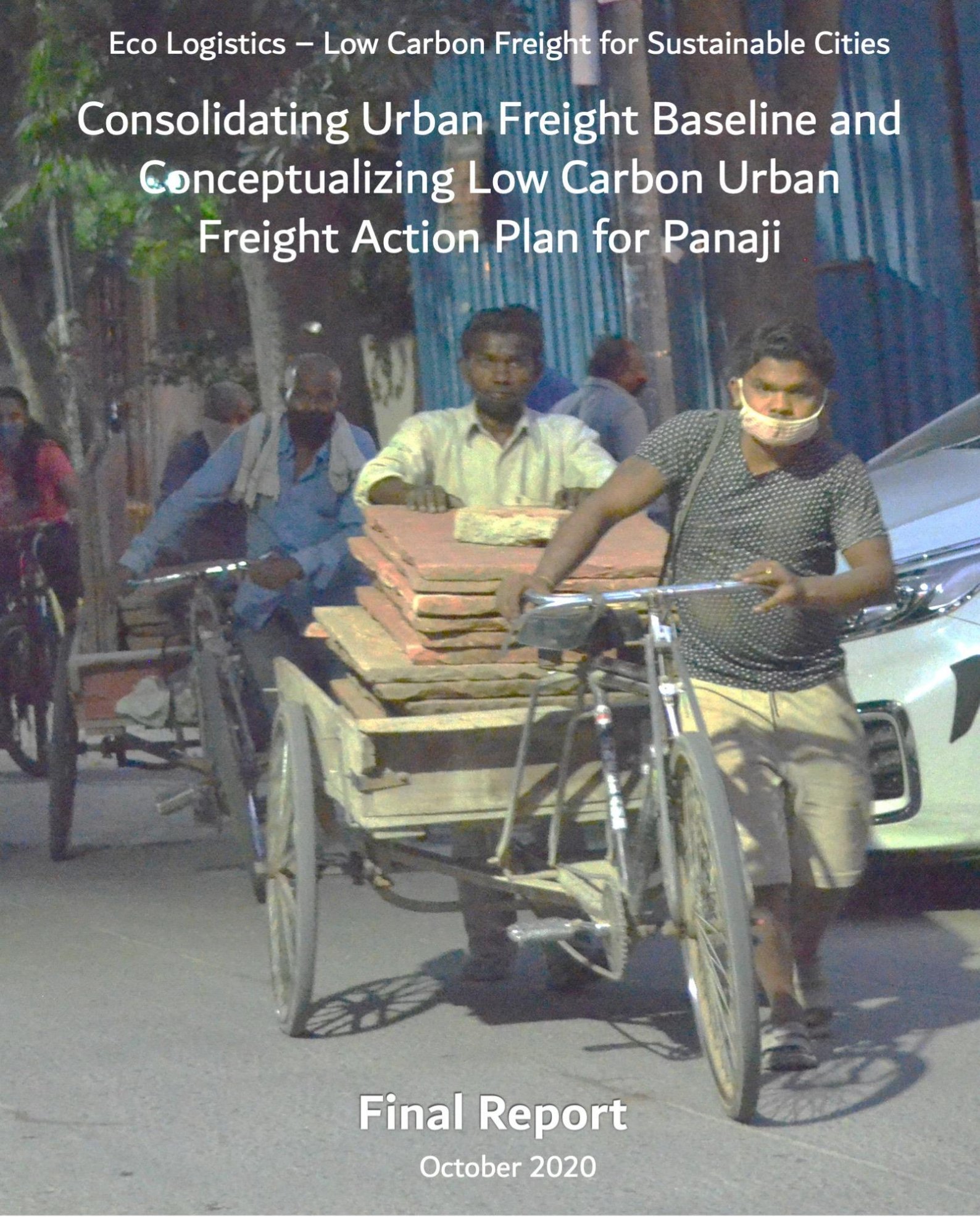
Eco Logistics – Low Carbon Freight for Sustainable Cities

Consolidating Urban Freight Baseline and Conceptualizing Low Carbon Urban Freight Action Plan for Panaji



Final Report

October 2020

ICLEI Local Governments for Sustainability

SGA sustainable mobility solutions

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Acknowledgement

We would like to express our sincere thanks to Shri Sanjit Rodrigues, commissioner, Corporation of the City of Panaji (CCP) and his team for their support and guidance during this study. We would also like to express our thanks to the Principal and all ten students of Dhempe college of Arts and Science for their constant support in conducting freight surveys in different parts of Panaji city. Also, we would like to thank Urban Mass Transit Company (UMTC) for providing advice on Panaji city traffic and transport situation, issues, etc.

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1 Background

Unlike urban passenger mobility, there exists little or no data, awareness or consensus of the type and scale of the issues related to urban freight mobility in India. There is thus little understanding of the adverse health impact of growing urban freight especially last mile freight (including home deliveries) in the Indian context. There is limited or no mention of urban freight in city mobility and development plans and our National Urban Transport Policy (2006) does not mention anything on freight or goods movement.

Urban freight is mainly characterized by last mile deliveries in the supply chain. It involves smaller volumes and frequent trips (or high trip rate) because of limitations of availability of large storage spaces with retailers in an urban area (Rodrique, 2017). Additionally, it has been observed that the growing trend and reliance on of app-based goods (home) deliveries, is leading to a shift in last mile freight delivery trend towards an increase in smaller volume freight delivery trips. While this is leading to an increase in adverse health impact (emissions, congestion, and accidents) on the citizens, it is also leading to higher inefficiencies in the urban freight delivery supply chain. This is encouraging suppliers to look for new solutions, in some case leading to an increase in density of smaller logistic hubs or a diffused warehouse network in the city fabric. Due to the evolving nature and changing face of challenges involving urban freight, the existing planning, policy, and regulatory framework is becoming more and more inept at addressing the same. There is thus growing attention on this issue. The issue of urban freight and logistics is now gaining increasing focus in transportation studies as well policy, regulatory and institutional environment, globally. This is especially true for the developed world. Many European cities are now actively researching on strategies to identify, quantify and addresses these issues, at planning, policy, and institutional levels. They are developing city logistics plans which is geared towards the evolving demands of urban freight movement and promotes economic as well environmental standards (Giuliano et al., 2013).

Urban centers in India are faced with similar growing concerns on freight transport. Spread over just 812 hectares (8.12 sq. km.), Panaji, the capital of the Indian State of Goa, is a prime tourist spot both for national as well as international tourists and houses critical infrastructure that supports vast tourism activity in the area. The population of Panaji (municipal limits) is 40,017 as per the latest census and as per the City Development Plan, the floating population of the city in 2020-2021 is 7,430 whereas tourist population (for this period) is 3,690. The decadal growth rate of population for Panaji city is 10.9%. Using this the estimate of total population in Panaji city in 2020-21 can be estimated to be 55,499 (including floating population). Due to its status of being an attractive tourist destination Panaji has a high motorized traffic density, catering to passenger mobility requirements. This leads to negative externalities like high emissions, congestions, and accidents. This issue is widely recognized, and the State has invested in the development of Comprehensive Mobility Plan (CMP) for the city in 2008 by Urban Mass Transit Corporation (UMTC). CMP Panaji presents a strategy and investment plan to improve passenger mobility and particularly sustainable passenger mobility in Panaji. However, it pays little or no attention to goods movement in the city. Likewise, there has been little or no effort in planning for current and evolving challenges in addressing urban freight issues in Panaji. However, there is policy in place to address goods transport issue at State level. The 'Goa Investment Policy 2014' (Directorate of Industry Trade and Commerce Government of Goa, 2014), presents a plan for improving freight logistics infrastructure, management and operations in Goa.

2 Objective of this study

To address this issue, ICLEI has initiated a study on urban freight in three nations, i.e. Argentina, Columbia, and India, called EcoLogistics. Three Indian cities have been included in this study. One of the cities selected in India is Panaji. ICLEI has undertaken preliminary study for these cities which has included collection of data on freight movement in these cities through secondary sources and stakeholder interaction. As a part of EcoLogistics, **the current study aims to develop the baseline for urban freight in Panaji and advocate a broad outline of an action plan to achieve low carbon freight movement in the city, with an aim to contribute in advancing the development of effective regulatory, planning and logistical instruments at all levels of government to support low-carbon freight in India.**

To develop this baseline the study estimates the demand from freight sector and the carbon emissions from this sector in two distinct categories – all transport related carbon emissions (including carbon equivalent emissions) from freight sector and carbon emissions from freight transport sector within the boundaries of the city. For the former, emissions from freight sector based on demand generated by the city is estimated even for the component of the trip outside the boundary of the city. For the latter only the portion of the freight trip within the boundary of the city is accounted for.

3 Methodology

To achieve the objectives of this study, a detailed survey to quantify and characterize urban freight demand in Panaji has been carried out. This survey design focuses on establishing a commodity, link, and vehicle wise freight demand for the city.

3.1 Study Design

The study design allows collection of both macro and micro level data for freight traffic and demand in Panaji city across three dimensions – by freight delivery network or link type, by freight commodity type and by freight vehicle type.

3.1.1 Freight Delivery Network or Link

There are four predominant delivery networks or links in the city. These can be classified as below:

- **Link 1** – Manufacturers or large warehouses/storage facilities outside the city to wholesalers/distributors in Panaji city. This is also referred to as the first mile freight delivery.
- **Link 2** – From wholesaler/distributors in or outside the city to retailers (or wholesaler cum retailers) in the Panaji City.
- **Link 3** – From retailers to home or another commercial establishment (such as a restaurant). This is also known as the last mile freight delivery.
- **Link 4** – Collection of solid waste and night soil from residence/retail and delivery to recycling plants.

3.1.2 Commodities and Freight Vehicles

A total of 16 different categories of commodities have been identified (including 'others'), a total of 3 types of distribution links have been identified - to wholesaler distributor, to retailer/ from wholesaler/distributor and to consumer/ from retailer and a total of 11 freight vehicle types have been identified (these include private modes used for freight transport). Table 1 presents the list of commodities and vehicle types used in the survey. The list of all different kinds of retail establishment that fall under each commodity type has been included in Annexure 6.3.

Table 1: List of commodities/item categories and freight vehicle types used

S. No.	Commodity type	Freight vehicle type
1	Food Grains	LCV (1 to 3.5 ton), Pickup truck, HCV truck, 2-wheeler, Bicycle
2	Perishable Foods	Multi Axle, HCV, LCV, 4 wheeled rickshaw, Pickup truck, 2-wheeler, Van, Car, Walk
3	Liquor	LCV, Pickup truck, Van
4	FMCG	LCV, HCV, Pickup truck, 4-wheeled rickshaw, 3W auto rickshaw, 2-wheeler, Van, Car
5	Couriers & E-commerce	LCV Truck, HCV, Pickup truck, 4-wheeled rickshaw, 3W auto rickshaw, 2-wheeler, Van, Car, Bus
6	Cash	Tempo, traveler, Pickup Truck
7	Pharmacy	HCV, LCV Truck, Pickup truck, 2-wheeler
8	Hotel & Restaurant	LCV Truck, Pickup truck, 4-wheeled rickshaw, 3W auto rickshaw, 2-wheeler, Van, Car, Bicycle, Walk
9	Solid Waste	Dumper, Multi Axle, HCV, LCV 4-wheeled rickshaw, Pickup truck
10	Construction & Demolition	Multi Axle, HCV, LCV, 3W auto rickshaw, 4 wheeled rickshaw, Pickup truck, Dumper, 2-wheeler, Van, Car, Walk
11	Oil & Natural Gas	HCV, LCV truck, Pickup truck, 4 wheeled rickshaw, Fuel Tanker
12	Clothes and Accessories	LCV Truck, Pickup truck, 4-wheeled rickshaw, 3W auto rickshaw, 2-wheeler, Train, Car, Bus

S. No.	Commodity type	Freight vehicle type
13	Electronics	LCV Truck, Pickup truck, 4-wheeled rickshaw, 2-wheeler, Van, Car, Bus, Walk
14	Printing & Publishing	4-wheeled rickshaw, 3W auto rickshaw
15	Sewage	Dumper
16	Others	LCV Truck, Pickup truck, 4-wheeled rickshaw, 3W auto rickshaw

The data collection methodology attempts to quantify Panaji freight demand characteristics (including inefficiencies, total load, total kilometer covered, etc.) for each vehicle type used on each distribution link for each commodity.

3.2 Identification of Study Zones

The sample data has been collected from five distinct zones (identified using Panaji land use maps and on ground understanding of demography). The study areas from which the samples have been collected in each zone represents 7% of the total land area for the city of Panaji. Each of the five study areas were carefully demarcated to ensure each is representative of the identified zone in terms of land use and demographics (including densities, etc.). Table 2 presents the list of identified study zones along with the study area details in each zone. Figure 1 presents the study area location on the map of Panaji. Figure 2 presents the detailed plan of the study area in each of the five identified zones in Panaji.

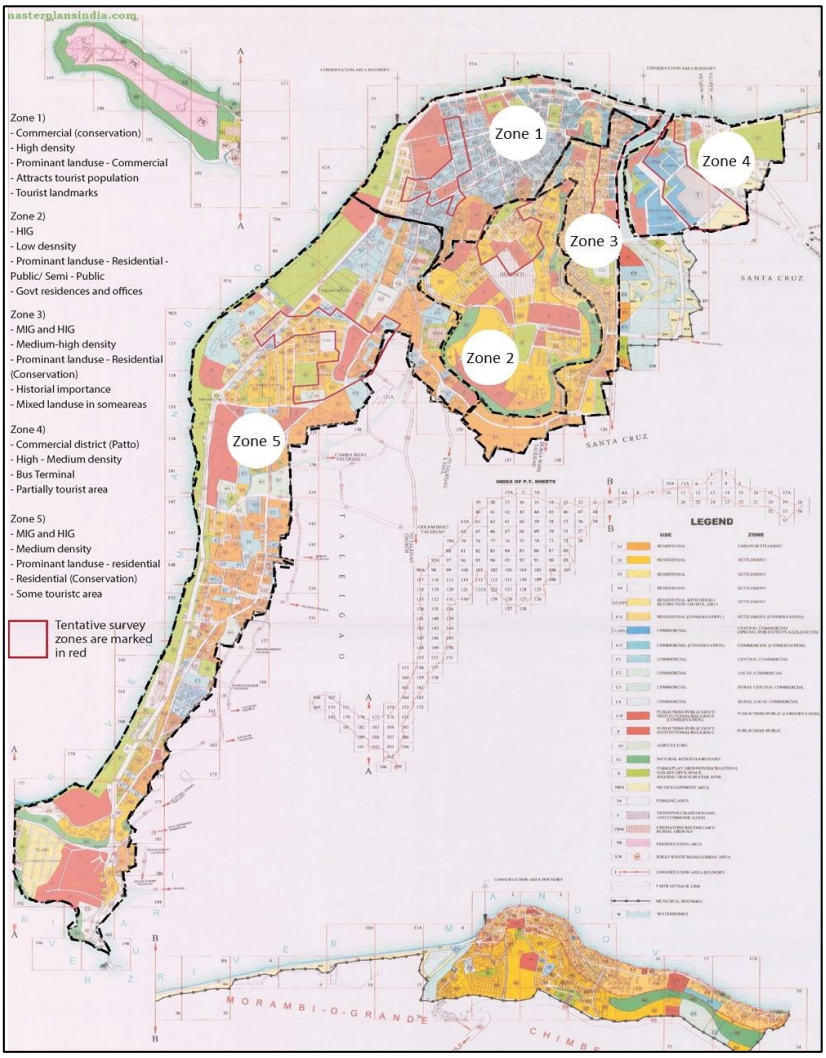

Figure 1: Map of Panaji showing the location of identified (demarcated in black dotted line) and the location of study area in each zone (demarcated with solid red line) along with respective zone numbers.

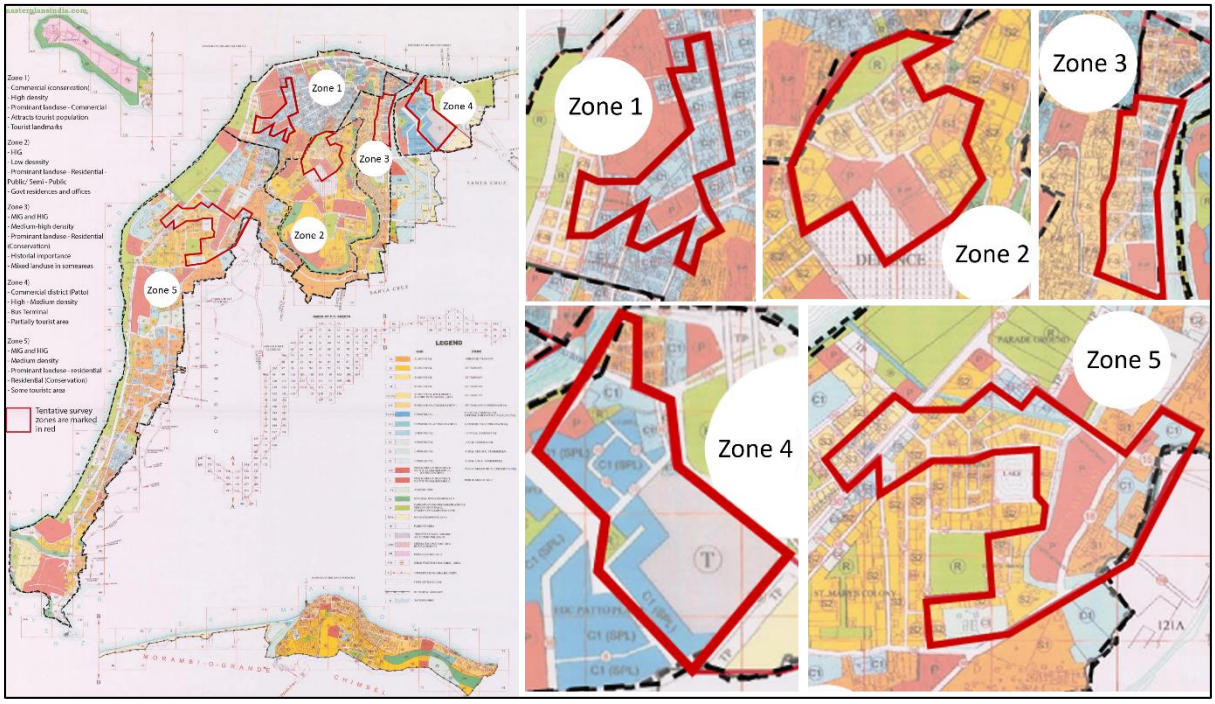

Figure 2: Detailed plan of study area in each zone

Table 2: Comparison of Area of each zone and the study area in each zone

Zone No.	Area	Zone Area (Sq. Km.)	Study area (Sq. km.)
1	Core market area	1.08	0.09
2	Govt. bungalows	1.07	0.09
3	Fontainhas (conservation)	0.78	0.05
4	Pato (Commercial	0.40	0.16
5	Mixed residential	3.48	0.17
	Conservation Area (zone 3)	0.90	0.00
	Preservation Area (zone 5)	0.42	0.00
	Total	**8.12**	**0.56**

A brief description of characteristics of each of the five zones is as following:

- Zone 1 – Zone 1 is the core CBD of Panaji. This zone is the main and the largest commercial hub in Goa, which comprises mainly of shops, restaurants, and retail activity. It not only serves the city of Panaji but a larger population from the surrounding areas in the State of Goa. Approximately 51 % of this area is designated as commercial while 15% is public & semi-public, 12% is residential and rest is green.
- Zone 2 – This zone mainly consists of government bungalows. Approximately 45% is designated as residential area while public & semi-public is 20%, 7% is defense and rest are green.
- Zone 3 – This zone is conservation area. It is the oldest Latin quarter of Panaji. This zone is a mix of heritage buildings with a mix of commercial and residential. Approximately 82% is designated as residential area while public & semi-public is 6%, 5% is commercial and rest is green.
- Zone 4 – This zone consists of Pato area which is mainly comprises of office buildings. Approximately 3% is designated as residential, 5% as public & semi-public, 24% as commercial, 10% as transport, warehouse & communication, 16% as green, non-development area is around 10% and rest is parking area. The commercial activity in Pato is mainly based on offices and its supporting retail activity (including courier and restaurants).

- Zone 5 – This is a mixed residential and commercial area. Some important establishments like Caculo mall, PWD office and Sewage treatment plant are part of this zone. Approximately 30% of this area is designated as residential, public & semi-public is 12%, commercial is 14% and rest is preservation & green area.

3.3 Primary Survey Methodology

Data for this study has been collected through 7 different primary surveys. The details of each of these surveys has been presented below.

3.3.1 Wholesaler and Distributor Survey

Wholesalers and distributors were identified through interactions with retailers and other local stakeholders. Varying number of these distributors and wholesalers were interviewed to collect data on the annual inward and outward freight movement as well demand for each of the identified commodities. These interviews also established the total number of wholesalers and distributors for each commodity, located within the municipal limits of the city. Distributors and wholesaler network do not exist for all commodities within the confines of the city and for some commodities these may be located outside the city Municipal limits.

3.3.2 Physical Count of Commercial Establishments

Physical counts of all commercial establishments in the study area of all identified zones was conducted with the help of local students. A total of 10 students and three project team members conducted this survey in the demarcated study areas. A list of commercial establishments (excluding offices and/or service providers such as lawyers, doctors, etc.) for all commodities was prepared for each study area. The number of establishments for each commodity in each study area was extrapolated over the entire zone. This extrapolation is based on area. Commercial establishments physically counted over a smaller study area have been extrapolated over a larger zone area (sperate for each zone) based on the ratio of their areas. Extrapolated numbers have been used to derive zone and city specific commodity wise number of establishments. Additional questionnaire based survey of staff at these commercial establishment was used to generate commodity wise freight traffic and load demand, and the same has been used to establish the overall number of trips, average weight carried and the distance over which the freight load is carried in the city for each category. Images capturing establishment survey has been presented in Figure 3.


Team heads briefing the methodology to all the surveyors


Figure 3: Establishment survey images

3.3.3 Freight Vehicle Parking Survey

As a part of this survey freight vehicles parked on the carriageway were observed and the vehicle type and their registration number recorded. These vehicles could be parked for a short period of time, or for longer duration. Therefore, the survey was repeated three times in a day for all five study areas in all 5 zones. The survey data when extrapolated over the entire zone provides an indication of short, medium- and long-term freight vehicle parking demand (by type of vehicle) in Panaji city. Images capturing parking survey has been presented in Figure 4.


Figure 4: Parking survey images

3.3.4 Commercial Establishment Survey

A questionnaire-based survey was carried out of randomly selected commercial establishment in the study area for each zone. The questionnaire used in this survey has been presented in Annexure 6.2.1. The establishment staff or owner was asked for the details of inward (from wholesaler/distributor/ factory) and outward (to consumer) freight demand. The questionnaire also collected details of the quantity of freight movement by different modes along with number of trips in a year (by the said modes). The survey is designed to provide a commodity wise assessment of freight traffic attracted and generated by each of these establishment. An average number of annual trips, weight per trip and distance of each trip by each vehicle type (for each commodity) has been multiplied by the total establishments for the said commodity in the Panaji Municipal limits, in order to derive the total freight trips generated by each of the commodity per along with the characteristics of these trips.

3.3.5 Consumer Survey

A questionnaire-based survey was carried out of randomly selected consumers. These consumers were approached near the surveyed commercial establishments. The questionnaire used in this survey has been presented in Annexure 6.2.4. The survey included questions on the commodity wise freight

demand of different consumers. The questionnaire also recorded demographic and socio-economic profile of the consumers. This allows the project team to classify consumer freight demand (last mile freight demand) for different socio-economic categories of consumers in Panaji city. The data collected included number of trips and weight of different commodities delivered by retailers or brought home by consumers (on their own from the retailers) and the mode used for this last mile delivery. The data from this survey allows estimation of last mile freight demand for all households in the Panaji Municipal limit.

3.3.6 Freight Traffic Count

Traffic counts were conducted at 15 different junctions (including some on highways at the periphery of the city). These counts were conducted up to 3 times in a day i.e. morning, afternoon and evening. The counts have been conducted using 10-minute videos (for each of the 3 times and 15 locations). In addition, 16-hour traffic counts conducted at 15 junctions in and around the city have been sourced from secondary sources and validated from sample primary survey numbers. All combined the traffic data for 28 junctions in and around Panaji is available. This data provides an insight of location or zone wise temporal demand variation in freight traffic and allows identification of high-volume peak and non-peak hour freight traffic locations. The locations of primary and secondary traffic data counts have been presented in Figure 6. The blue and the red dots denote the locations for secondary 16-hour traffic data, while the yellow rhombus denotes the location of primary video-based traffic data count, conducted for 10 minutes each, 3 times a day. Images capturing parking survey has been presented in Figure 5.

Figure 5: Traffic video images

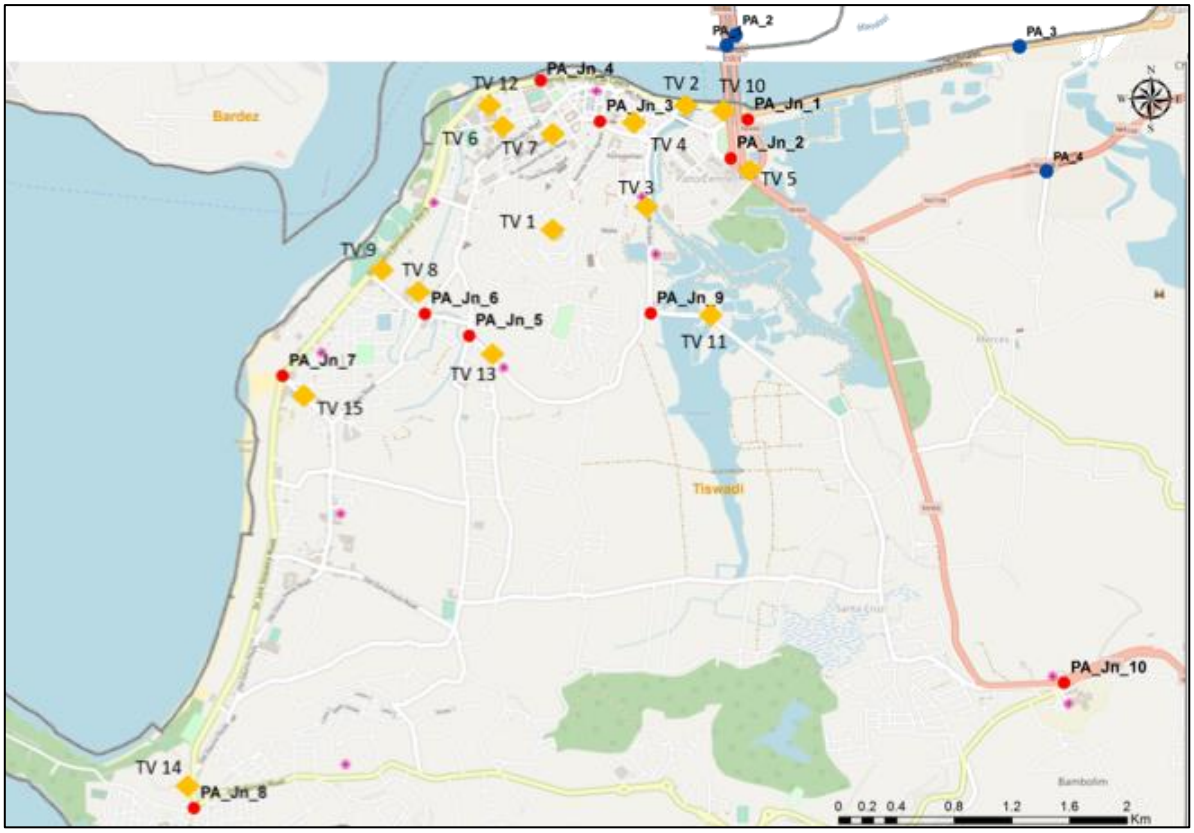

Figure 6: Traffic count locations in and around Panaji City

3.3.7 Driver Survey

Drivers of parked freight vehicles were randomly approached with a questionnaire to collect data for the characteristics of their current freight trip. This data was collected in terms of the load carried by the vehicle, number of daily return trips, total kilometers operated per day, operational number of days per week, age of the vehicle, odometer reading of the vehicle, average number of stops per trip and details of freight being carried by the vehicle. This data allows an insight on the average efficiency in terms of load carried by different freight vehicles for different commodities, the average age of different freight vehicle types, etc. Images capturing parking survey has been presented in Figure 7.

Figure 7: Driver survey images

4 Data and Analysis

Primary data for urban freight traffic and demand at Panaji has been collected through six surveys. The methodology for these surveys has been discussed in the previous chapter. This chapter presents and discusses the data from the surveys. The data has been presented in the two categories (discussed in Chapter 2), i.e. freight transport data based on demand generated by the city, accounting for proportion of trips extending even beyond city limits, and those only accounting for proportion of trips only within the city limits.

4.1 Wholesaler and Distributor Data for Link 1

It is estimated that a total of 130 wholesalers and distributors warehouses exist within the Municipal limits of Panaji. Together these distributors are expected to generate 62944 freight return trips (origin to destination and back to origin – each return trips results in 2 one-way trips) annually, which is 172.45 return trips in a day in the city. These trips are from the identified distributors/wholesalers to the retailers, hotels/offices in the city. The total tonnage carried in a year by these return trips is approximately 63006.3 tons, which is 173 tons per day. Additionally, these wholesalers and distributors attract freight trips from manufacturers or larger hubs from outside the city boundaries.

In addition to trips to the wholesale/distribution network in the city freight trips are made from wholesale/distribution hubs outside the city to and from the retailers in the city. These have been discussed separately in later sections. The commodity and vehicle wise details of urban freight trips (including trip length extending beyond the boundary of the city) involving wholesale/distribution network that exist within the city has been presented in Table 3. The commodity and vehicle wise details of urban freight trips with proportion of trip length limited within the boundary of the city, involving wholesale/distribution network that exist within the city has been presented in Table 4.

Table 3: Commodity wise details of wholesalers/distributors within Panaji city including the freight demand and trips (entire trip length even beyond the city boundary) generated/attracted by them.

S. No.	Commodity	No. of wholesaler /distributors in Panaji	Total number of Inward freight trips in a day	Total weight of supplies delivered in a day (Kg)	Average one-way distance for each trip (Km)	Total kg-km per day	Vehicle type
1	Food grain	6	13.49	13,500	201.5	8,154,623	6 HCV + 3 LCV
2	Perishable	20	31.56	31,720	65.00	3,728,706	12 HCV, 23 LCV
3	FMCG	84	98.63	98,630	660.00	130,191,600	150 LCV
4	Pharmacy	15	20.55	20,550	270.00	11,097,000	25 LCV
5	Liquor	5	8.22	8,220	30.00	493,200	10 LCV

Table 4: Commodity wise details of wholesalers/distributors within Panaji city including the freight demand and trips (portion of trip length limited within the city boundary) generated/attracted by them.

S. No.	Commodity	No. of wholesaler /distributors in Panaji	Total number of Inward freight trips in a day	Total weight of supplies delivered in a day (Kg)	Average one-way distance for each trip (Km)	Total kg-km per day	Vehicle type
1	Food grain	6	13.49	13,500	3.70	1,49,738	6 HCV + 3 LCV
2	Perishable	20	31.56	31,720	3.00	1,72,094	12 HCV, 23 LCV
3	FMCG	84	98.63	98,630	2.50	4,93,150	150 LCV
4	Pharma	15	20.55	20,550	3.90	1,60,290	25 LCV
5	Liquor	5	8.22	8,220	1.50	24,660	10 LCV

4.2 Commercial Establishment Data

Physical count of the commercial establishments in the city of Panaji uses a 7% sample (by land area). This count suggests that the total number of small and big establishments in Panaji city is approximately 6,873. Surveyors physically visited all lanes and by lanes in each of the five study areas in the five identified zones of Panaji, in order to make a commodity wise count of all commercial establishments located at different floors (and streets) of all buildings in the study area. As expected, the largest number and density of commercial or retail establishment is in zone 1 i.e. total of 4,670 units or 4,338 commercial units per sq. km. This followed by Zone 4 (Pato) where the number of commercial units is estimated to be 617 or approximately 1,550 units per sq. km. The lowest number and density of commercial units is in Zone 2 (institutional and government residential zone) at 24 commercial units or 22 units per sq. km. Figure 8 presents the distribution of commercial establishment in different identified zones of Panaji while Table 5 Presents the total number of commercial units along with density of freight attracting commercial in each zone.

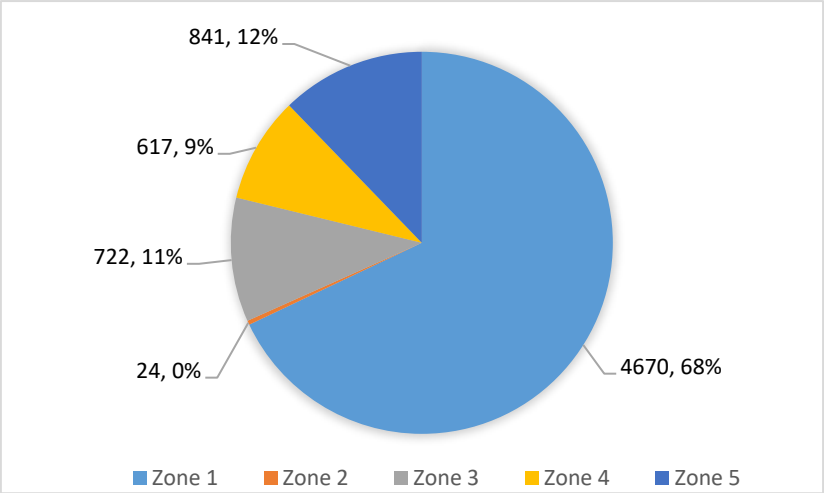

Figure 8: Total number and percentage distribution of commercial units in each of the five identified study zones in Panaji

Table 5: Total number and density of commercial units in each zone (excluding offices).

Zone No.	Total number of units	Density (per sq. km.)
1	4670	4338
2	24	22
3	721	920
4	617	1550
5	841	242

Table 6 and Figure 9 to Figure 14 presents category wise commercial establishments in each zone. Zone 3 has the highest number of establishments in hotel and restaurant, FMCG and printing and publishing categories i.e. 338 and 61 (each) respectively. Zone 4 has highest number of establishments in perishable food category (149) while zone 5 has highest number of hotel and restaurants (300). Highest number of establishments in all other categories are in Zone 1.

Table 6: Category wise number of commercial establishments in each of the five study zones in Panaji

S. No.	Establishment	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Total
1	Food Grains	367	0	0	0	0	367
2	Perishable Food	481	0	31	149	20	681
3	Liquor	73	0	15	28	0	116
4	FMCG	274	0	61	23	80	438

S. No.	Establishment	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Total
5	Couriers & E-comm.	60	0	31	92	0	183
6	Cash	73	0	31	26	40	170
7	Pharmacy	97	12	31	5	40	185
8	Hotel & Restaurant	425	12	338	77	300	1152
9	Solid Waste	24	0	0	5	0	29
10	Construction & Demolition	181	0	15	21	120	337
11	Oil & Natural Gas	24	0	15	0	0	39
12	Clothes & Accessories	724	0	46	62	80	912
13	Electronics	880	0	0	57	40	977
14	Printing & Publishing	171	0	61	72	40	344
15	Sewage	0	0	0	0	1	1
16	Others - Households - toys, utensils	816	0	46	0	80	942
Total		**4670**	**24**	**721**	**617**	**841**	**6873**

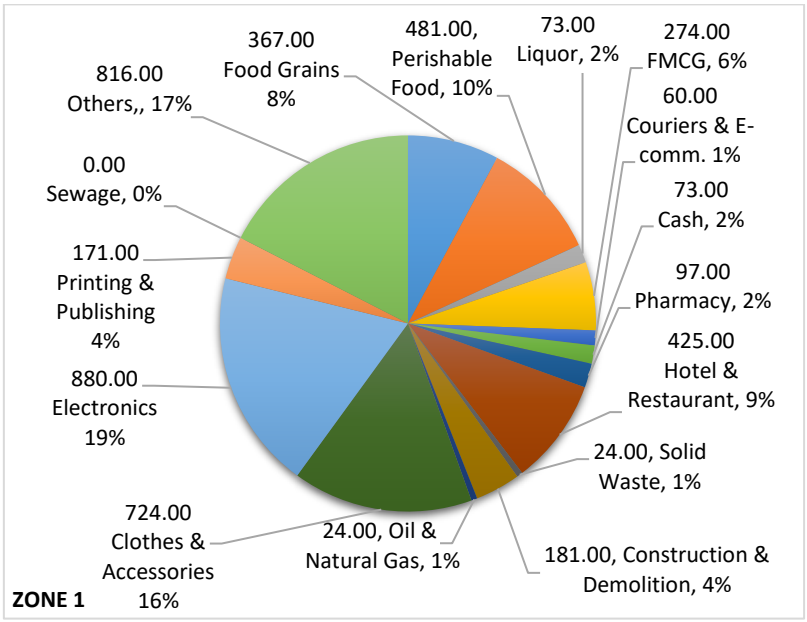

Figure 9: Category wise break up of number of commercial units in Zone 1, Panaji city

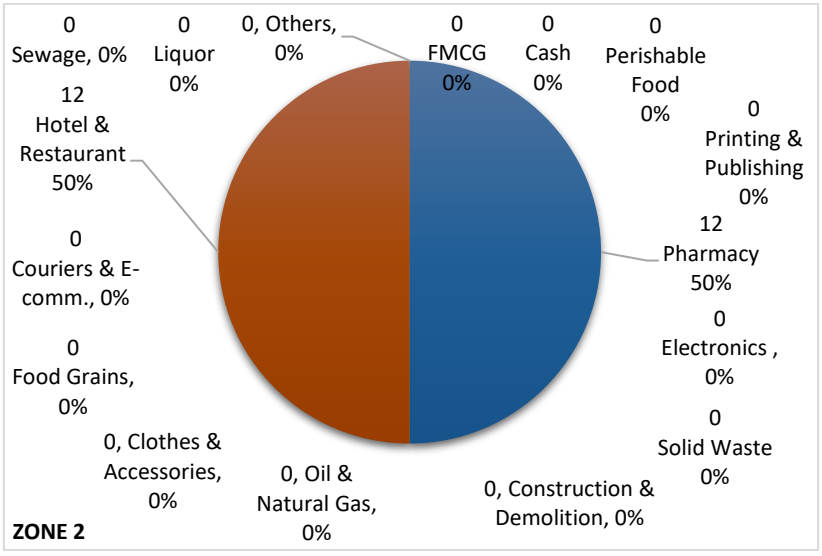

Figure 10: Category wise break up of number of commercial units in Zone 2, Panaji city

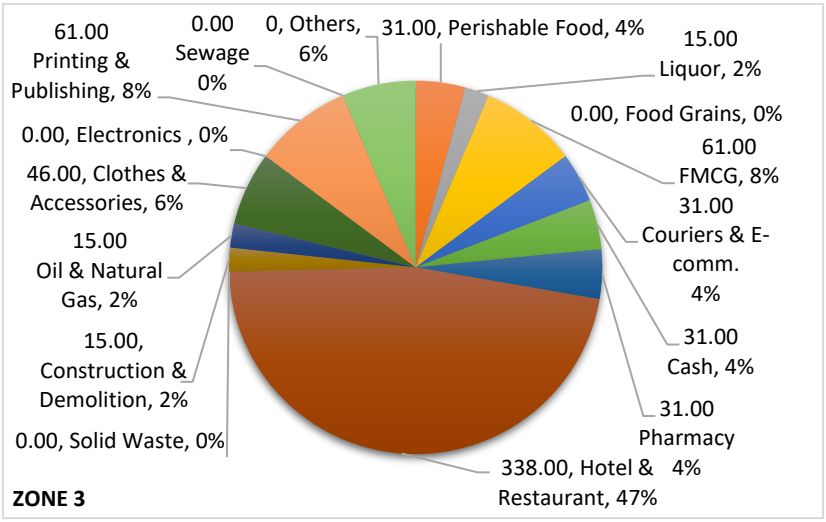

Figure 11: Category wise break up of number of commercial units in Zone 3, Panaji city

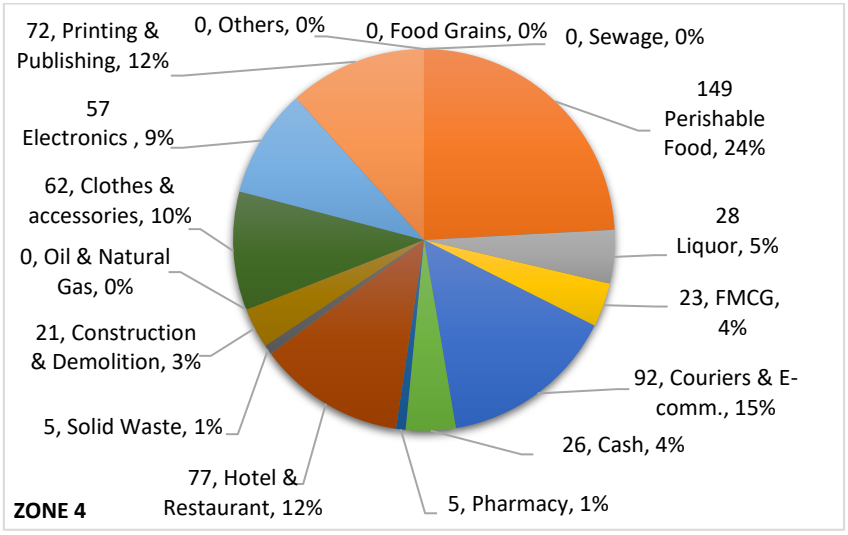

Figure 12: Category wise break up of number of commercial units in Zone 4, Panaji city

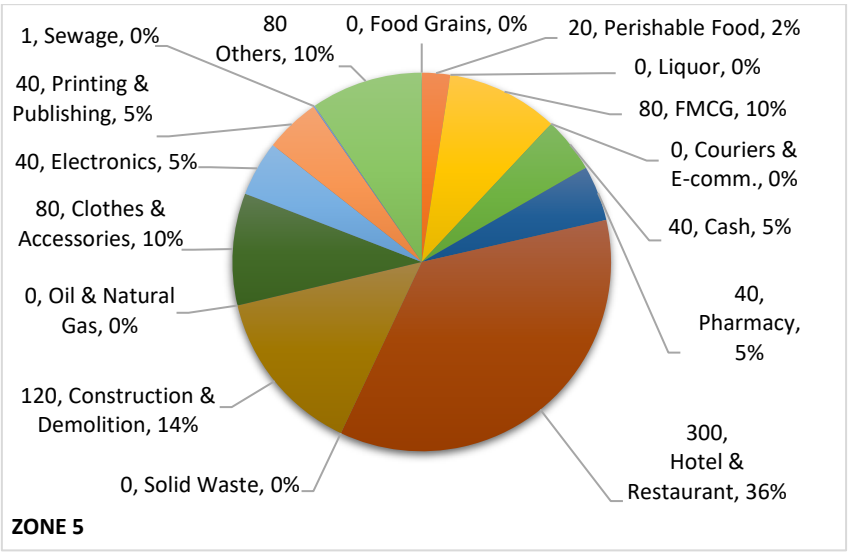

Figure 13: Category wise break up of number of commercial units in Zone 5, Panaji city

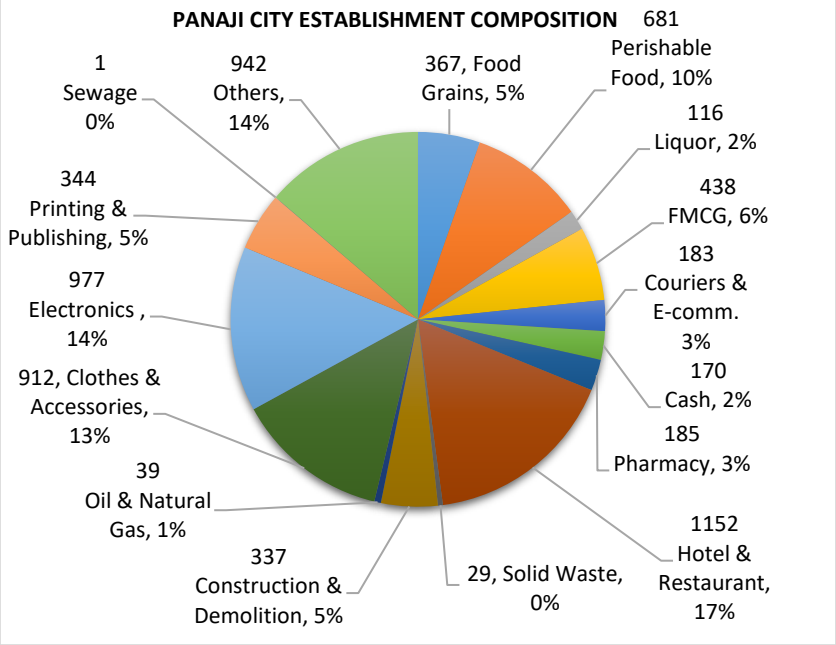

Figure 14: Category wise break up of number of commercial units in overall Panaji City

4.3 Freight Vehicle Parking Data

The parking data collected in the study area for each zone suggests, that majority of freight vehicles park for less than 4 hours throughout the city. It is estimated that a total of 1761 freight vehicles park for less than 4 hours (short term parking) each day throughout the city. This number is 283 for parking duration between 4 to 8 hours (medium term parking) while 216 freight vehicles are estimated to park for more than 8 hours (long term parking) in the city. Assuming that each parking bay can accommodate 4 vehicles parking for less than 4 hours in a day, 2 vehicles parking for between 4 to 8 hours in a day and 1 vehicle parking for more than 8 hours in a day, it is estimated that a total of 11 two wheeler parking bays (2 wheelers carrying freight including e-commerce), 511 car parking bays and 275 truck parking bays need to be provided for freight vehicle parking in the city. Table 7 to Table 12 to present the estimated zone wise freight vehicle parking demand (short, medium and long term), along with total parking bays (vehicle type specific) required in the city.

Table 7: Short, medium- and long-term freight vehicle parking demand in Zone 1

Vehicle Type	<4 Hour	4 to 8 Hour	>8 Hour	Total Bays required[1]
2W	11	0	0	3
Auto Rick.	134	11	11	50
4W Rickshaw	448	67	11	157
Van	78	22	11	42
LCV (1 -3.5T)	146	22	0	48
HCV	11	0	0	3
Multi Axle (7.5-18T)	0	0	0	0
Tanker	11	0	0	3

[1] Number of parking bays required depends on the number of vehicles that need to be parked and the duration of parking. Observed data on the current number of freight vehicles that need to park in a day and maximum duration of their parking, has been used to estimate parking bay requirement such that 1/4th bay is required if parking duration less than 4 hours, 1/2 bay is required if parking duration is between 4 and 8 hours and 1 bay is required if parking duration is more than 8 hours. This is because, if all freight vehicles parks for less than 4 hours, then a single bay can accommodate approximately 4 freight vehicle parking in a day (over a period of 16 hours)

Vehicle Type	<4 Hour	4 to 8 Hour	>8 Hour	Total Bays required[1]
Pickup	22	0	0	6
Car	0	0	0	0

Table 8: Short, medium- and long-term freight vehicle parking demand in Zone 2

Vehicle Type	<4 Hour	4 to 8 Hour	>8 Hour	Total Bays required
2W	0	0	0	0
Auto Rick.	0	0	0	0
4W Rickshaw	0	0	0	0
Van	0	0	0	0
LCV (1-3.5T)	35	0	0	9
HCV (3.5 to 7.5 T)	24	0	0	6
Multi Axle (7.5-18T)	0	0	0	0
Tanker	0	0	0	0
Pickup	0	0	0	0
Car	0	0	0	0

Table 9: Short, medium- and long-term freight vehicle parking demand in Zone 3

Vehicle Type	<4 Hour	4 to 8 Hour	>8 Hour	Total Bays required
2W	29	0	0	7
Auto Rick.	57	0	14	28
4W Rickshaw	115	0	29	58
Van	0	14	0	7
LCV (1-3.5T)	43	0	0	11
Truck	0	0	0	0
HDT (7.5-18T)	0	0	0	0
Tanker	14	0	14	18
Pickup	57	29	0	29
Car	14	0	0	4

Table 10: Short, medium- and long-term freight vehicle parking demand in Zone 4

Vehicle Type	<4 Hour	4 to 8 Hour	>8 Hour	Total Bays required
2W	4	0	0	1
Auto Rick.	4	0	4	5
4W Rickshaw	33	8	8	20
Van	16	4	0	6
LCV (1-3.5T)	0	12	33	39
HCV (3.5 to 7.5 T)	33	0	0	8
Multi Axle (7.5-18T)	8	0	0	2
Tanker	21	0	0	5
Pickup	53	4	12	27
Car	0	0	0	0

Table 11: Short, medium- and long-term freight vehicle parking demand in Zone 5

Vehicle Type	<4 Hour	4 to 8 Hour	>8 Hour	Total Bays required
2W	0	0	0	0
Auto Rick.	0	0	0	0
4W Rickshaw	0	0	0	0
Van	23	0	0	6
LCV (1-3.5T)	68	0	23	40
HCV (3.5 to 7.5 T)	23	0	23	28
Multi Axle (7.5-18T)	0	0	0	0
Tanker	45	45	23	56
Pickup	181	45	0	68
Car	0	0	0	0

Table 12 Presents the overall freight vehicle parking demand for Panaji city.

Table 12: Overall short, medium- and long-term freight vehicle parking demand in Panaji city

Vehicle Type	< 4 Hours	B/w 4-8 Hours	> 8 Hours	Total Bays required
2W	44	0	0	11
Auto Rick.	195	11	29	83
4W Rickshaw	596	75	48	235
Van	117	40	11	60
LCV (1-3.5T)	292	34	56	146
HCV (3.5 to 7.5 T)	91	0	23	45
Multi Axle (7.5-18T)	8	0	0	2
Tanker	91	45	37	82
Pickup	313	78	12	129
Car	14	0	0	4

4.4 Retail Establishment Questionnaire Data for Link 2 and Link 3

Data from retailers has been sorted as per the category of commodity and the vehicle type used to transfer the same. These were then averaged (per establishment) in terms of average weight carried per trip, number of trips per year and the average distance of each trip for all inward trips i.e. from the wholesalers/distributors (for each vehicle type serving each commodity). This number when multiplied by the total number of establishments for each commodity in the city of Panaji, provides an estimate of total urban freight demand and associated emissions for each category in the city. The analyzed data for each commodity classification has been presented below. For each commodity, data has been presented in separate tables for entire trip length of freight trips (including outside city boundaries) and trip length for the proportion of trip limited within city boundary. In each of the categories both inward trips to retailers (link 2) and trips from retailers (trips to other retailer and home deliveries, i.e. link 3) have been presented in separate tables.

4.4.1 Clothes and Accessories

It is estimated that each 'clothes and accessories' establishment in the city of Panaji attracts on an average a total of 3,600 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through seven different modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each establishment in the city has been presented in Table 13 and Table 14 (for total trip length and for portion of trip length within city boundary, respectively).. Total of nine clothes and accessories outlets were included in the study and the sample available for averaging of trip characteristics was 15.

Table 13: Details of each establishment in terms of average weight per trip, average number of trips and average one way distance for each trip by each mode for the commodity – 'clothes and accessories'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	Bus	50.00	4.87	404.67	269.78
2	4W rickshaw	75.00	22.07	22.30	101.15
3	Pickup truck	143.75	7.20	154.38	437.75
4	LCV Truck	112.50	3.20	451.13	444.95
5	Train	50.00	0.40	600.00	32.88
6	Car	175.00	1.00	332.50	159.42
7	2-wheeler	32.00	3.48	4.50	1.37

Table 14: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'clothes and accessories'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	Bus	50.00	4.87	3.50	2.33
2	4W Rickshaw	75.00	22.07	3.50	15.87
3	Pickup truck	143.75	7.20	4.63	13.11
4	LCV Truck	112.50	3.20	3.75	3.70
5	Train	50.00	0.40	1.00	0.05
6	Car	175.00	1.00	1.00	0.48
7	2-wheeler	32.00	3.48	4.50	1.37

It is also estimated that a small proportion of 'clothes and accessories' is delivered home or too other retail establishments. Home deliveries are mostly made by two different types of modes. An average of about 1,040 kg of goods are delivered by each 'clothes and accessories' retail establishment every year. All last mile deliveries by this commodity are expected to be within the Panaji city boundary. Mode wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is presented in Table 15.

Table 15: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'clothes and accessories'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km per day per establishment ([1] X [2] X [3] X 2 / 365)
1	Walk	5.00	2.50	8.00	0.60	0.07
2	Pickup Truck	375.00	125.00	2.67	2.00	3.65

4.4.2 Construction and Demolition

It is estimated that each 'construction and demolition goods' establishment in the city of Panaji attracts on an average a total of 22,549 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through five different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each establishment in the city has been presented in Table 16 and Table 17 (for total trip length and for portion of trip length within city boundary, respectively). Total of five 'construction and demolition goods' outlets were included in the study and the sample available for averaging of trip characteristics was six.

[2] Most of the freight vehicles carry load in one direction and are empty in the other direction. Where the driver carries complete load and offloads it at the end of a one-way trip but returns empty – the average load carried is given by (X+0)/2 = X/2 (where X is the load at the start of the journey). Where the driver makes multiple (or more than one stop in the one way journey) offloading part of the cargo at mid stop (it is assumed that stops are equally spaced and cargo offloaded is of equal weight), and returns empty - the average load is calculated as between (X/1.333 + 0)/2 = X/2.666, for 2 stops (equidistant) (X/2 + 0)/2 = X/4 for infinite stops (equidistant). Since number of stops for hoe deliveries is significantly less than that for inward retail deliveries, a factor of 0.33 is used to estimate average journey weight from start weight for last mile or home deliveries while a factor 0.25 is used to estimate average journey weight for inward deliveries, i.e. driver survey (for trips with more than 1 stops).

Table 16: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'construction and demolition'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	2-wheeler	32.00	19.55	2.50	4.29
2	Van	375.00	6.52	7.50	50.22
3	LCV Truck	175.00	4.50	100.00	215.75
4	Pickup Truck	91.67	97.25	207.00	5055.67
5	4 wheeled rickshaw	750.00	13.04	22.00	589.29

Table 17: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'construction and demolition'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	2-wheeler	32.00	19.55	2.50	4.29
2	Van	375.00	6.52	3.50	23.44
3	LCV Truck	175.00	4.50	3.50	7.55
4	Pickup Truck	91.67	97.25	4.67	113.98
5	4 wheeled rickshaw	750.00	13.04	3.00	80.36

It is also estimated that a small proportion of the construction and demolition goods are home delivered. Home deliveries are mostly made by pick-up trucks and each trip carries on an average 50kg of weight. An average of about 6,087 kg of 'construction and demolition' goods is home delivered per annum (per establishment) by three modes. Modes wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is presented in Table 18 and Table 19 (for total trip length and for portion of trip length within city boundary, respectively).

Table 18: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'construction and demolition'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight $(Kg)^2$ [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	32.00	16.00	0.13	2.00	0.02
2	4 wheeled rickshaw	175.00	87.50	8.69	4.25	17.71
3	Pickup Truck	50.00	25.00	91.25	11.00	137.50

Table 19: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for proportion of trip length limited within city boundary limits)for the commodity – 'construction and demolition'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	32.00	16.00	0.13	2.00	0.02
2	4 wheeled rickshaw	175.00	87.50	8.69	3.00	12.50
3	Pickup Truck	50.00	25.00	91.25	3.00	37.50

4.4.3 Courier and E-commerce

It is estimated that each 'courier and e-commerce' establishment in the city of Panaji attracts on an average a total of 507,958 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through six different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each establishment in the city has been presented in Table 20 and Table 21 (for total trip length and for portion of trip length within city boundary, respectively).

Total of three courier and e-commerce' establishment were included in the study and the sample available for averaging of trip characteristics was 10.

Table 20: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'courier and e-commerce'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	4W Rickshaw	375.00	486.67	62.50	31250.00
2	Pickup Truck	375.00	243.33	110.00	27500.00
3	LCV Truck	375.00	243.33	200.00	50,000.00
4	Van	375.00	243.33	50.00	12500.00
5	Car	375.00	121.67	32.50	4062.50
6	Bus	50.00	121.67	100.00	1666.67

Table 21: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'courier and e-commerce'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	4W Rickshaw	375.00	486.67	3.50	1750.00
2	Pickup Truck	375.00	243.33	3.50	875.00
3	LCV Truck	375.00	243.33	3.50	875.00
4	Van	375.00	243.33	3.50	875.00
5	Car	375.00	121.67	3.50	437.50
6	Bus	50.00	121.67	0.70	11.67

It is also estimated that most of the 'courier and e-commerce' goods are home delivered. Home deliveries are mostly made by five different types of modes. An average of about 486,545 kg of 'courier and e-commerce' goods are home delivered by each establishment every year. Modes wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is

presented in Table 22 and Table 23 (for total trip length and for portion of trip length within city boundary, respectively).

Table 22: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'courier and e-commerce'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	32.00	10.67	851.67	19.00	945.78
2	4W Rickshaw	375.00	125.00	486.67	6.50	2166.67
3	Pickup truck	266.67	88.89	365.00	72.67	12918.52
4	Van	275.00	91.67	486.67	7.50	1833.33
5	Car	375.00	125.00	121.67	13.50	1125.00

Table 23: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for proportion of trip length limited within city boundary limits)for the commodity – 'courier and e-commerce'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	32.00	10.67	851.67	2.57	127.76
2	4W Rickshaw	375.00	125.00	486.67	6.50	2166.67
3	Pickup truck	266.67	88.89	365.00	2.57	456.30
4	Van	275.00	91.67	486.67	3.50	855.56
5	Car	375.00	125.00	121.67	3.50	291.67

4.4.4 Electronics

It is estimated that each establishment dealing in 'electronic' goods in the city of Panaji attracts on an average a total of 15,972 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through five different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each electronics establishment in the city has been presented in Table 24 and Table 25 (for total trip length and for portion of trip length within city boundary, respectively). Total of seven 'electronics' establishment were included in the study and the sample available for averaging of trip characteristics was eight.

Table 24: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'electronics'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	2-wheeler	11.67	152.70	6.17	30.10
2	Walk	5.00	44.69	1.5	0.92
3	Bus	375.00	7.45	600	4591.84
4	4W Rickshaw	750.00	7.45	7.00	107.14
5	LCV truck	750.00	7.45	35.00	535.71

Table 25: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'electronics'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	2-wheeler	11.67	152.70	6.17	30.10
2	Walk	5.00	44.69	1.5	0.92
3	Bus	375.00	7.45	1	7.65
4	4W Rickshaw	750.00	7.45	7.00	107.14
5	LCV truck	750.00	7.45	3.00	45.92

It is also estimated that significant 'electronics' goods are home delivered. Home deliveries are mostly made by four different types of modes. An average of about 14,492 kg of 'electronics' goods are home delivered by each 'electronics' establishment every year. Modes wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is presented in Table 26 and Table 27 (for total trip length and for portion of trip length within city boundary, respectively).

Table 26: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'electronics'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight $(Kg)^2$ [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	32.00	10.67	64.14	4.83	18.12
2	4W Rickshaw	750.00	250.00	7.45	11.00	112.34
3	Pickup truck	375.00	125.00	7.45	6.00	30.61
4	Van	50.00	16.67	22.35	5.50	11.22
5	Bus	375.00	375.00	7.43	10.00	152.64
6	Car	50.00	16.67	29.20	4.50	12.00

Table 27: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for proportion of trip length limited within city boundary limits) for the commodity – 'electronics'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight $(Kg)^2$ [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	11.67	3.89	64.14	4.83	6.61
2	4W Rickshaw	750.00	250.00	7.45	1.00	10.20
3	Pickup truck	375.00	125.00	7.45	6.00	30.61
4	Van	50.00	16.67	22.35	3.00	6.12
5	Bus	375.00	375.00	7.43	1.00	15.26
6	Car	50.00	16.67	29.20	2.00	5.33

4.4.5 FMCG

It is estimated that each establishment dealing in 'FMCG' goods in the city of Panaji attracts on an average a total of 22,849 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through seven different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each 'FMCG' establishment in the city has been presented in Table 28 and Table 29 (for total trip length and for portion of trip length within city boundary, respectively). Total of 24 'FMCG' establishment were included in the study and the sample available for averaging of trip characteristics was 40.

Table 28: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'FMCG'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	104.17	39.10	14.67	163.65
2	Pickup truck	81.25	23.34	36.31	188.70
3	Auto rickshaw	81.25	37.77	36.31	305.33
4	4W Rickshaw	63.89	177.90	8.36	260.36
5	Van	81.25	13.80	11.13	34.18
6	2-wheeler	13.18	87.38	8.36	26.39
7	Car	50.00	3.42	305.75	143.25

Table 29: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'FMCG'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	104.17	39.10	3.08	34.40
2	Pickup truck	81.25	23.34	2.46	12.80
3	Auto rickshaw	81.25	37.77	5.71	48.03
4	4W Rickshaw	63.89	177.90	5.71	177.67
5	Van	81.25	13.80	5.30	16.28
6	2-wheeler	13.18	87.38	4.18	13.20
7	Car	50.00	3.42	0.70	0.33

It is also estimated that a small proportion of 'FMCG is delivered home or too other retail establishments. Home deliveries are made by five different types of modes. An average of about 4,736 kg of goods are delivered by each 'FMCG' retail establishment every year. All last mile deliveries by this commodity are expected to be within the Panaji city boundary. Mode wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is presented in Table 30.

Table 30: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'FMCG'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	7.50	2.50	16.09	2.50	0.55
2	Car	375.00	125.00	10.74	3.50	25.74
3	Pickup truck	375.00	125.00	1.53	10.00	10.50
4	Walk	2.00	0.67	4.59	0.15	0.003
5	Bicycle	5.00	1.67	1.03	1.00	0.01

4.4.6 Food Grain

It is estimated that each establishment dealing in 'food grains' in the city of Panaji attracts on an average a total of 11,080 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through two different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each 'food grain' establishment in the city has been presented in Table 31 and Table 32 (for total trip length and for portion of trip length within city boundary, respectively). Total of two 'food grain' establishment were included in the study and the sample available for averaging of trip characteristics was two.

Table 31: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'food Grain'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	Pickup truck	50.00	26.07	4.00	14.29
2	HCV truck	375.00	26.07	4.00	107.14

Table 32: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'food grain'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	Pickup truck	50.00	26.07	3.50	12.50
2	HCV truck	375.00	26.07	3.50	93.75

It is also estimated that only a fraction of 'food grain' are home delivered. Home deliveries are mostly made by two different types of modes. An average of about 5,475 kg of 'food grain' are home delivered by each 'food grain' establishment every year. Mode wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is presented in Table 33 and Table 34 (for total trip length and for portion of trip length within city boundary, respectively).

Table 33: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'food grain'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight $(Kg)^2$ [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-Wheeler	15.00	7.50	182.50	10.00	75.00
2	Bicycle	15.00	7.50	182.50	0.75	5.63

Table 34: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for proportion of trip length limited within city boundary limits)for the commodity – 'food grain'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight $(Kg)^2$ [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-Wheeler	15.00	7.50	182.50	3.50	26.25
2	Bicycle	15.00	7.50	182.50	0.75	5.63

4.4.7 Hotels and Restaurant

It is estimated that each 'hotel and restaurant' in the city of Panaji attracts on an average a total of 28,414 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through eight different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each 'hotel and restaurant' in the city has been presented in Table 35 and Table 36 (for total trip length and for portion of trip length within city boundary, respectively). Total of 33 'hotels and restaurants' were included in the study and the sample available for averaging of trip characteristics was 56 (only for inbound freight).

Table 35: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'hotel and restaurant'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	125.00	27.59	14.50	137.00
2	Pickup truck	95.45	71.18	5.86	109.15
3	4W Rickshaw	130.00	89.58	8.43	269.05
4	Van	112.50	25.28	13.75	112.50
5	2-wheeler	15.00	200.67	4.53	37.35
6	Car	50.00	6.81	11.38	10.60
7	Walk	5.00	33.18	1.25	0.57
8	Bicycle	15.00	11.06	2.00	0.91

Table 36: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'hotel and restaurant'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	125.00	27.59	2.44	23.05
2	Pickup truck	95.45	71.18	2.79	51.95
3	4W Rickshaw	130.00	89.58	4.01	128.04
4	Van	112.50	25.28	5.25	40.91
5	2-wheeler	15.00	200.67	3.81	31.45
6	Car	50.00	6.81	3.75	3.50
7	Walk	5.00	33.18	1.25	0.57
8	Bicycle	15.00	11.06	2.00	0.91

It is also estimated that only a fraction of food prepared at hotels and restaurants is home delivered. Home deliveries are mostly made by four different types of modes. An average of about 885 kg of food is home delivered by each 'hotel and restaurant' every year. Mode wise weight per trip, average number of trips and average one-way trip distance for home delivery of food is presented in Table 37 and Table 38 (for total trip length and for portion of trip length within city boundary, respectively).

Table 37: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'hotel and restaurant'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight $(Kg)^2$ [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	2.00	1.00	155.00	4.50	3.82
2	Car	50.00	25.00	11.06	4.50	6.82
3	Walk	2.00	1.00	11.06	2.00	0.12
4	Bicycle	2.00	1.00	0.15	2.50	0.002

Table 38: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for proportion of trip length limited within city boundary limits)for the commodity – 'hotel and restaurant'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight $(Kg)^2$ [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	2.00	1.00	155.00	3.15	2.68
2	Car	50.00	25.00	11.06	0.70	1.06
3	Walk	2.00	1.00	11.06	2.00	0.12
4	Bicycle	2.00	1.00	0.15	2.50	0.002

4.4.8 Liquor

It is estimated that each 'liquor' establishment in the city of Panaji attracts on an average a total of 16,729 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through four different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each 'liquor' establishment in the city has been presented in Table 39 and Table 40 (for total trip length and for

portion of trip length within city boundary, respectively). Total of nine 'liquor' establishments were included in the study and the sample available for averaging of trip characteristics was twelve.

Table 39: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'liquor'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	50.00	17.38	22.50	53.57
2	Pickup truck	193.75	57.94	21.88	672.74
3	4W Rickshaw	50.00	40.56	22.50	125.00
4	Auto Rickshaw	50.00	52.14	23.33	166.67

Table 40: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'liquor'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	50.00	17.38	0.70	1.67
2	Pickup truck	193.75	57.94	2.80	86.11
3	4W Rickshaw	50.00	40.56	0.70	3.89
4	Auto Rickshaw	50.00	52.14	0.70	5.00

It is also estimated that only a fraction of liquor is home delivered. Home deliveries are made by 'other' category vehicle which is car. An average of about 3,200kg of 'Liquor' is home delivered every year. All last mile deliveries by this commodity are expected to be within the Panaji city boundary. Mode wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is presented in Table 41.

Table 41: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'liquor'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	Car	200	66.67	16.00	4.67	27.28

4.4.9 Perishable Goods

It is estimated that each 'perishable goods' establishment in the city of Panaji attracts on an average a total of 22,755 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through seven different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each 'perishable goods' establishment in the city has been presented in Table 42 and Table 43 (for total trip length and for portion of trip length within city boundary, respectively). Total of 15 'perishable goods' establishments were included in the study and the sample available for averaging of trip characteristics was 25.

Table 42: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'perishable goods'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	562.50	6.95	600.00	6428.57
2	Pickup truck	50.00	52.14	9.00	64.29
3	Auto rickshaw	50.00	93.86	7.33	94.29
4	4W Rickshaw	50.00	13.90	10.75	20.48
5	Van	50.00	45.19	9.00	55.71
6	2-wheeler	32.00	97.33	5.50	46.93
7	Car	112.50	48.67	106.25	1593.75

Table 43: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'perishable goods'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	562.50	6.95	3.50	37.50
2	Pickup truck	50.00	52.14	1.13	8.10
3	Auto rickshaw	50.00	93.86	7.33	94.29
4	4W Rickshaw	50.00	13.90	0.70	1.33
5	Van	50.00	45.19	5.90	36.52
6	2-wheeler	32.00	97.33	5.50	46.93
7	Car	112.50	48.67	2.00	30.00

It is also estimated that a significant amount of perishable goods is home delivered. Home deliveries are mostly made by four different types of modes. An average of about 16,990 kg of perishable goods is home delivered by each 'perishable goods' establishment every year. Mode wise weight per trip, average number of trips and average one-way trip distance for home delivery of perishable goods is presented in Table 44 and Table 45 (for total trip length and for portion of trip length within city boundary, respectively).

Table 44: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'perishable goods'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	Pickup Truck	562.50	187.50	24.40	3.00	75.21
2	2-wheeler	32.00	10.67	56.40	4.17	13.74
3	4W Rickshaw	50.00	16.67	24.33	15.00	33.33
4	Walk	5.00	2.50	48.67	1.25	0.83

Table 45: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for proportion of trip length limited within city boundary limits)for the commodity – 'perishable goods'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	Pickup Truck	562.50	187.50	24.40	3.00	75.21
2	2-wheeler	32.00	10.67	56.40	4.17	13.74
3	4W Rickshaw	50.00	16.67	24.33	3.00	6.67
4	Walk	5.00	2.50	48.67	1.25	0.83

4.4.10 Pharmacy

It is estimated that each 'pharmacy' in the city of Panaji attracts on an average a total of 48,473 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through seven different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each 'pharmacy' in the city has been presented in Table 46 and Table 47 (for total trip length and for portion of trip length within city boundary, respectively). Total of six 'pharmacies' were included in the study and the sample available for averaging of trip characteristics was 15.

Table 46: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'pharmacy'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	140.00	44.44	139.00	2369.37
2	Pickup truck	158.33	79.04	13.67	468.58
3	Auto rickshaw	212.50	17.38	8.25	83.48
4	Van	375.00	60.83	3.50	218.75
5	2-wheeler	5.00	210.74	4.54	13.09
6	Car	50.00	0.08	16.00	0.18
7	4W Rickshaw	50.00	43.45	5.38	31.99

Table 47: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'pharmacy'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	140.00	44.44	2.50	42.61
2	Pickup truck	158.33	79.04	6.92	237.15
3	Auto rickshaw	212.50	17.38	8.25	83.48
4	Van	375.00	60.83	3.50	218.75
5	2-wheeler	5.00	210.74	4.54	13.09
6	Car	50.00	0.08	2.50	0.03
7	4W Rickshaw	50.00	43.45	4.25	25.30

It is also estimated that only a small proportion of goods from 'pharmacies' are home delivered. Home deliveries are mostly made by two wheelers only. An average of about 386 kg of goods from pharmacy stores is home delivered by each 'pharmacy' establishment every year. All last mile deliveries by this commodity are expected to be within the Panaji city boundary. Mode wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is presented in Table 48.

Table 48: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'pharmacy'

S. No.	Travel mode (freight vehicle)	Average starting weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Average Kg Km Per Day per establishment ([1] X [2] X [3] X 2 / 365)
1	2-wheeler	5.00	2.50	77.13	4.10	4.33

4.4.11 Printing and Publishing

It is estimated that each 'printing and publishing (including stationary)' goods establishment in the city of Panaji attracts on an average a total of 7,691 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through five different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each 'printing and publishing' establishment in the city has been presented in Table 49 and Table 50 (for total trip length and for portion of trip length within city boundary, respectively). Total of 10 'printing and publishing' establishments were included in the study and the sample available for averaging of trip characteristics was 18.

Table 49: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'printing and publishing'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	4W Rickshaw	100.00	20.86	7.33	41.90
2	Pickup truck	100.00	5.21	13.00	18.57
3	Van	50.00	45.36	9.50	59.04
4	2-wheeler	15.00	135.57	9.07	50.54
5	Car	50.00	15.64	22.50	48.21

Table 50: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'printing and publishing'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	4W Rickshaw	2.20	20.86	7.33	41.90
2	Pickup truck	0.07	5.21	0.70	1.00
3	Van	50.00	45.36	0.70	4.35
4	2-wheeler	15.00	135.57	5.21	29.05
5	Car	50.00	15.64	1.85	3.96

It is also estimated that only a fraction of goods from 'printing and publishing' establishments are home delivered. Home deliveries are made by auto rickshaw and car. An average of about 1,082 kg of goods from printing and publishing establishments is home delivered by each establishment every year. All last mile deliveries by this commodity are expected to be within the Panaji city boundary. Mode wise weight per trip, average number of trips and average one-way trip distance for home delivery of goods is presented in Table 51.

Table 51: Details of mode wise last mile (including home delivery) trips (link 3) from each retail establishments (for total trip length of each trip) for the commodity – 'printing and publishing'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg	Average journey weight (Kg)[2] [1]	Average number of trips per year [2]	Average one-way distance for each trip in Km [3]	Avg Kg Km Per Day ([1] X [2] X [3] / 365)
1	4W Rickshaw	50.00	25.00	15.64	6.50	13.93
2	Car	50.00	25.00	6.00	4.00	3.29

4.4.12 Cash

Interview with bankers was conducted to understand the quantum of weight of cash attracted by ATMs. Primary data related to cash could not be directly collected from ATMs because personnel manning them were not willing to provide details due to security concern. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each such establishment in the city has been presented in Table 52.

Table 52: Details of each establishment in terms of average weight per trip, average number of trips and average one way distance for each trip by each mode for the commodity – 'cash'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	Pickup truck	5.00	120.00	4.50	7.40

4.4.13 Others

Establishments included in the others category include mostly those dealing in household goods, toys etc. It is estimated that each such establishment in the city of Panaji attracts on an average a total of 17,436 kg of inbound (from wholesalers/distributors) freight per annum per establishment. This is received by each establishment through two different travel modes. The details of average weight per trip, average number of trips and average (one-way) trip distance for each mode for each such establishment in the city has been presented in Table 53 and Table 54 (for total trip length and for portion of trip length within city boundary, respectively). Total of 3 such establishments were included in the study and the sample available for averaging of trip characteristics was four.

Table 53: Details of mode wise inward delivery trips (link 2) to each retail establishment (for total trip length of each trip) for the commodity – 'others'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	366.67	12.00	600.00	7232.88
2	Pickup truck	750.00	17.38	21.50	767.86

Table 54: Details of mode wise inward delivery trips (link 2) to each retail establishment (for proportion of trip length limited within city boundary limits) for the commodity – 'others'

S. No.	Travel mode (freight vehicle)	Average weight per trip in kg [1]	Average number of trips per year per establishment [2]	Average one-way distance for each trip in Km [3]	Average Kg-Km Per day per establishment ([1]/2 X [2] X [3] X 2 / 365)
1	LCV Truck	366.67	12.00	3.50	42.19
2	Pickup truck	750.00	17.38	3.50	125.00

4.5 Consumer Data for Link 3

Data from consumers has been sorted as per household (HH) income, category of commodity and the mode used for this last mile delivery to bring the commodity home by consumers. These were then averaged (per commodity) in terms of average annual expenditure per trip by each mode, average number of trips per year and the average one-way distance (for each mode serving each commodity). This number when multiplied by the total population as per income level distribution in the city of Panaji, will provide an estimate of total expenditure, urban freight demand generated by each last mile mode and associated emissions for each category in the city. The analyzed data for each commodity classification has been presented below.

4.5.1 Clothes and Accessories

A total of 89 consumer samples were included in the study out of which 82 responded under clothes and accessories commodity across 4 household (HH) income level group. This is brought by each consumer through four different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that to buy 'clothes and accessories' commodity, the consumer prefers to travel by 4-wheeler and 2-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 55. Total of 82 'clothes and accessories' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 16.

Table 55: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'clothes and accessories'

For HH income >1lakh				
S. No.	Travel mode (freight vehicle)	Average expenditure per trip in Rs	Average number of trips per year	Average one-way distance for each trip in Km
1	2-wheeler (7 sample)	2509.27	4.19	2.50
2	4-wheeler (9 sample)	2986.30	9.13	5.22

b) Household Income between 30k to 1lakh

In this income level group, it is observed that to buy 'clothes and accessories' commodity, the consumer majorly travels by 2-wheeler and 4-wheeler followed by walk. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 56. Total of 82 'clothes and accessories' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 31.

Table 56: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'clothes and accessories'

For HH income 30k to 1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (18 sample)	2544.04	6.23	3.51
2	4-wheeler (11 sample)	1447.46	6.20	7.18
3	Walk (2 sample)	3000.00	0.10	2.00

c) Household Income between 10k to 30k

In this income level group, it is observed that to buy 'clothes and accessories' commodity, the consumer prefers to travel mostly by 2-wheeler and only few by 4-wheeler and bus. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 57. Total of 82 'clothes and accessories' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 23.

Table 57: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'clothes and accessories'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (20 sample)	1936.87	6.22	2.88
2	4-wheeler (2 sample)	430.98	2.79	6.50
3	Bus (1 sample)	1000.00	0.17	5.00

d) Household Income lesser than 10k

In this income level group, it is observed that to buy 'clothes and accessories' commodity, the consumer prefers to travel mostly by 2-wheeler and very few by 4-wheeler, walk and bus. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 58. Total of 82 'clothes and accessories' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 12.

Table 58: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'clothes and accessories'

For HH income <10k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (8 sample)	964.06	5.33	2.63
2	4-wheeler (1 sample)	1000.00	1.00	3.00
3	Walk (1 sample)	500.00	0.17	0.50
4	Bus (2 sample)	1240.00	2.08	4.35

The data collected suggests that almost all trips for 'clothes and accessories' commodity under high income group are majorly covered by 4W and 2W whereas middle- and lower-income group trips are by 2W, 4W, walk and bus.

4.5.2 Construction and Demolition

A total of 89 consumer samples were included in the study out of which 12 responded under 'construction and demolition' commodity across 3 household (HH) income level group. Trips for this commodity was made through three different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that for 'construction and demolition' commodity, the consumer chose to bring this commodity by 4-wheeler, 2-wheeler, and truck. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 59. Total of 12 'construction and demolition' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 4.

Table 59: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'construction and demolition'

For HH income >1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	4-wheeler (4 sample)	1125.00	12.00	2.25

b) Household Income between 30k to 1lakh

In this income level group, it is observed that for 'construction and demolition' commodity, the consumer chose to bring this commodity mostly by 4-wheeler followed by truck. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 60. Total of 12 'construction and demolition' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 6.

Table 60: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'construction and demolition'

For HH income 30k to 1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	4-wheeler (5 sample)	829.63	4.50	3.00
2	Truck (1 sample)	250.00	2.00	11.00

c) Household Income between 10k to 30k

In this income level group, it is observed that for 'construction and demolition' commodity, the consumer chose to bring this commodity by 2-wheeler and truck. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 61. Total of 12 'construction and demolition' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 2.

Table 61: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'construction and demolition'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (1 sample)	6000	0.50	3.00

For HH income 10k to 30k				
S. No.	Travel mode (freight vehicle)	Average expenditure per trip in Rs	Average number of trips per year	Average one-way distance for each trip in Km
2	Truck (1 sample)	500	6.00	8.00

d) Household Income lesser than 10k

In this income level group, data for 'construction and demolition' commodity is not available.

The data collected suggests that almost all trips for 'construction and demolition' commodity under high income group are majorly covered by 4-wheeler and very few by truck and 2-wheeler.

4.5.3 Courier and E-commerce

A total of 89 consumer samples were included in the study out of which 50 responded under 'courier and e-commerce' commodity across 4 household (HH) income level group. Trips for this commodity was made through two different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that for 'courier and e-commerce' commodity, the consumer made trips (or received this commodity) by 2-wheeler and van. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 62. Total of 50 'courier and e-commerce' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 10.

Table 62: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'courier and e-commerce'

For HH income >1lakh				
S. No.	Travel mode (freight vehicle)	Average expenditure per trip in Rs	Average number of trips per year	Average one-way distance for each trip in Km
1	2-wheeler (8 sample)	341.51	15.9	2.63
2	2-wheeler (delivered - 1 sample)	461.92	2.4	Not Available
3	Van (1 sample)	1500	5.21	3.00

b) Household Income between 30k to 1lakh

In this income level group, it is observed that for 'courier and e-commerce' commodity, the consumer made trips (or received this commodity) by 2-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 63. Total of 50 'courier and e-commerce' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 22.

Table 63: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'courier and e-commerce'

For HH income 30k to 1lakh				
S. No.	Travel mode (freight vehicle)	Average expenditure per trip in Rs	Average number of trips per year	Average one-way distance for each trip in Km
1	2-wheeler (11 sample)	397.08	8.32	2.90
2	2-wheeler (delivered - 11 sample)	729.05	17.28	Not Available

c) Household Income between 10k to 30k

In this income level group, it is observed that for 'courier and e-commerce' commodity, the consumer made trips (or received this commodity) by 2-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 64. Total of 50 'courier and e-commerce' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 12.

Table 64: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'courier and e-commerce'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (3 sample)	533.33	3	7.67
2	2-wheeler (delivered - 9 sample)	1344.62	5.42	Not Available

d) Household Income lesser than 10k

In this income level group, it is observed that for 'courier and e-commerce' commodity, the consumer made trips (or received this commodity) by 2-wheeler and van. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 65. Total of 50 'courier and e-commerce' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 6.

Table 65: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'courier and e-commerce'

For HH income <10k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (3 sample)	833.33	6	2.33
2	2-wheeler (delivered – 2 sample)	550	4	Not Available
3	Van (1 sample)	500	2	3.00

The data collected suggests that almost all trips for 'courier and e-commerce' commodity is majorly covered by 2W (for both self and delivery) and partly by van.

4.5.4 Solid Waste

A total of 89 consumer samples were included in the study out of which 36 responded under 'solid waste' commodity across 4 household (HH) income level group. Trips for this commodity was made through seven different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that for 'solid waste' commodity, the consumer made trips (or received this commodity) by 2-wheeler, trolley, and truck. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 66. Total of 36 'solid waste' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 6.

Table 66: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'solid waste'

For HH income >1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (1 sample)	0.82	60.83	0.2
2	Trolley (picked - 2 sample)	0.55	243.33	NA
3	Truck (picked - 3 sample)	0.68	243.33	NA

b) Household Income between 30k to 1lakh

In this income level group, it is observed that for 'solid waste' commodity, the consumer made trips (or received this commodity) by 3-wheeler, trolley, and truck. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 67. Total of 36 'solid waste' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 14.

Table 67: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'solid waste'

For HH income 30k to 1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	3-wheeler (1 sample)	4.00	26.07	0.5
2	Trolley (picked - 7 sample)	0.75	234.64	NA
3	Truck (picked - 6 sample)	1.02	160.15	NA

c) Household Income between 10k to 30k

In this income level group, it is observed that for 'solid waste' commodity, the consumer made trips (or received this commodity) by trolley and truck. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 68. Total of 36 'solid waste' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 12.

Table 68: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'solid waste'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	Trolley (picked - 8 sample)	0.78	282.44	NA
2	Truck (picked 4 sample)	0.82	121.67	NA

d) Household Income lesser than 10k

In this income level group, it is observed that for 'solid waste' commodity, the consumer made trips (or received this commodity) by 4-wheeler, trolley, and van. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 69. Total of 36 'solid waste' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 4.

Table 69: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'solid waste'

For HH income <10k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (1 sample)	3.29	91.25	1
2	Trolley (picked - 2 sample)	0.82	182.50	NA
3	Van (picked 4 sample)	1.37	91.25	NA

The data collected suggests that almost all trips for 'solid waste' commodity is majorly served by trolley and truck.

4.5.5 FMCG

A total of 89 consumer samples were included in the study out of which 77 responded under 'FMCG' commodity across 4 household (HH) income level group. This is brought by each consumer through four different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that to buy 'FMCG' commodity, the consumer prefers to travel by 2-wheeler followed by 4-wheeler and walk. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 70. Total of 77 'FMCG' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 16.

Table 70: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'FMCG'

For HH income >1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (12 sample)	313.44	178.69	1.92
2	4-wheeler (3 sample)	773.68	17.06	1.83
3	Walk (1 sample)	250.00	45.63	0.10

b) Household Income between 30k to 1lakh

In this income level group, it is observed that to buy 'FMCG' commodity, the consumer prefers to majorly travel by 2-wheeler followed by 4-wheeler and walk. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 71. Total of 77 'FMCG' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 32.

Table 71: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'FMCG'

For HH income 30k to 1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (20 sample)	391.60	135.49	1.82
2	4-wheeler (7 sample)	374.69	45.49	3.86
3	Walk (4 sample)	315.39	36.22	0.90
4	Auto-rickshaw (1 sample)	2000.00	0.38	3.00

c) Household Income between 10k to 30k

In this income level group, it is observed that to buy 'FMCG' commodity, the consumer prefers to majorly travel by 2-wheeler followed by walk and 4-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 72. Total of 77 'FMCG' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 20.

Table 72: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'FMCG'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (11 sample)	244.19	65.55	2.18
2	4-wheeler (3 sample)	165.62	41.71	1.83
3	Walk (5 sample)	118.40	85.85	0.36
4	Auto-rickshaw (1 sample)	1000.05	2.61	0.50

d) Household Income lesser than 10k

In this income level group, it is observed that to buy 'FMCG' commodity, the consumer prefers to travel by 2-wheeler and walk. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 73. Total of 77 'FMCG' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 9.

Table 73: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'FMCG'

For HH income <10k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (6 sample)	76.10	102.49	0.40
2	Walk (3 sample)	99.72	20.05	1.33

The data collected suggests that almost all trips for 'FMCG' commodity across all 4-income group are majorly carried by 2-wheeler followed by 4-wheeler and walk.

4.5.6 Food Grain

A total of 89 consumer samples were included in the study out of which 5 responded under 'Food Grain' commodity across 4 household (HH) income level group. This is brought by each consumer through two different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that to buy 'Food Grain' commodity, the consumer prefers to travel by 2-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 74. Total of 5 'Food Grain' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 1.

Table 74: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'Food Grain'

For HH income >1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (1 sample)	384.61	156.43	0.90

b) Household Income between 30k to 1lakh

In this income level group, it is observed that to buy 'Food Grain' commodity, the consumer travel (or received this commodity) by walk or by truck. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 75. Total of 5 'Food Grain' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 2.

Table 75: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'Food Grain'

For HH income 30k to 1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	Walk (1 sample)	300.00	52.00	0.3
2	Truck (1 sample)	500.03	52.14	10

c) Household Income between 10k to 30k

In this income level group, it is observed that to buy 'Food Grain' commodity, the consumer prefers to travel by 2-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 76. Total of 5 'Food Grain' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 1.

Table 76: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'Food Grain'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (1 sample)	149.99	104.29	1.00

d) Household Income lesser than 10k

In this income level group, data for 'Food Grain' commodity is not available.

4.5.7 Liquor

A total of 89 consumer samples were included in the study out of which 19 responded under 'liquor' commodity across 4 household (HH) income level group. Trips for this commodity was made through two different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that for 'liquor' commodity, the consumer chose to bring this commodity by 2-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 77. Total of 19 'liquor'

consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 6.

Table 77: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'liquor'

For HH income >1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (6 sample)	1034.35	46.12	2.00

b) Household Income between 30k to 1lakh

In this income level group, it is observed that for 'liquor' commodity, the consumer prefers to travel by 2-wheeler and 4-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 78. Total of 19 'liquor' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 6.

Table 78: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'liquor'

For HH income 30k to 1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (4 sample)	731.55	45.50	2.38
2	4-wheeler (2 sample)	281.92	10.67	4.00

c) Household Income between 10k to 30k

In this income level group, it is observed that for 'liquor' commodity, the consumer prefers to travel by 2-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 79. Total of 19 'liquor' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 3.

Table 79: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'liquor'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (3 sample)	340.93	38.76	1.17

d) Household Income lesser than 10k

In this income level group, it is observed that for 'liquor' commodity, the consumer prefers to travel by 2-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 80. Total of 19 'liquor' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 4.

Table 80: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'liquor'

For HH income <10k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (4 sample)	204.09	116.29	0.75

The data collected suggests that almost all trips for 'liquor' commodity across all income group are covered by 2-wheeler.

4.5.8 Perishable Goods

A total of 89 consumer samples were included in the study out of which 85 responded under 'perishable goods' commodity across 4 household (HH) income level group. Trips for this commodity was made through five different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that for 'perishable goods' commodity, the consumer made trips mostly by 2-wheeler followed by 4-wheeler and walk. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 81. Total of 85 'perishable goods' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 16.

Table 81: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'perishable goods'

For HH income >1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (12 sample)	200.18	335.69	1.90
2	4-wheeler (2 sample)	935.71	11.25	1.20
3	Walk (2 sample)	276.24	68.44	0.10

b) Household Income between 30k to 1lakh

In this income level group, it is observed that for 'perishable goods' commodity, the consumer made trips mostly by 2-wheeler followed by walk, 4-wheeler, and auto rickshaw. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 82. Total of 85 'perishable goods' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 33.

Table 82: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'perishable goods'

For HH income 30k to 1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (22 sample)	196.72	197.52	2.20
2	4-wheeler (4 sample)	103.92	33.91	4.50
3	Walk (6 sample)	244.54	101.12	0.85
4	Auto-rickshaw (1 sample)	501.37	1.58	2.00

c) Household Income between 10k to 30k

In this income level group, it is observed that for 'perishable goods' commodity, the consumer made trips mostly by 2-wheeler followed by walk, 4-wheeler and bus. The details of average

expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 83.

Total of 85 'perishable goods' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 26.

Table 83: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'perishable goods'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (14 sample)	75.41	192.54	1.07
2	4-wheeler (1 sample)	75.21	4.00	1.00
3	Walk (10 sample)	85.95	132.35	0.53
4	Bus (1 sample)	150.01	2.01	3.00

d) Household Income lesser than 10k

In this income level group, it is observed that for 'perishable goods' commodity, the consumer made trips by 2-wheeler and walk. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 84. Total of 85 'perishable goods' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 10.

Table 84: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'perishable goods'

For HH income <10k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (8 sample)	115.83	187.71	2.06
2	Walk (2 sample)	53.02	46.93	0.25

4.5.9 Pharmacy

A total of 89 consumer samples were included in the study out of which 70 responded under 'pharmacy' commodity across 4 household (HH) income level group. Trips for this commodity was made through three different travel modes. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, it is observed that for 'pharmacy' commodity, the consumer made trips mostly by 2-wheeler and 4-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 85. Total of 70 'pharmacy' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 16.

Table 85: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'pharmacy

For HH income >1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (12 sample)	917.43	36.06	0.60
2	4-wheeler (4 sample)	663.22	11.75	3.38

b) Household Income between 30k to 1lakh

In this income level group, it is observed that for 'pharmacy' commodity, the consumer made trips majorly by 2-wheeler, followed by 4-wheeler and walk. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 86. Total of 70 'pharmacy' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 28.

Table 86: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'pharmacy'

For HH income 30k to 1lakh				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (12 sample)	977.17	39.46	1.28
2	4-wheeler (2 sample)	1090.00	1.43	13.75
3	Walk (2 sample)	220.17	2.32	0.47

c) Household Income between 10k to 30k

In this income level group, it is observed that for 'pharmacy' commodity, the consumer made trips majorly by 2-wheeler, followed by walk and 4-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 87. Total of 70 'pharmacy' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 17.

Table 87: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'pharmacy'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (9 sample)	515.47	15.21	1.07
2	4-wheeler (2 sample)	414.29	0.41	1.50
3	Walk (6 sample)	491.59	4.18	0.47

d) Household Income lesser than 10k

In this income level group, it is observed that for 'pharmacy' commodity, the consumer made trips majorly by 2-wheeler, followed by walk and 4-wheeler. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 88. Total of 70 'pharmacy' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 9.

Table 88: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'pharmacy'

For HH income <10k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	2-wheeler (4 sample)	650.00	6.00	2.18
2	4-wheeler (1 sample)	200.00	0.33	1.00
3	Walk (4 sample)	299.81	9.79	0.68

4.5.10 Water

A total of 89 consumer samples were included in the study out of which 7 responded under 'water' commodity across 4 household (HH) income level group. Trips for this commodity was made through one travel mode. The analyzed data for each HH income level classification has been presented below.

a) Household Income greater than 1lakh

In this income level group, data for 'water' commodity is not available.

b) Household Income between 30k to 1lakh

In this income level group, data for 'water' commodity is not available.

c) Household Income between 10k to 30k

In this income level group, it is observed that for 'water' commodity, the consumer made trips (or received this commodity) by water tanker. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 89. Total of 7 'water' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 4.

Table 89: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'water'

For HH income 10k to 30k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	Water tanker (4 sample)	14.73	100.25	2.25

d) Household Income lesser than 10k

In this income level group, it is observed that for 'water' commodity, the consumer made trips (or received this commodity) by water tanker. The details of average expenditure per trip, average number of trips and average (one-way) trip distance for each mode has been presented in Table 90. Total of 7 'water' consumer samples were included in the study and the sample available for averaging of trip characteristics for this income group was 3.

Table 90: Details of average expenditure per trip, average number of trips and average one-way distance for each trip by each mode for the commodity – 'water'

For HH income <10k				
S. No.	**Travel mode (freight vehicle)**	**Average expenditure per trip in Rs**	**Average number of trips per year**	**Average one-way distance for each trip in Km**
1	Water tanker (3 sample)	8.37	126.00	1.33

4.6 Waste Collection Data for Link 4

Data on waste collection (from household and commercial establishments) is available for solid waste and night soil tankers. Study Zone 5 in Panaji has a sewage treatment plant which receives night soil tankers for treatment, most of which are from outside Panaji. The data has been recorded and used for this study as Panaji acts as an attractor for this waste as part of link 4. Additionally, Panaji city generates close to 50 tonnes of solid waste daily, of which close to 42 tonnes is collected daily. The data for night soil tankers has been collected from tanker operators and also through interviews at the sewage treatment plant. Data on solid waste has been collected from the Corporation of the City of Panaji (CCP) office. A total of 23 vehicle owned by CCP are used for home collection of waste and transfer of the same to 68 small composting and 3 bulk composting stations. Most of the fleet of these vehicles are HCV while 1 is tata ace and 3 pickup trucks.

Solid waste is segregated at source in three categories, i.e. natural waste (dry leaves, etc.), wet waste and dry waste. Dry waste is segregated at a sorting facility located in the city, into recyclable and non-recyclable waste. Recyclable waste is sold to vendors, while non-recyclable waste is transported to cement plants. There are three main sources of solid waste, household waste, hotels and restaurants and marketplaces. Household wet waste is partly treated at the compost stations and the rest is transported daily to the bulk composting facility. The dry waste from households is collected twice a week and transported to the sorting stations. Wet waste from hotels and restaurants is transported to the bulk composting facility. The dry waste is transported to the material recovery facility. Part of vegetable waste is composted at the market composting facility. Floriculture waste + Chicken waste + vegetable waste is transported to the bulk composting facility. Table 91 presents the details of different types of solid waste collected.

Table 91: Details of solid waste collected from different sources in Panaji city.

Type of Waste	Quantity Generated (tonnes)	Quantity Collected (tonnes)
Dry Waste (Non- Biodegradable)	7	7
Residential wet waste	9	9
Hotel and rest. wet waste	11	11
Fish/ Chicken waste	2	2
Vegetable/ Floriculture waste	6	6
Garden Waste	9	7
Littered Waste	6	0

4.7 Freight Traffic Count

16-hour junction and mid-block traffic counts data is available for the year 2018-19 for a total of 15 Locations. This data includes classification of freight traffic as only HCV and LCV. Additionally, a classification of vehicle as 3-wheeler is used, but it is not clear if the 3 wheelers counted are passenger or goods three wheelers. To make better sense of this data, the project team recorded 10-minute traffic videos at 3 times a day at 11 locations. A total of 50 videos have been recorded of which 35 could be used to derive traffic data. The analysis of these video recordings provides a detailed arm wise traffic data of the surveyed junctions. For example, it is known that on an average 0.95 percent of 4 wheelers are pickup trucks while 2.76 percent are 4 wheeled rickshaw (Tata Ace or similar). Similarly, it is known that on an average 9.72 percent of 3 wheelers are goods auto rickshaw. This data provides an average relationship of PCU and percentage share of different vehicle types in the traffic mix. It also provides the details of breakup of goods auto percentage in total auto traffic. These values have been used to extract details from existing 16-hour traffic counts (secondary data). Overall, the data provides an understanding of the share of freight traffic in the overall traffic mix, at different times of the day at different locations in the city of Panaji. Location wise average hourly traffic data (total for all directions) has been presented as PCU for both 16 hour counts (PA series) and 10 minute counts (TV series) in Table 92. The traffic data has been presented as average (of 16-hour secondary

data) or projected from 10-minute counts, for total 20 locations, 3 time periods (9:00 am to 11:00am, 11:00am to 5:00pm and 5:00pm to 7:00pm). The data has been presented as total PCU counts (including freight vehicles) and also only freight vehicle PCU counts. The locations of all traffic volume count (of both junctions and mid-block) has been presented in Figure 15.

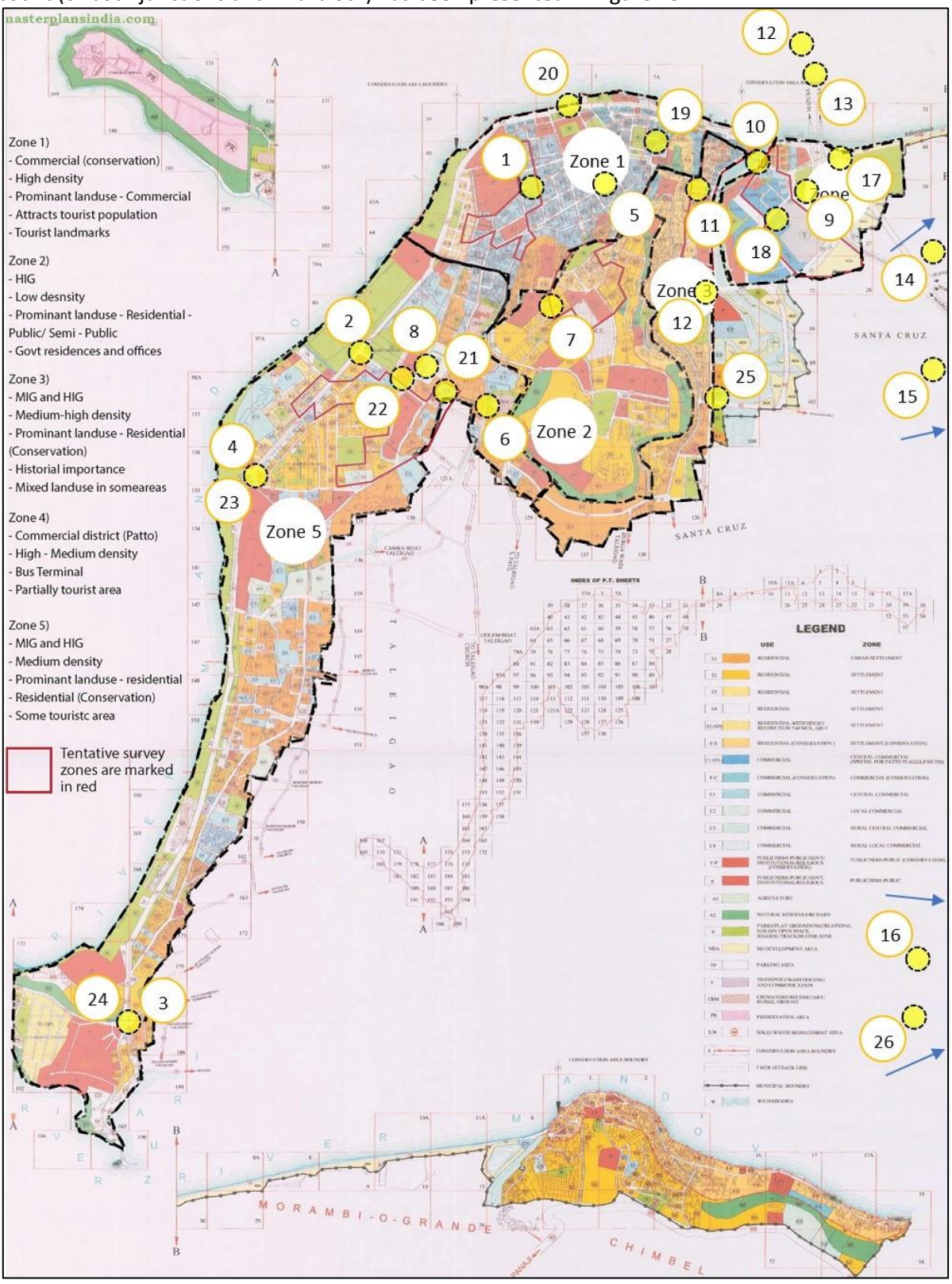

Figure 15: Traffic Volume Count Locations

Table 92: Total hourly traffic and Freight Traffic PCU count for 20 locations of Panaji City

S. No.	Jn. No.	Location name	Mid-block/ Junction	Zone no.	Primary/ secondary data	Survey date	9:00 am to 11:00 am		11:00 am to 5:00 pm		5:00 pm to 7:00 pm	
							Hourly All traffic (PCU)	Hourly Freight Veh. PCU	Hourly All traffic (PCU)	Hourly Freight Veh. PCU	Hourly All traffic (PCU)	Hourly Freight Veh. PCU
1.	TV- 7	MG Road Junction	Junction	1	Primary Data	Nov-19	934.8	28.80	834.00	40.50	1282.80	124.80
2.	TV- 9	Bal Bhawan Chowk	Junction	5	Primary Data	Nov-19	3111.60	43.20	2492.10	270.30	3244.20	165.60
3.	TV- 14	Dona Paula Jn	Junction	5	Primary Data	Nov-19	1423.20	112.50	1401.90	173.70	1450.50	70.50
4.	TV- 15	Miramar Circle	Junction	5	Primary Data	Nov-19	1789.80	120.00	1689.30	243.00	1847.40	156.90
5.	TV- 17	Bombay Bazar Jn	Junction	1	Primary Data	Nov-19	2010.90	197.40	1677.00	52.50	1812.00	76.50
6.	TV- 13	Tambdi Mati	Junction	Near Zone 4	Primary Data	Nov-19	5032.2	718.8	494.4	768.6	5053.2	616.8
7.	TV-1	Altin	Junction	2	Primary Data	Nov-20	1543.8	30	1198.8	127.8	1212	126.6
8.	TV-8	Caculo Circle	Junction	5	Primary Data	Nov-19	5233.2	637.2	4563	450.6	5739.6	504.6
9.	TV-16	Pato near Parking	Junction	4	Primary Data	Nov-19	7884	0	8063	0	7720.8	0
10.	TV-2	Pato Bridge	Junction	3	Primary Data	Nov-19	318.6	26.4	316.2	24	203	6
11.	TV -4	Cortin	Junction	3	Primary Data	Nov-19	3087	273.6	1804	84	2409	50.4
12.	IC-PA-IC_1	Panaji - Mapusa	Mid-block	Atal Setu (Near zone 4)	Secondary Data	2018-19	3527.1	222.90	3485.40	226.31	3387.21	287.16
13.	IC-PA-IC_2	Panaji - Mapusa	Mid-block	First Mondovi Bridge (Near zone 4)	Secondary Data	2018-19	3532.30	703.98	3072.37	801.08	3357.86	592.72
14.	IC-PA-IC_3	Old goa - Panaji	Mid-block	Ponte de Linharse Causeway (Near Zone 4)	Secondary Data	2018-19	1946.95	134.98	1317.01	120.79	1181.30	58.21
15.	IC-PA-IC_4	Panaji - Belagavi Road	Mid-block	Ponda Panaji (Near Zone 4)	Secondary Data	2018-19	256.38	29.75	275.90	50.02	374.91	67.00
16.	IC-PA-IC_5	Santha Cruze - Siridao	Mid-block	(Near Zone 4)	Secondary Data	2018-19	3755.51	607.14	3424.24	645.62	3481.96	532.55
17.	PA-JN-1	Diuvja Circle	Junction	4	Secondary Data	2018-19	4134.94	495.21	3431.55	467.35	4233.61	359.81
18.	PA-JN-2	Front of KTC Bus Stand	Junction	4	Secondary Data	2018-19	5485.08	336.43	3922.05	269.59	3255.62	153.17

S. No.	Jn. No.	Location name	Mid-block/ Junction	Zone no.	Primary/ secondary data	Survey date	9:00 am to 11:00 am		11:00 am to 5:00 pm		5:00 pm to 7:00 pm	
							Hourly All traffic (PCU)	Hourly Freight Veh. PCU	Hourly All traffic (PCU)	Hourly Freight Veh. PCU	Hourly All traffic (PCU)	Hourly Freight Veh. PCU
19.	PA-JN-3	Near Immaculate Conception Church	Junction	1	Secondary Data	2018-19	2682.72	158.17	2668.95	216.97	2647.92	151.51
20.	PA-JN-4	Near Panaji Ferry Terminal	Junction	1	Secondary Data	2018-19	3597.99	381.26	3583.14	383.65	3783.86	291.89
21.	PA-JN-5	Santa Inez Near Candolim Urban Co-operate Bank	Junction	5	Secondary Data	2018-19	1844.74	112.3	1874.13	179.01	2538.08	262.92
22.	PA-JN-6	Caculo Circle	Junction	5	Secondary Data	2018-19	2131.82	250.49	2250.31	256.10	2079.68	200.01
23.	PA-JN-7	Miramar Circle	Junction	5	Secondary Data	2018-19	2535.33	409.82	2872.77	443.64	2618.48	321.57
24.	PA-JN-8	Dona Paula Circle	Junction	5	Secondary Data	2018-19	909.53	83.59	875.91	80.85	905.78	58.63
25.	PA-JN-9	Taleigao Circle	Junction	3	Secondary Data	2018-19	2408.73	208.05	1999.53	180.95	2277.58	149.27
26.	PA-JN-10	Bambolim Junction	Junction	Panvel Kochi Kanyakumari Highway	Secondary Data	2018-19	4383.46	736.34	3286.16	643.30	3449.77	524.72

4.8 Freight Vehicle and Driver Data

Data from driver survey has been sorted as per the category of commodity and the vehicle type used to transfer the same. These were then averaged (per commodity) in terms of average weight carried per trip, number of trips per year and the average (one-way) distance of each trip from the wholesalers/distributors (for each vehicle type serving each commodity). Here average weight carried is derived from data provided on maximum load carried (in both directions), number of stops (in a one-way journey). Most of the freight vehicles carry load in one direction and are empty in the other direction. Where the driver carries complete load and offloads it at the end of a one-way trip but returns empty – the average load carried is given by (X+0)/2 = X/2 (where X is the load at the start of the journey). Where the drive makes multiple (or more than one stop in the one way journey) offloading part of the cargo at mid stop (it is assumed that stops are equally spaced and cargo offloaded is of equal weight), and returns empty - the average load is calculated as (X/2 + 0)/2 = X/4. Here clearly the maximum desirable load carrying capacity is X in both directions. So, when average load is X/4, the efficiency is 25%. The following sub sections present the details of findings of this survey for each vehicle type servicing each commodity type, and also an aggregated vehicle type-based findings.

4.8.1 Clothes and Accessories

The freight vehicle and driver survey could record data from only one sample for clothes and accessories. The vehicle type was LCV and the age of this vehicle surveyed was 1 year. It is observed that freight vehicle carrying 'clothes and accessories' commodity in the city is undertaken by one mode only. The age of transport vehicle is 1 year, odometer reading is 20,000. These vehicles typically undertake one trip (per vehicle) at 100% load capacity (6000kg) in a day in one direction and returns empty. Therefore, the estimated average journey weight for LCV carrying clothes and accessories is (6000+0)/2 = 3,000kg. The details of average journey weight per trip, average number of trips and average (one-way) trip distance for each mode for each establishment in the city has been presented in Table 93.

Table 93: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'clothes and accessories'

S. No	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odo-meter reading (km)
1	LCV	3000	52.14	37	0.14	1	31,080	1	20,000

4.8.2 Construction and Demolition

The freight vehicle and driver survey could record data from 27 samples across six vehicle types used for 'construction and demolition' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day[3] have been presented in Table 94.

[3] This is a measure equivalent to average passenger km used in passenger transport analysis. This measure is derived as a product of average journey weight, average return trip distance and number of return trips in a day. This measure is used because all impact of freight (negative and positive) is related to both weight and distance of transport.

Table 94: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'construction and demolition'

S. No	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odo-meter reading (km)
1	Multi Axle	4625.00	365.00	26.00	1.00	1	240500	8.00	1,74,616
2	LCV	445.25	941.70	13.60	2.58	12	31246	7.22	63545.11
3	3W Rickshaw	34.37	1095.00	3.06	3.00	2	624	16.5	92,500
4	4W Rickshaw	111.45	365.00	15.33	1.00	3	3,403	6.33	80,167
5	Pickup Truck	187.81	865.00	18.60	2.37	8	16,574	5.00	85,427
6	Dumper	1050.00	365.00	5.00	1.00	1	10,500	13	56,780

4.8.3 Courier and E-commerce

The freight vehicle and driver survey could record data from 24 samples across six vehicle types used for 'courier and e-commerce' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 95.

Table 95: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'courier and e-commerce'

S. No	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	HCV	761.80	730.00	11.25	2	2	34,281	8.5	1,125,00
2	LCV	195.62	2828.75	8.80	7.75	4	26683	4	67628
3	Van	284.00	1460.00	25.46	4.00	2	57,845	6.00	78,000
4	4W Rickshaw	197.91	485.45	26.04	1.33	6	13,709	5.83	72,415
5	Pickup Truck	256.43	949.00	19.35	2.60	10	25,802	5.10	86,369

4.8.4 Solid Waste

The freight vehicle and driver survey data has been provided by CCP. The data is available for 23 vehicles operated by CCP, which includes heavy duty trucks and smaller pickup trucks as well 4 wheeled rickshaw. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 96.

Table 96: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'solid waste'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	HCV	262.50	1192.33	6.32	3.27	15	10849.86	6.20	86,914
2	LCV	91.82	1,095.00	5.59	3.00	3	3079.64	6.00	66,440
3	4 Wheeled Rickshaw	77.30	156.43	13.22	0.43	1	439.42	8.00	83,186
4	Pickup truck	63.05	1,034.17	6.96	2.83	3	2483.77	12.00	71,450
5	Multi axle	893.92	1,095.00	1.56	3.00	1	8367.09	12.00	63,994

4.8.5 FMCG

The freight vehicle and driver survey could record data from 47 samples across five vehicle types used for 'FMCG' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 97.

Table 97: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'FMCG

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odo meter reading (km)
1	Van	26	486	14.50	1.33	3	1002.82	8.00	3,80,496
2	HCV	912	365	20.00	1.00	1	36,480	4.00	1,25,000
3	LCV	758	821	17.34	2.25	24	59,147	7.05	1,11,950
5	4W Rickshaw	130	456	13.19	1.25	8	4,287	8.00	63,159
6	Pickup Truck	146	796	13.99	2.18	11	8,906	8.36	86,880

4.8.6 Food Grain

The freight vehicle and driver survey could record data from 3 samples across two vehicle types used for 'food grain' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 98.

Table 98: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'food grain'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Multi Axle	15,000	730	150.00	2.00	1	90,00,000	5.00	2,24,190
2	Pickup truck	150	1460	7.50	4.00	1	9,000	1.00	38,000
3	LCV	225	365	10.00	1.00	1	4,500	10.00	1,29218

4.8.7 Hotel and Restaurant

The freight vehicle and driver survey could record data from 5 samples across one vehicle types used for 'hotel and restaurant' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 99.

Table 99: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'hotel and restaurant'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Two-wheeler	1.15	7519	1.80	20.60	5	85.28	4.40	60,298

4.8.8 Liquor

The freight vehicle and driver survey could record data from 5 samples across three vehicle types used for 'liquor' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 100.

Table 100: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'liquor'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odo-meter reading (km)
1	Pickup truck	125	365	75.00	1.00	1	18,750	1.00	14,700
2	LCV	956	606	27.50	1.66	3	87297	7.00	54,571
3	Van	50	1825	1.20	5.00	1	600.00	3.00	71,646

4.8.9 Perishable Goods

The freight vehicle and driver survey could record data from 31 samples across seven vehicle types used for 'perishable goods' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 101.

Table 101: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'perishable goods'

S. No	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odo-meter reading (km)
1	HCV	1331	485.45	18.67	1.33	3	66,080	9.00	51,150
2	LCV	239	646.05	10.21	1.77	9	8,634	6.11	78,568
3	3W Rickshaw	79	850.45	3.80	2.33	3	1,402	9.00	54,351
4	4W Rickshaw	301	638.75	16.38	1.75	4	17,256	4.75	19,901

S. No	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odo-meter reading (km)
5	Pickup Truck	268	1175	28.44	3.22	9	49,085	6.37	4,03,898
6	2-wheeler	6	365	27.50	1.00	2	350	2.5	7,500
7	Van	120	365	2.5	1.00	1	600	10.00	1,04,615

4.8.10 Pharmacy

The freight vehicle and driver survey could record data from 2 samples across two vehicle types used for 'pharmacy' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 102.

Table 102: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'pharmacy'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Pickup truck	369	365	28	1	1	20,664	3.00	1,07,541
2	LCV	500	365	40	1	1	40,000	4.00	65,277

4.8.11 Sewage

The freight vehicle and driver survey could record data from 3 samples across one vehicle types used for 'sewage' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 103.

Table 103: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'sewage'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Dumper	989	486	11.67	1.33	3	30,701	8.66	1,10,000

4.8.12 Electronics

The freight vehicle and driver survey could record data from 2 samples across two vehicle types used for 'electronics' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 104.

Table 104: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'electronics'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Pickup truck	150	1095	9	3	1	8,100	4.00	60,000
2	4W Rickshaw	88	1460	5	4	1	3,520	17.00	1,21,894

4.8.13 Cash

The freight vehicle and driver survey could record data from 1 samples across one vehicle types used for 'cash' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 105.

Table 105: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'cash'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Pickup truck	375	2190	2	6	1	9,000	10.00	2,71,533

4.8.14 Printing and Publishing

The freight vehicle and driver survey could record data from 1 samples across one vehicle types used for 'printing and publishing' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 106.

Table 106: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'printing and publishing'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	4W rickshaw	140	1095	2.2	3	1	1,848	2.00	11,509

4.8.15 Oil & Natural Gas

The freight vehicle and driver survey could record data from 8 samples across five vehicle types used for 'oil & natural gas' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 107.

Table 107: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'oil and natural gas'

S. No	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Pickup truck	516	365	32.25	1.00	2	33,282	2.00	10,885
2	4W rickshaw	70	730	25.00	2.00	1	7,000	6.00	1,77,900
3	Fuel Tanker	4,400	730	37.00	2.00	2	6,51,200	3.00	1,46,541
4	HCV	1,022	365	15.00	1.00	1	30,660	17.00	1,71,768
5	LCV	1,022	365	9.00	1.00	2	18,396	12.00	1,42,406

4.8.16 Water supply

The freight vehicle and driver survey could record data from 16 samples across one vehicle types used for 'water (unbottled)' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 108.

Table 108: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'water supply'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Water tanker	2,330	1664	5.20	4.56	16	1,10,498	7.80	64,521

4.8.17 Others

The freight vehicle and driver survey could record data from 13 samples across four vehicle types used for 'all other commodity' related freight. The details of average journey weight per trip, average number of trips, average (one-way) trip distance and average kg km per day have been presented in Table 109.

Table 109: Details of average weight per trip, average number of trips per year, average return distance for each trip, etc. by each travel mode for the commodity – 'others'

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average age (years)	Average odometer reading (km)
1	Pickup truck	192	883	76.88	2.42	3	71,443	4.66	77,033
2	3W rickshaw	138	1095	3.13	3.00	2	2,592	13.50	63,758
4	4W rickshaw	145	1643	16.17	4.50	4	21,102	6.00	3,72,942
5	LCV	350	639	16.67	1.75	4	20,421	16.66	4,92,205

4.8.18 Vehicle Type Specific Data/Analysis

Total of 193 vehicle/drivers were surveyed covering a total of 11 vehicle type for 16 different commodities. The sample size of freight vehicle when divided commodity wise is not sufficient to provide a reliable mean values. However, when grouped by vehicle types across commodities (except waste collection) acceptable sample for most vehicle type emerges. The weighted average values of Kg Km, age, journey weight, etc., per vehicle type can be used in conjunction with data from other surveys, to derive findings and outcomes, such as daily number of vehicle specific trips expected for each commodity for each of three links. Table 110 presents the weighted average values for each vehicle type across commodities[4].

Table 110: Weighted (per vehicle) average values for each vehicle type across commodities

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average number of trips per year	Average return journey distance (km)	No. of return trips per day	Sample size	Average kg km per day	Average daily run in km	Average age (years)	Average odo meter reading (km)
1	3W Rickshaw	83.00	990.19	3.40	2.71	7	1530	18.43	12.43	67938
2	4W Rickshaw	165.82	716.74	16.79	1.96	28	10934	65.94	6.64	109391
3	Dumper	626.57	833.00	13.34	2.28	7	38151	60.89	8.57	83124
4	Fuel Tanker	4400.00	730.00	37.00	2.00	2	651200	148.00	3.00	146541
5	HCV	1193.83	547.04	14.73	1.50	8	52698	48.75	8.63	68517
6	LCV	598.45	885.57	16.35	2.43	61	47496	80.62	7.43	115718
7	Multi Axle	9812.5	365.00	88.00	1.00	2	1727000	264.00	6.50	199403
8	Pickup Truck	226.23	929.06	24.35	2.55	48	28044	120.92	5.78	143386
9	Van	116.57	938.29	14.02	2.57	7	8399	72.05	7.00	210536
10	2-Wheeler	7.10	144.40	9.14	0.40	7	51	274.29	4.46	45213
11	Water Tanker	2330.00	1664.00	5.20	4.56	16	110498	47.42	7.80	64521

[4] It is important to note, that this is a simple average of all vehicles in a category and is not a weighted by the number of establishments in each commodity. This is because there is not sufficient data for a commodity wise representative sample.

5 Findings and Low Carbon Action Plan

This section presents the findings from the analysis of data collected from both primary and secondary sources in Panaji city. Based on these findings a set of recommendations have been made. These recommendations are targeted to achieve reduction in any negative externalities of freight movement on the city of Panaji.

5.1 Findings

This section presents the findings from the freight traffic demand data collected for the city of Panaji. These findings have been presented for the three freight delivery links, and both for the entire trip length of freight trips as well that for portion of the trip length limited within city boundaries. Additionally, findings from the utilization of freight vehicles and the impact of freight traffic on the overall Panaji city traffic has been discussed.

5.1.1 First Mile Freight Traffic (to wholesalers/distributors) – Link 1

Analysis for Link 1 using data presented in Section 4.1 suggests that a total of approximately 173 tonnes of freight is supplied to about 130 wholesalers/distributors in the city. This is achieved by approximately 18 HCV and 211 LCV vehicles in a day. The total distance travelled (to and from, between logistics hub or manufacturer and the wholesalers located within the city boundary) by these freight vehicles per day is 1,51,321 km. Of this, the total distance travelled by these vehicles within the Panaji boundary is about 967 km. This amounts to about 1,53,665 tonne-km achieved per day (for the whole trip length), of which about 1000 tonne-km is achieved within the city boundary (and the rest is outside the municipal boundary). This data is presented in Table 111 for total trip length of these trips (including the component of trip length outside city boundary) and in Table 112 for segment of trip length limited within city boundary.

Table 111: Mode wise details of inward freight delivery to wholesalers when the entire trip length is accounted for

S. No.	Travel mode (freight vehicle)	Total kg-km attracted for Panaji per day	Total weight delivered per day (kg)	Total trips per day	Total distance covered per day (km)
1	LCV	14,63,28,865.03	1,42,400.00	152.94	1,46,328.87
2	HCV	73,36,264.30	30,220.00	19.51	4,991.86
Total		**15,36,65,129.33**	**1,72,620.00**	**172.45**	**1,51,320.73**

Table 112: Mode wise details of inward freight delivery to wholesalers when only the segment of trips within Panaji boundary are accounted for

S. No.	Travel mode (freight vehicle)	Total kg-km attracted for Panaji per day	Total weight delivered per day (kg)	Total trips per day	Total distance covered per day (km)
1	LCV	8,37,602.38	1,42,400.00	152.94	837.60
2	HCV	1,62,329.24	30,220.00	19.51	129.67
Total		**9,99,931.62**	**1,72,620.00**	**172.45**	**967.27**

5.1.2 Freight Traffic to Retail Establishments

Data from Commercial establishment count (Section 4.2), retail establishment survey (Section 4.4) and freight vehicle/driver survey (Section 4.8) has been used to derive the total inward demand of

freight traffic to retail establishments in Panaji City. In order to establish this, the following analysis has been undertaken:

- All freight traffic using private modes such as two wheelers, cars, bicycle and walk have been considered as single establishment specific trip, i.e. the total load carried in a journey is for one establishment only.
- All freight traffic using commercial vehicles such as LCV, HCV, pick-up truck, etc., are considered to possibly serving more than one retail outlet in each trip (as established through freight vehicle/driver survey).
- Number of freight trips and aggregated kg km of these trips per private vehicle per establishment per day have been generated through the product of per private vehicle per retail establishment (for each commodity) per day kg km data (Section 4.4) and number of commercial establishments per commodity data (Section 4.2).
- Similarly, total weight of freight transported per private mode per commodity per day is derived through the product of average per private mode per commodity per day per establishment weight carried (Section 4.4) and total commercial establishments per commodity in the city.
- For freight carried by commercial vehicles (for each commodity), the mean per day per mode per establishment weight delivered (Section 4.4) is divided by, mean per day weight delivered by the said transport mode as derived in the freight vehicle/driver survey (Section 4.7). This provides the per day per mode per establishment vehicle trips attracted by each commodity. This value when multiplied by the total number of establishments for each commodity (in the city) provide the total number of daily freight trips attracted by each commercial transport mode for each commodity per day in the city.

Similarly, total weight of freight carried per commercial vehicle type per day for each commodity is derived by multiplying the per commercial vehicle freight weight carried per day per retail establishment for each commodity by the number of those category of establishments in the city. This data has been presented in Table 113 for the total trip length of the (freight) journey, i.e. from wholesalers/distributors/other retailers to retailers and in Table 114 for trip length limited to Panaji city boundary.

Table 113: Total freight carried by commercial vehicles (for the entire trip length of the trip) in the 2nd link (supply to retailers) in Panaji City

S. No.	Travel mode (Freight Vehicle)	Average Journey weight per trip kg	Average age (years)	Average odometer reading (km)	Total kg km attracted for Panaji per day	Total kg delivered per day	Average Trips per day	Total distance covered per mode per day (km)
1	3W Rickshaw	83.00	12.43	67,938.43	2,47,135.85	17,104.90	25.79	745.19
2	4W Rickshaw	165.82	6.64	1,09,390.64	65,72,612.78	1,73,052.15	281.27	20,037.26
3	Fuel Tanker	4,400.00	3.00	1,46,541.00	66,60,000.00	90,000.00	10.23	757.02
4	HCV	1,193.83	8.63	68,517.25	39,321.43	9,830.36	2.06	16.47
5	LCV	598.45	7.43	1,15,718.12	2,20,17,169.33	1,00,184.04	41.85	18,395.15
6	Pickup Truck	226.23	5.78	1,43,385.65	82,88,598.19	1,30,787.09	144.53	18,319.03
7	Van	116.57	7.00	2,10,535.57	25,41,543.68	76,244.99	163.52	10,901.23
8	2-Wheeler	7.10	4.46	45,212.86	1,38,454.53	24,768.62	1,589.88	14,169.65
9	Car	NA	NA	NA	2,065,748.57	35,545.64	194.67	28,584.72
10	Bicycle	NA	NA	NA	1,047.27	523.64	34.91	139.64
11	Walk	NA	NA	NA	1,551.79	1,121.80	224.36	364.70

S. No.	Travel mode (Freight Vehicle)	Average Journey weight per trip kg	Average age (years)	Average odometer reading (km)	Total kg km attracted for Panaji per day	Total kg delivered per day	Average Trips per day	Total distance covered per mode per day (km)
12	Bus	NA	NA	NA	50,37,261.82	11,135.04	93.10	45,968.02
13	Train	NA	NA	NA	29,983.56	49.97	1.00	1,199.34
Total		NA	NA	NA	5,36,40,428.82	6,70,348.24	2,807.15	1,59,597.41

Table 114: Total freight carried by commercial vehicles (for proportion of trip length limited within the city boundary) in the 2nd link (supply to retailers) in Panaji City

S. No.	Travel mode (Freight Vehicle)	Average Journey weight per trip kg	Average age (years)	Average odometer reading (km)	Total kg km attracted for Panaji per day	Total kg delivered per day	Average Trips per day	Total distance covered per mode per day (km)
1	3W Rickshaw	83.00	12.43	67,938.43	1,15,686.45	17,104.90	25.79	348.83
2	4W Rickshaw	165.82	6.64	1,09,390 .64	6,97,845.86	1,73,052.15	281.27	2,277.30
3	Fuel Tanker	4,400.00	3.00	1,46,541.00	6,30,000.00	90,000.00	10.23	71.61
4	HCV	1,193.83	8.63	68,517.25	34,406.25	9,830.36	2.06	14.41
5	LCV	598.45	7.43	1,15,718.12	3,25,891.39	100,184.04	41.85	272.28
6	Pickup Truck	226.23	5.78	1,43,385.65	4,59,265.33	130,787.09	144.53	1,015.04
7	Van	116.57	7.00	2,10,535.57	2,89,121.03	76,244.99	163.52	1,240.10
8	2-Wheeler	7.10	4.46	45,212.86	1,18,487.14	24,768.62	1,589.88	11,401.03
9	Car	NA	NA	NA	1,06,469.59	35,545.64	194.67	1,016.79
10	Bicycle	NA	NA	NA	1047.27	523.64	34.91	139.64
11	Walk	NA	NA	NA	1,551.79	1,121.80	224.36	364.70
12	Bus	NA	NA	NA	11,740.04	11,135.04	93.10	210.40
13	Train	NA	NA	NA	49.97	49.97	1.00	2.00
Total		NA	NA	NA	27,91,562.11	6,70,348.24	2,807.15	18,374.13

Table 113 and Table 114 presents the total goods delivery in link 2 for all retail commercial establishments in Panaji City (for entire trip length and for proportion of trip length within city boundary respectively). Following are the key findings for freight delivery in Link 2 for Panaji.

- The total weight of goods delivered to retail establishments in Panaji is estimated to be 670 tonnes per day. These deliveries are made by a total 2,807 freight trips (per day) made by 13 different modes.
- Total freight demand (for inward delivery to retail) in Panaji city in terms of overall kg-km of freight traffic per day is to the tune of 5.36 crore kg-km, of which 0.28 crore kg-km is achieved within the city boundary, and the rest is outside. However, this demand is generated by activities within the city boundary only.
- A total of about 1,59,597 km of inward freight delivery (to retail establishments) journeys are undertaken per day by all freight modes put together. Of this about 18,374 km of cumulative freight delivery distance is covered within the city boundary, while the rest is outside.
- Largest proportion of the total freight weight delivered in the city is by '4 wheeled rickshaw' (25.82%) followed by 'pickup truck' (19.51%) (Figure 17).

- 4W rickshaws are estimated to deliver an average of 254 kg (per establishment) over an average return trip distance of 78 km (for total trip length, including outside city boundary). Majority of these trips service courier as well hotels and restaurant type establishments.
- Largest proportion of goods delivered over total trip length of delivery in terms of kg-km is by 'LCV' (41%) followed by 'Pickup Truck' (15%) (Figure 16). Majority of these deliveries by 'LCV' (in terms of total kg-km) are for 'courier and e-commerce.'
- 'LCV's' are estimated to deliver on an average of 298 kg per establishment and each return trip is expected to be for an average length of 344 km.
- If only the segment of trip length within the boundary of Panaji city is accounted for, majority of deliveries in terms of total kg-km are by '4W rickshaw' and 'fuel tanker' i.e. 25% and 22.57% respectively. (Figure 20).
- '4W rickshaws' are expected to deliver about 254 kg per trip while 'fuel tanker' are estimated to deliver an average of 9000 kg per trip. The average return trip length for both the modes within the city boundary is estimated as 7.8 km and 7km respectively.
- Largest number of freight trips are made by 'Two Wheelers' (57%). This is followed by '4W rickshaw' (10%), (Figure 18). Maximum number of trips made by 'two wheelers' is for the 'pharmacy' and 'hotel and restaurant' category of establishments.
- 'Two Wheelers' are estimated to ferry an average of 14.2 kg for an average return distance of 10 km if total trip length is evaluated and about 8 km if proportion of trip within city boundaries is considered.
- Maximum proportion of total cumulative one way distance of travel (when total trip length is considered) by freight modes (for Panaji) is by 'Bus'[5] (29%) this is followed by (private) 'Car' (18%) (Figure 19).
- Maximum cumulative distance of freight trips undertaken by Bus is for 'electronics' commodity. An average of 68 kg is delivered by this mode over an average return journey distance of 278 km per trip (across all commodities).
- When only the proportion of trip length limited within city boundary is considered, the maximum proportion of cumulative total distance covered by freight modes is by 'two wheeler' (62%) followed by '4W rickshaw' (12%) (Figure 21).
- Maximum distance of cumulative freight trips (within the city boundary) by 'two wheelers' is undertaken for 'hotels and restaurant' segment. An average of 14.2kg is delivered by this mode over an average return distance of 7.98 km per trip.

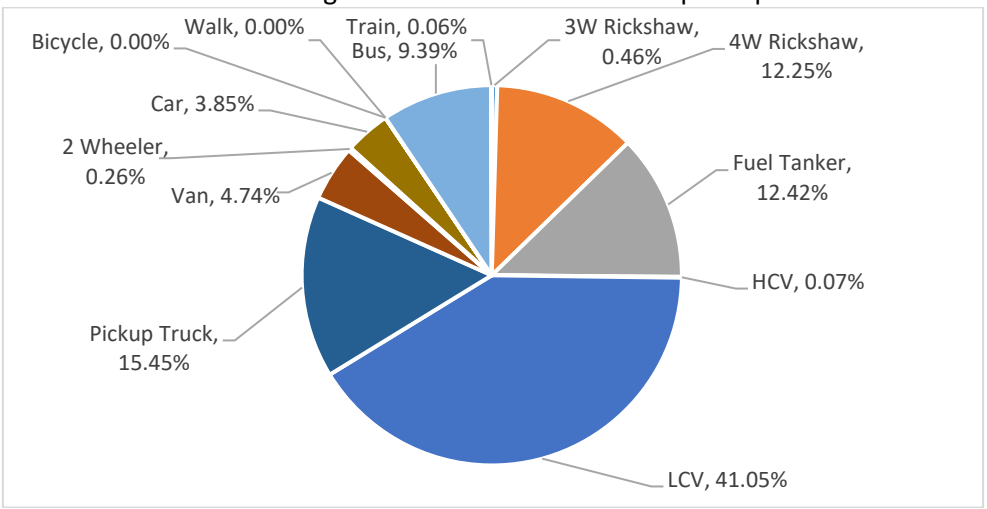

Figure 16: Mode wise distribution of freight demand - weight carried and distance over which it is carried (entire trip length) in kg-km

[5] Freight delivery by Bus can be both with or without the passenger and is usually undertaken in the luggage compartment on non-urban bus services

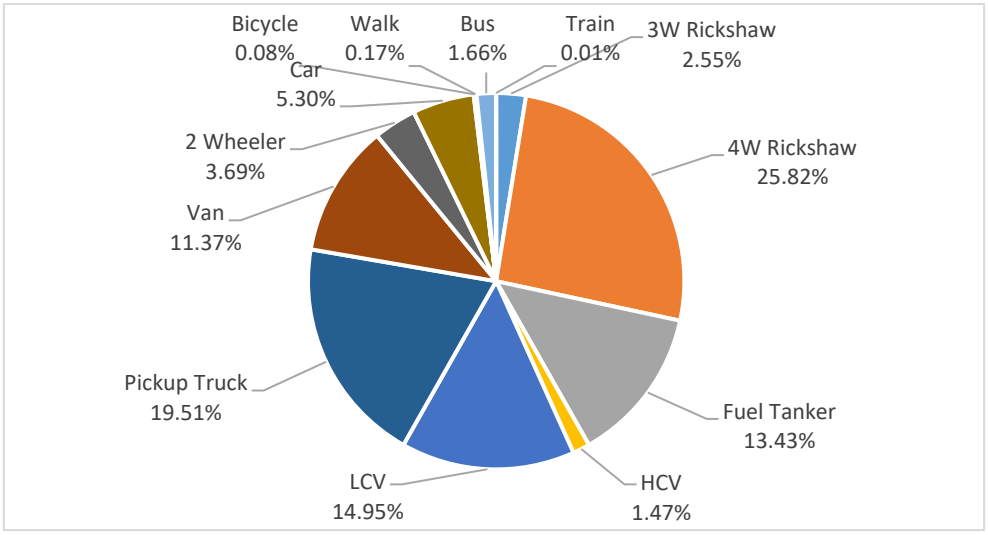

Figure 17: Mode wise distribution of goods delivered in terms of aggregated weight of goods delivered per day

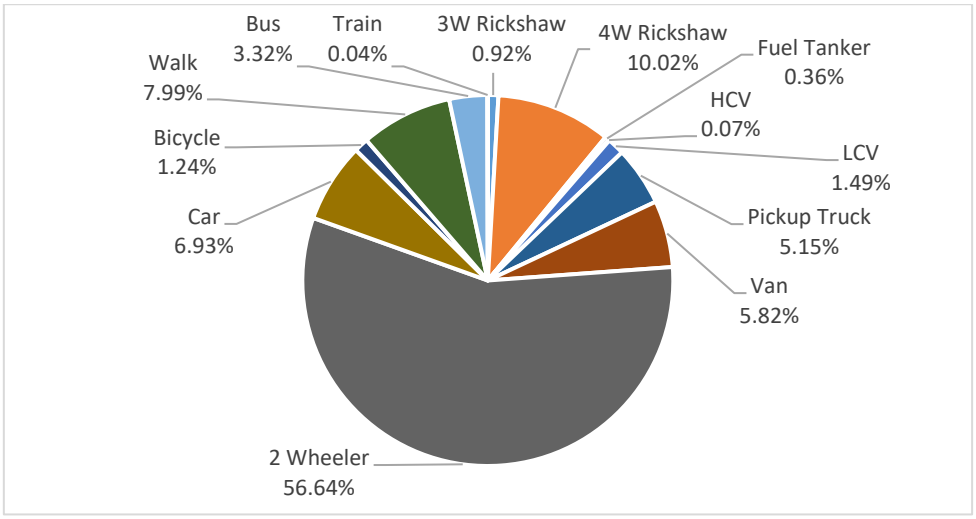

Figure 18: Mode wise distribution of freight Trips to retail establishment

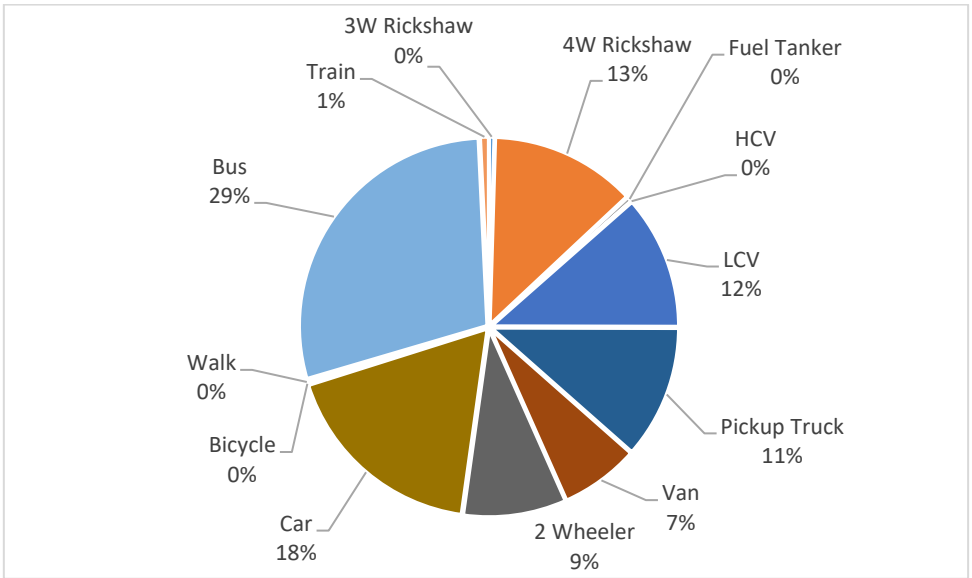

Figure 19: Mode wise distribution of total distance covered by different modes while delivering to retail establishments (entire trip length)

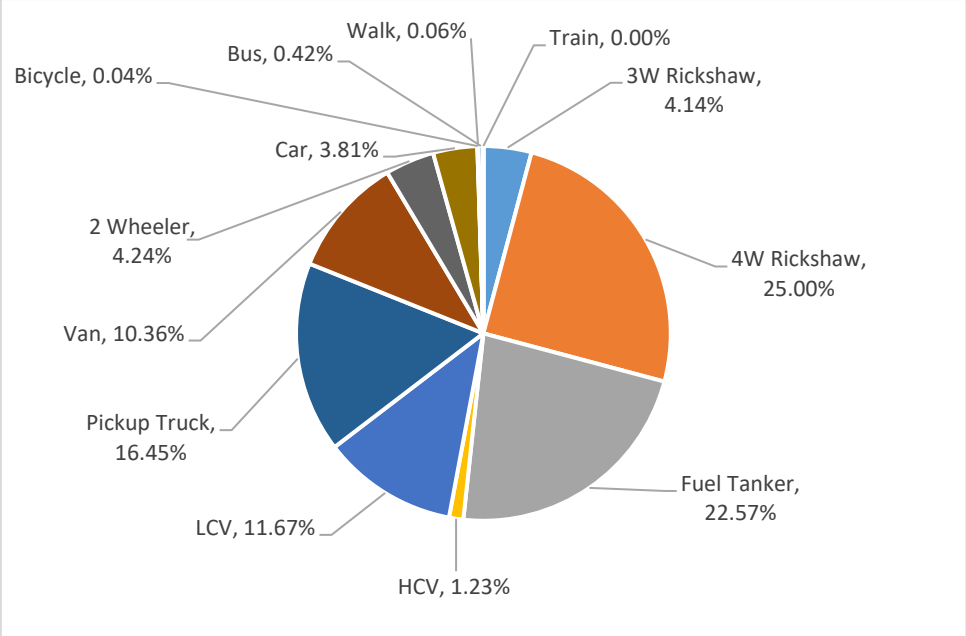

Figure 20: Mode wise distribution of freight demand - weight carried and distance over which this weight is carried (kg-km) for portion of trip inside the city boundary

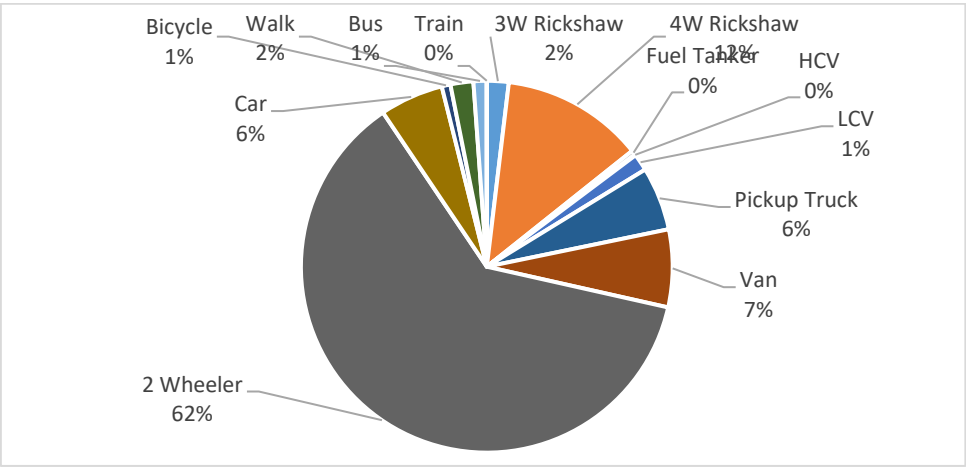

Figure 21: Mode wise distribution of total distance covered by different modes while delivering to retail establishments (portion of trip inside the city boundary)

5.1.3 Freight Traffic for Home Deliveries

Data from the questionnaire-based survey conducted at retail establishments in the five identified zones in Panaji city provides details of per day per establishment per mode kg km, number of trips and average journey weight per trip of goods in last mile delivery (home or other retail deliveries) or link 3 (for each commodity). Unlike inward goods delivery to freight establishments which can be based on trip sharing, i.e. each delivery trip is serving more than one establishment, outward or last mile goods deliveries (including home deliveries) from retail establishments, is a single trip per establishment. Though multiple destinations/households may be serviced in each trip. Therefore, in order to estimate the total demand of home delivery in terms of volume/load of goods and number of trips for each vehicle type per day per commodity, the data from questionnaire based retail establishment survey (Section 4.4) and commercial establishment survey (Section 4.2) is used. The total kg of goods delivered per day per mode per establishment is multiplied with the total number of establishments (for each commodity) in order to generate the total volume of goods home delivered by each vehicle type per day in the city of Panaji. Similarly, total number of trips, total kg-km

undertaken, and cumulative distance covered for home delivery for each vehicle type per day in the city of Panaji is also estimated, along with weighted average journey weight per trip (for each vehicle type). This data for last mile deliveries from retail establishments is presented in two categories – when the entire trip length for freight demand generated from Panaji city is accounted for (Table 115) and when the proportion of freight trip within the boundary of the city is considered (Table 116).

Table 115: Freight data for last mile deliveries from retail establishments (for entire freight trip length)

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average age (years)	Average odometer reading (km)	Total Kg Km attracted for Panaji per day	Total Kg delivered per day	Average trips per day	Total distance covered per day (km)
1	4W Rickshaw	118.38	6.64	1,09,390.64	5,39,622.40	1,10,865.39	332.11	5,232.51
2	Pickup Truck	82.79	5.78	1,43,385.65	24,99,481.83	89,285.76	341.22	29,025.37
3	Van	88.37	7.00	2,10,535.57	3,46,466.33	70,090.82	303.82	4,317.98
4	Two-Wheeler	8.33	4.46	45,212.86	2,21,863.24	23,109.24	1,435.14	27,252.98
5	Car	95.19			2,41,022.16	34,659.61	197.70	2,847.59
6	Bicycle	7.46			2,070.88	2,759.63	185.21	280.11
7	Walk	2.15			768.20	634.78	151.20	392.27
8	Bus	375.00			1,03,949.12	5,197.46	13.86	277.20
9	Water Tanker	2,330.00	7.80	64,521.00	11,06,466.40	106,391.00	14.16	15.16
	Total				50,61,710.57	4,42,993.68	2,974.42	69,641.18

Table 116: Freight data for last mile deliveries from retail establishments (for portion of freight trip length limited within the boundary of the city)

S. No.	Travel mode (freight vehicle)	Average journey weight per trip in kg	Average age (years)	Average odometer reading (km)	Total Kg Km attracted for Panaji per day	Total Kg delivered per day	Average trips per day	Total distance covered per day (km)
1	4W Rickshaw	118.38	6.64	1,09,390.64	4,20,013.32	110,865.39	332.11	3,724.08
2	Pickup Truck	82.79	5.78	1,43,385.65	185,195.16	89,285.76	341.22	2,020.77
3	Van	88.37	7.00	2,10,535.57	1,62,548.30	70,090.82	303.82	2,066.90
4	Two-Wheeler	8.33	4.46	45,212.86	52,954.43	23,109.24	1,435.14	9.512.56
5	Car	95.19			75,375.19	34,659.61	197.70	971.43
6	Bicycle	7.46			2,070.88	2,759.63	185.21	280.11
7	Walk	2.15			768.20	634.78	151.20	392.27
8	Bus	375.00			10,394.91	5,197.46	13.86	27.72
9	Water Tanker	2,330.00	7.80	64,521.00	11,06,466.40	1,06,391.00	14.16	15.16
Total					2,015,786.80	4,42,993.68	2,974.42	19,011.00

Table 115 and Table 116 presents the total goods delivery in link 3, from all retail commercial establishments in Panaji City (for entire trip length and for proportion of trip length within city boundary respectively) to homes or other retail establishments (outward or last mile delivery). Following are the key findings for freight delivery in Link 3 for Panaji.

- Average total daily weight of goods transported in link 3 (outward delivery from retail or last mile retail deliveries) is 443 tonnes per day, and this is achieved through a total of 2,974 trips undertaken by 10 different modes.
- Total last mile delivery freight demand in Panaji city in terms of overall Kg Km of freight traffic per day is to the tune of 0.51 crore Kg-km per day, of which about 0.20 crore kg-km is undertaken within the boundary of the city.
- A total of 69,641 km of outward freight delivery (from retail establishments) journeys are undertaken per day by all freight modes put together. Of this about 19,011 km of cumulative freight delivery distance is covered within the city boundary, while the rest is outside.
- Largest proportion of freight demand, in terms of weight carried and distance over which this weight is carried (i.e. kg-km) when entire trip length is accounted for, is catered by 'Pickup Truck' (49%) followed by 'Water Tanker' (22%) (Figure 22).
- Major component of this kg-km is undertaken from 'courier and e-commerce' establishments.
- Largest proportion of freight demand, in terms of weight carried and distance over which this weight is carried (i.e. kg-km) for the portion of entire trip length within the city boundary, is catered by 'Water Tanker' (55%) followed by '4W Rickshaw' (21%) (Figure 26). Major proportion of this kg-km by '4W Rickshaw' is undertaken for 'courier and e-commerce' establishments.
- 'Pickup Trucks' are estimated to deliver 244 kg and cover a distance 112 km per return trip. On an average 5.5 km is the length of the portion if these return freight trips that is limited to within city boundary.
- Largest proportion of goods delivered in terms of aggregated weight of goods delivered per day is by '4W Rickshaw' (25%) followed by 'Water Tanker' (24%) (Figure 23).
- Majority of the total weight delivered by 4W rickshaw (per day) is from courier and e-commerce establishment.
- '4W rickshaw' are estimated to deliver 353 kg and cover an average distance 14 km in a return trip; Of this about 12 km of distance is within the city boundary.
- Largest proportion of freight trips are made by 'Two Wheelers' (48%) followed by 'Pickup Trucks' and '4W rickshaws' (both 11%) in the city of Panaji (Figure 24).
- 'Two Wheelers' are estimated to ferry an average of 23.78 kg for an average length of 27.95 km per return trip when entire trip length is accounted for 6.01 km when only the segment of trip within city boundary is accounted for. Majority of outward delivery (including home delivery) trips from retail by two wheelers, serve 'courier and e-commerce' as 'hotels and restaurant' establishments.
- Largest proportion of total cumulative distance covered by freight trips to and from Panaji city (when total trip length is accounted for) is by 'Pickup Trucks' (42%) followed by 'Two Wheelers' (39%) (Figure 25). Majority of the cumulative distance (overall trip length) covered by 'Pickup Trucks' is for delivery from 'courier and e-commerce' establishments.
- Largest proportion of total cumulative distance covered by freight trips to and from Panaji city (when only the portion of trips within city boundary is accounted for) is by 'Two Wheelers' (50%) followed by '4W Rickshaw' (20%) (Figure 27). Majority of the cumulative distance (overall trip length) covered by 'Two Wheelers' is for delivery from 'hotels and restaurant' type establishments.

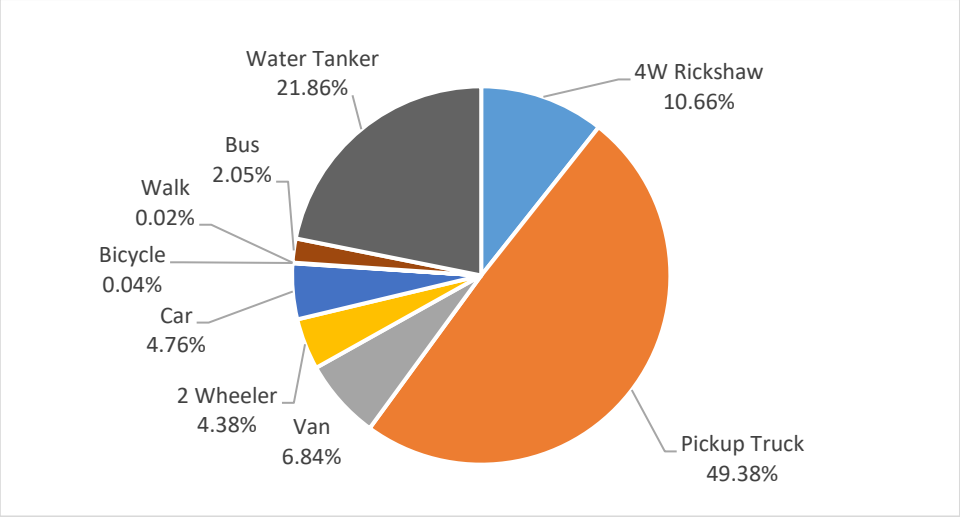

Figure 22: Mode wise distribution of freight demand in terms of weight carried and the distance over which it is carried (kg-km) for entire trip length of the journey

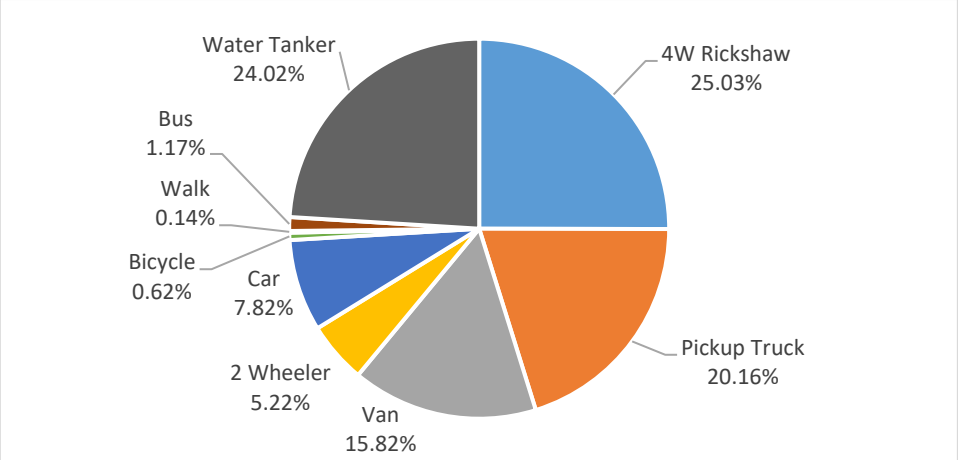

Figure 23: Mode wise distribution of goods delivered in terms of aggregated weight of goods delivered per day

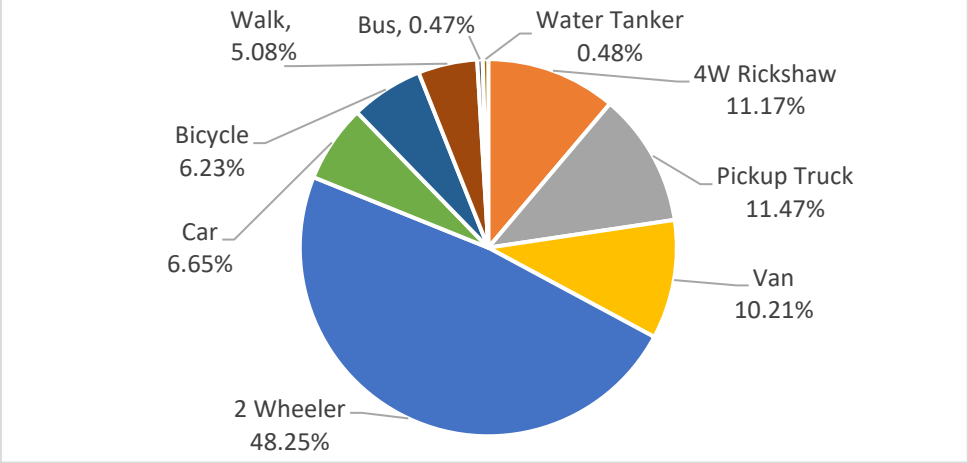

Figure 24: Mode wise distribution of freight trips for home deliveries

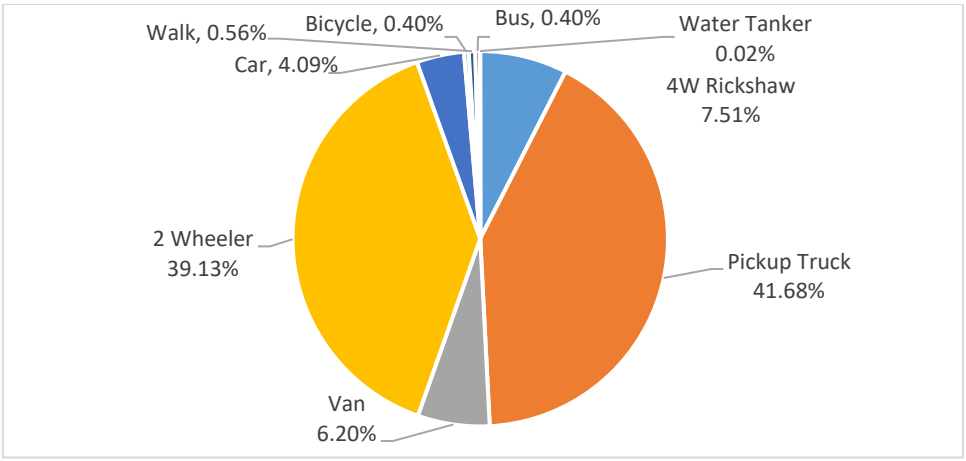

Figure 25: Mode wise distribution of Cumulative distance covered by freight trips for entire trip length of the journey

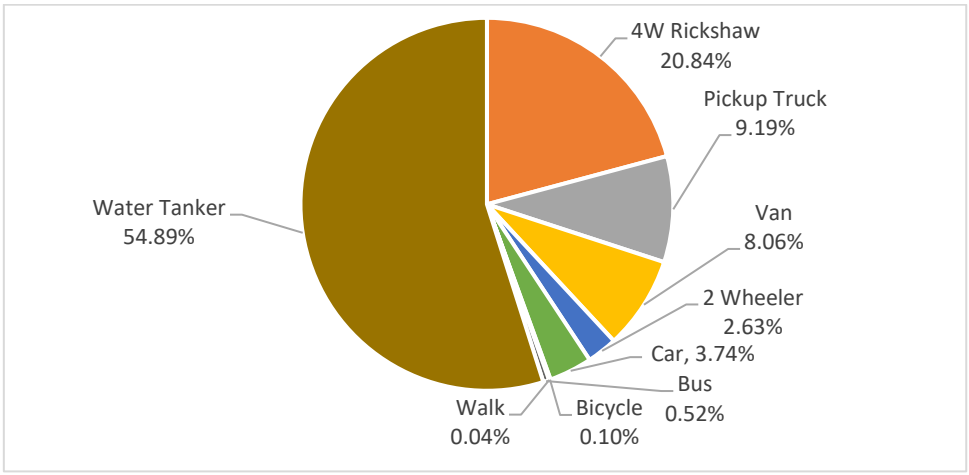

Figure 26: Mode wise distribution of freight demand (link 3) in terms of weight carried and the distance over which it is carried (kg-km) for portion of trip length limited within the city boundary

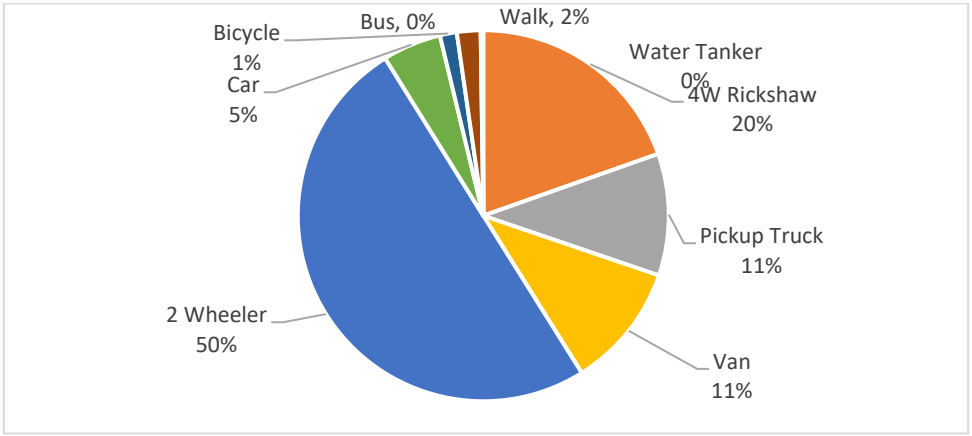

Figure 27: Mode wise distribution of Cumulative distance covered by freight trips for portion of trip length limited within the city boundary

5.1.4 Waste Collection

Analysis of data collected through secondary sources provides details of waste collected per mode kg km, number of trips and average journey weight per trip collected. While solid waste collection and disposal trips are almost entirely within the city boundaries, a large proportion of night soil vehicle trips is outside the city boundary. It is estimated that on an average each night soil tanker travels 4.5

km within the city limits and about 15.5 km outside the city limits in each one-way trip. The total number of waste related trips generated by each vehicle type per day in the city of Panaji is estimated, along with total weight carried in each trip (for each vehicle type). This data is presented in Table 117 for total trip length of these trips (including the component of trip length outside city boundary) and in Table 118 for segment of trip length limited within city boundary.

Table 117: Freight data for Sewage and Solid Waste Collection for entire trip length

S. No	Travel mode (freight vehicle)	Average journey weight attracted per trip in kg	Average age (years)	Average odo meter reading (km)	Total kg-km attracted for Panaji per day	Total kg collected per day	Average trips per day	Total distance covered per day (km)
1	4W Rickshaw	77.30	8.00	83,186.00	876.06	132.51	0.43	11.33
2	HCV	262.50	6.20	86913.73	1,67,123.63	31,095.79	3.27	579.67
3	Pickup Truck	63.05	12.00	71449.67	7,063.72	2,028.47	2.83	110.00
4	LCV	91.82	6.00	66440.00	14,439.63	3,305.47	3.00	100.67
5	Multi axle	893.92	12.00	63994.00	8,343.26	5,363.52	3.00	9.33
Total		NA				1,97,845	41,925.76	811.00
6	Night Soil Tankers	91.25	NA	NA	1,42,02,739.73	7,10,136.98	88.77	3,550.80
Total for all waste					1,44,00,585	7,52,062.75	101.30	4361.80

Table 118: Freight data for Sewage and Solid Waste Collection for portion of trip length within city boundary

S. No	Travel mode (freight vehicle)	Average journey weight attracted per trip in kg	Average age (years)	Average odo meter reading (km)	Total kg km attracted for Panaji per day	Total kg collected per day	Average trips per day	Total distance covered per day (km)
1	4W Rickshaw	77.30	8.00	83,186	876.06	132.51	0.43	11.33
2	HCV	262.50	6.2	86913.73	1,67,122.63	31,095.79	3.27	579.67
3	Pickup Truck	63.05	12.00	71449.67	7,063.72	2,028.47	2.83	110.00
4	LCV	91.82	6.00	66440.00	14,439.63	3,305.47	3.00	100.67
5	Multi axle	893.92	12.00	63994.00	8,343.26	5,363.52	3.00	9.33
Total for solid waste					**1,97,845**	**41,925.76**	**12.53**	**811.0**
6	Night Soil Tankers	91.25	NA	NA	31,95,616.44	7,10,136.99	88.77	798.93
Total for all waste					**33,93,462**	**7,52,062.75**	**101.30**	**1,609.93**

Table 117 and Table 118 presents the details of freight delivery in link 4, i.e. waste related freight trips in the city (for entire trip length and for proportion of trip length within city boundary respectively). Following are the key findings for freight delivery in link 4 for Panaji.

- A total of 752 tonnes of waste is estimated to be collected and/or transported from or to the city every day. This includes 710 tonnes of sewage and 42 tonnes of solid waste. This waste is collected and transferred through a total of about 101 daily trips.
- Cumulative length of all trips made for waste collection per day is about 4,362 km, of which 1,610 km is within the city boundary while the rest is outside.
- Total waste transport demand (including solid waste and septic tank waste) generated by Panaji city in terms of total kg-km per day is 1.44 crore kg-km. Of this 0.34 crore kg-km is undertaken within the city boundary, while the rest is outside.
- Largest proportion of this waste transport demand (when entire trip length is accounted for), in terms of weight carried and distance over which it is weight is carried (kg-km), is by 'Night Soil Tankers' (98.63%) followed by 'HCV 'for solid waste (1.2%) and 'LCV' (0.1%) also for solid waste (Figure 28).
- When only the segment of trip length within city boundary is accounted for, the largest proportion of this waste transport demand, in terms of weight carried and distance over which it is weight is carried (kg-km), is by 'Night Soil Tankers' (94.17%) followed by 'HCV 'for solid waste (4.92%) and 'LCV' (0.43%) also for solid waste (Figure 32).
- Solid waste transport trips are mostly limited within city boundary. Total solid waste in Panaji city in terms of overall kg-km of waste transferred per day is estimated to be 1,97,845 kg-km.
- Largest proportion of weight of waste collected per day is by 'Night Soil Tankers' (94%) followed by 'HCV' (4%) for solid waste and 'Multi Axle' (1%) also for solid waste (Figure 29). Largest proportion of waste collection trips are made by 'Night Soil Tankers' (88%) whereas solid waste freight trips are made by LCV, 'Multi Axle' trucks, HCV and pickup trucks (3% each) in the city of Panaji (Figure 30).
- Largest proportion of waste collection/transport trips per day is by 'Night Soil Tankers' (87.63%) followed by 'HCV' (3.23%) for solid waste (Figure 30).
- Largest proportion of cumulative distance covered (when entire trip length is accounted for) by all waste trips per day is by 'Night Soil Tankers' (81.41%) followed by 'HCV' (13.29%) for solid waste (Figure 31).
- Largest proportion of cumulative distance covered (when only the distance covered within city boundary is accounted for) by all waste trips per day is by 'Night Soil Tankers' (49.63%) followed by 'HCV' (36.01%) for solid waste (Figure 33).

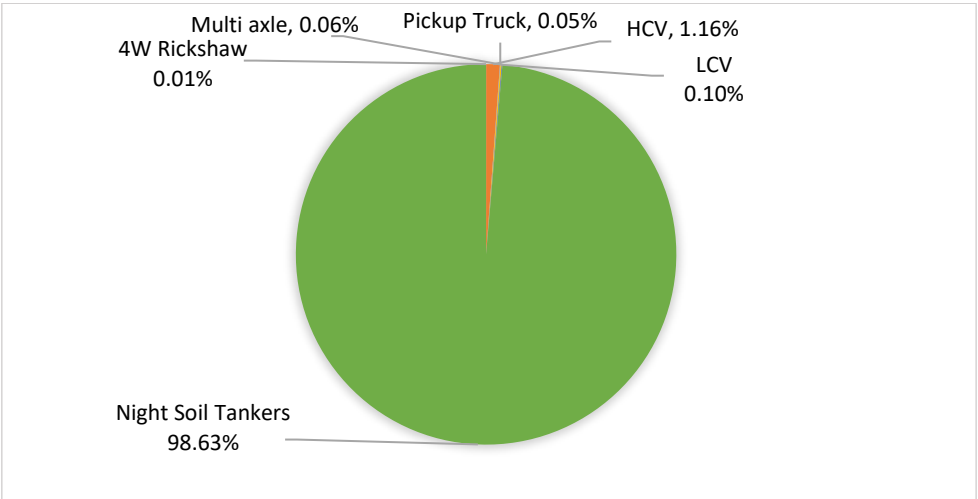

Figure 28: Mode wise distribution of waste (night soil and solid waste) freight demand in terms of weight carried and distance over which this weight is carried (Kg Km) for entire trip length

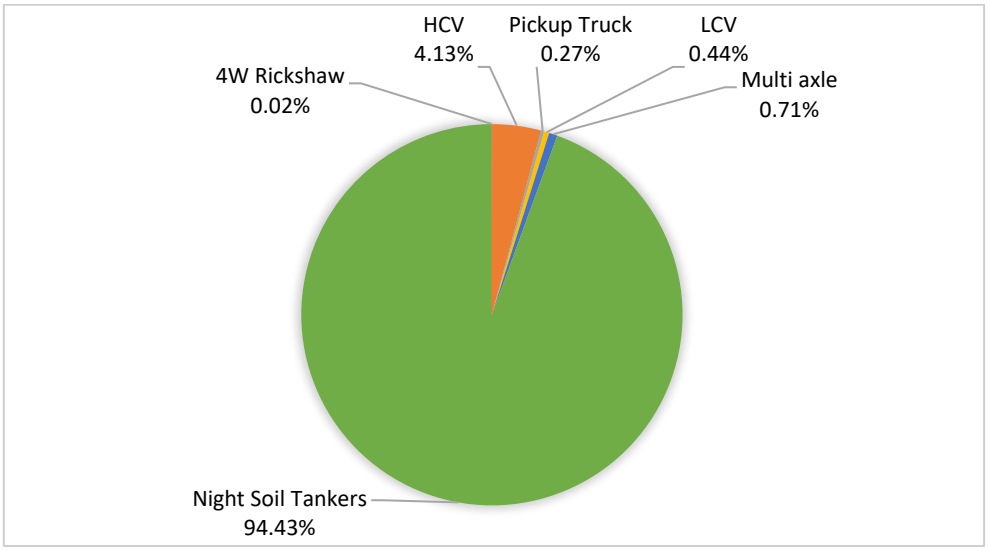

Figure 29: Mode wise distribution of waste (night soil and solid waste) collected per day (by weight)

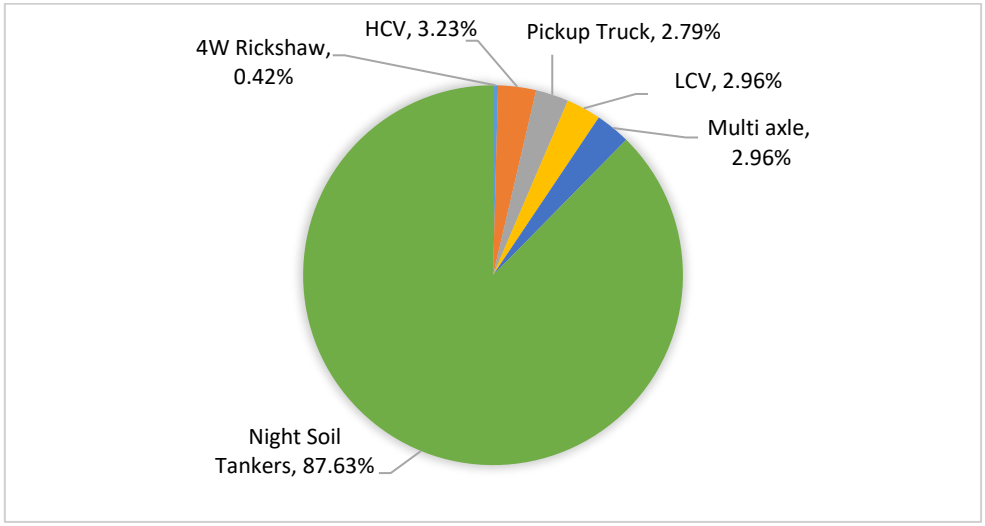

Figure 30: Mode wise distribution of waste collection (night soil and solid waste) trips per day

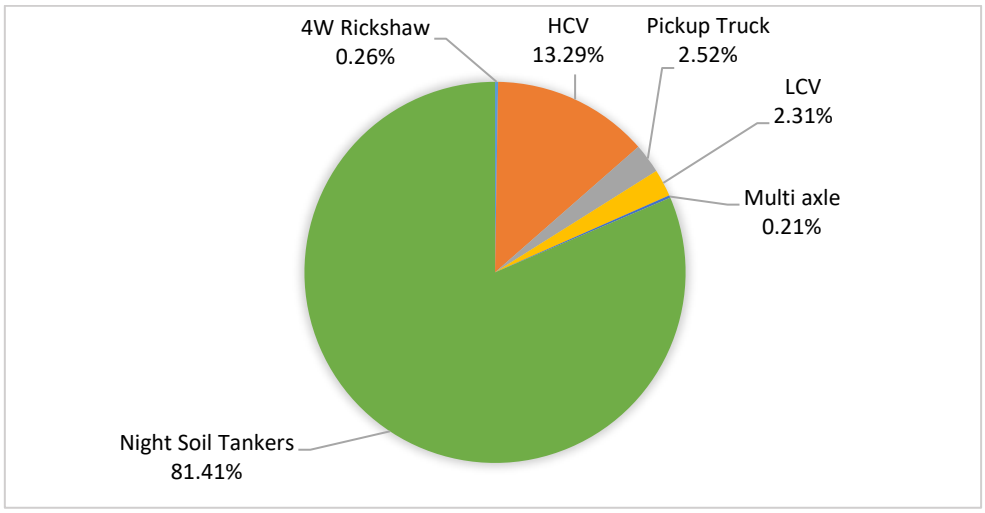

Figure 31: Mode wise distribution of waste collection (night soil and solid waste) cumulative total trip length of all trips per day

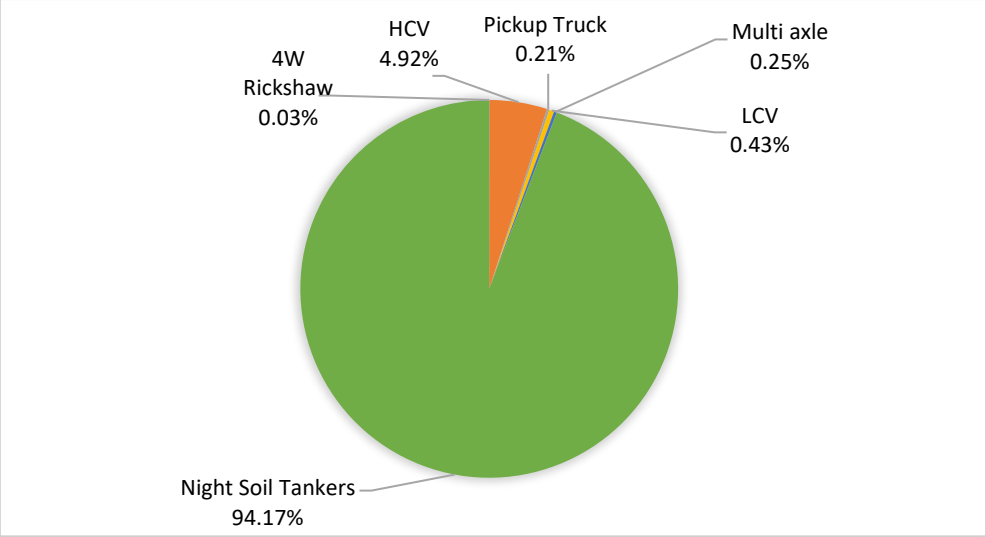

Figure 32: Mode wise distribution of waste (night soil and solid waste) freight demand in terms of weight carried and distance over which this weight is carried (Kg Km) for segment of trip within city boundary

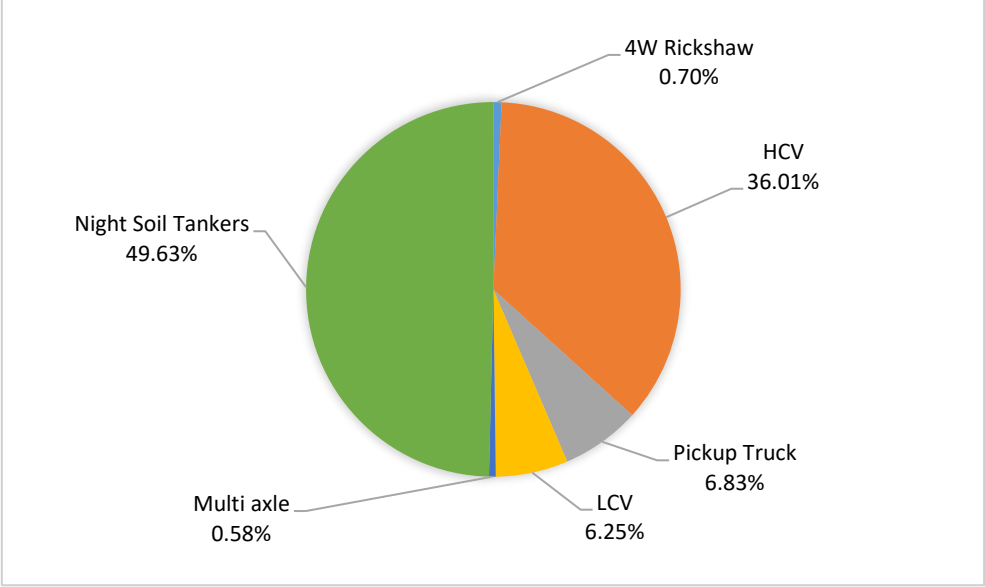

Figure 33: Mode wise distribution of waste collection (night soil and solid waste) cumulative length of segment of trips within city boundary for all trips per day

5.1.5 Overall Freight Distribution in Panaji

The aggregated freight traffic numbers (including freight transport all 4 links) have been derived based on data presented above. These numbers include total weight delivered, total Kg-Km of freight transported, total trips made, and total distance covered, per day by different modes of freight delivery in the city. A total of 0.74 million tonnes of freight movement demand is generated every year by Panaji (does not include goods collected by consumers from the retailers themselves). This translates to 82.57 million tonne-km per year of which 3.30 million tonne-km is achieved within the city limits, while the rest is outside the Panaji municipal boundary. The total goods and waste transport requirement for Panaji generates an annual demand for 2.21 million return freight trips. This totals to 139.06 million kilometres covered by freight vehicles each year, of which 14.59 million kilometres are covered within the city boundary, while the rest is outside. This link wise data is presented in Table 119 for total trip length of these trips (including the component of trip length outside city boundary) and in Table 120 for segment of trip length limited within city boundary.

Table 119: Details of overall per day freight demand generated by Panaji city when total trip length is accounted for

Link	Total weight of freight per day (kg)	Million Kg Km per day	Return Trips per day	Distance covered per day (km)
1 - To wholesalers	172.62	153.67	172.45	1,47,391.86
2 - To retailers	670.35	53.64	2,807.15	1,59,597.41
3 - To homes	442.99	5.06	2,974.42	69,641.18
4 - To waste	752.06	14.40	101.30	4,361.80
Total	**2,038.85**	**266.22**	**6,055.31**	**3,80,992.25**

Table 120: Details of overall per day freight demand generated by Panaji city when segment of trip length within city boundary is accounted for

Link	Total weight of freight per day (kg)	Million Kg Km per day	Return Trips per day	Distance covered per day (km)
1 - To wholesalers	172.62	1.00	172.45	967.27
2 - To retailers	670.35	2.79	2,807.15	18,374.13
3 - To homes (last mile)	442.99	2.02	2,974.42	19,011.00
4 - To waste	752.06	3.39	101.30	1,609.93
Total	**2,038.85**	**9.05**	**6,055.31**	**39,962.33**

Following are the key findings for on the overall freight demand in Panaji.

- The maximum weight of freight is delivered in the wholesale to retail distribution network (link 2) (33%). This link also sees the maximum number of freight trips (46%) (Figure 35 and Figure 36).
- Maximum freight transport demand in terms of tonne-km, is catered to in Link 1, i.e. freight trips to wholesalers in the city, when the entire trip length of delivery is accounted for (68%) (Figure 34). However it is highest in Link 4, i.e. waste transport, when only the segment of trips undertaken within city boundary is considered (37%) (Figure 38).
- Maximum cumulative distance covered by freight vehicles is in Link 2, or wholesaler to retailer distribution network – both when the entire trip length is considered (42%) and portion of the trip length within city boundary is considered (46%) (Figure 37 and Figure 39).
- Of the total freight demand (all links combined) attracted by Panaji city, the maximum weight of freight is delivered by HCV (40%) (Figure 41). These HCV also include night soil tankers.
- Of the total freight trips attracted by Panaji city (all links combined), the maximum number of trips are undertaken by 'Two Wheelers' (50%) (Figure 42).
- Of the total freight demand in Panaji city in terms of tonnes-km (all links combined) maximum demand (in terms of tonne-km), is catered by LCV, when the entire trip length of delivery is accounted for (74%) (Figure 40). However, maximum demand is catered by HCV, when only the segment of trips undertaken within city boundary is considered (39%) (Figure 44). This is because of contribution due to transportation of 'night soil' using HCV tankers within the city.
- Of the total distance covered in all freight distribution networks in all links, maximum distance in terms of cumulative trip length, is undertaken by LCV, when the entire trip length of delivery is accounted for (42%) (Figure 43). However maximum cumulative distance is covered by 'Two Wheelers', when only the segment of trips undertaken within city boundary is considered (52%) (Figure 45).

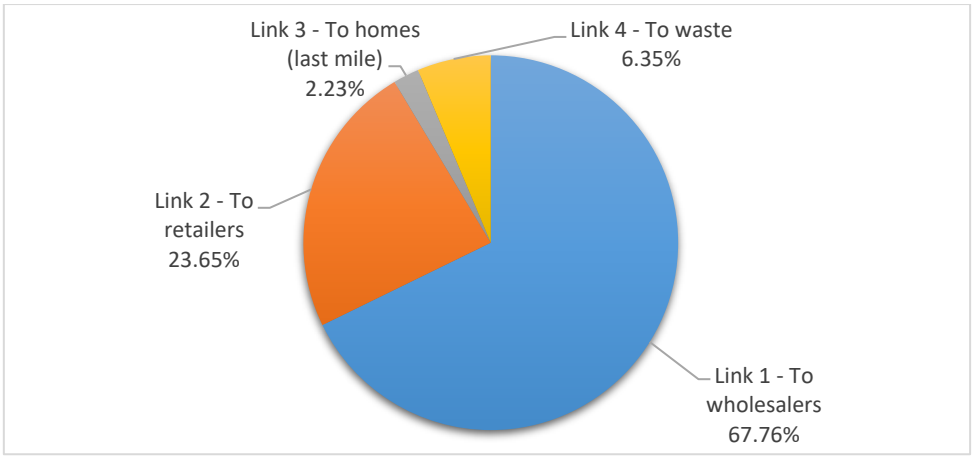

Figure 34: Link wise breakup of total freight delivery by tonne-km in Panaji – for total trip length

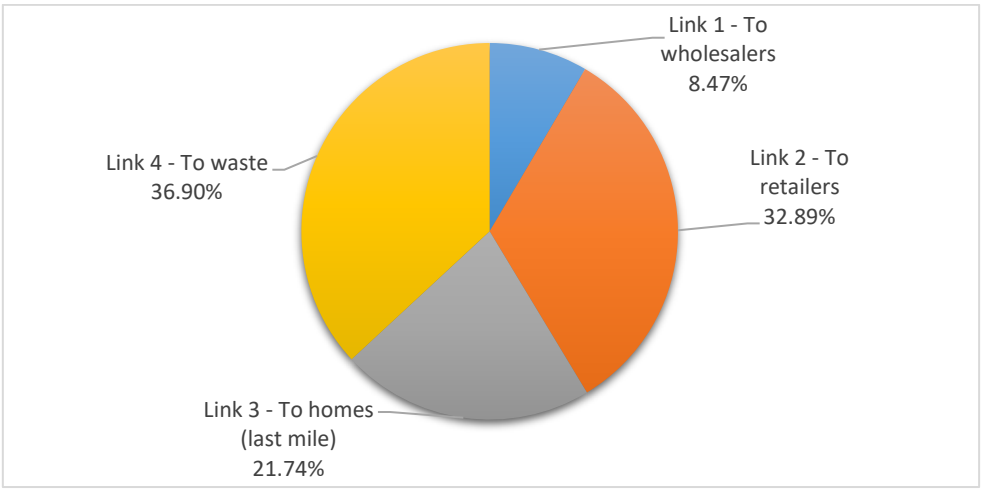

Figure 35: Link wise breakup of total freight delivery by weight in Panaji

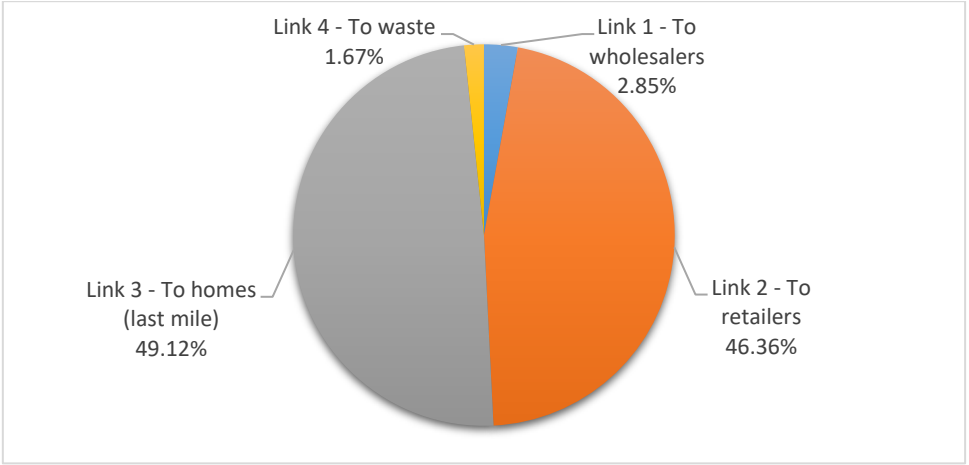

Figure 36: Link wise breakup of total freight delivery by number of trips in Panaji

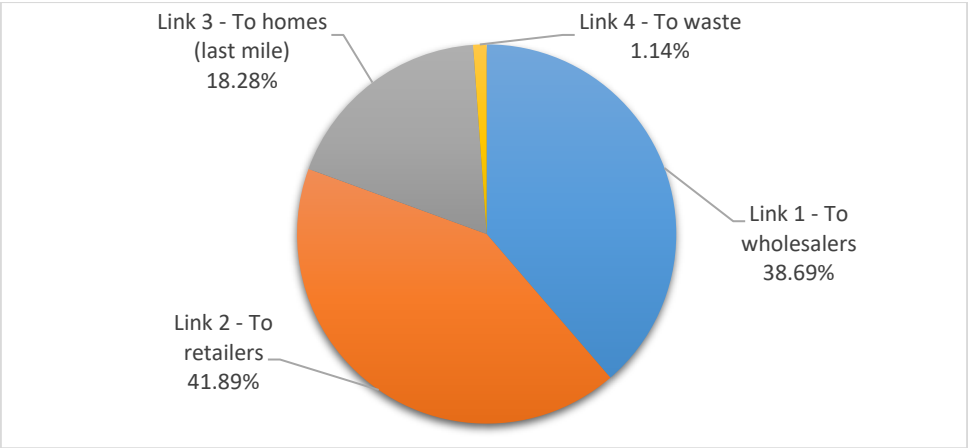

Figure 37: Link wise breakup of total freight delivery in terms of total distance covered (entire trip length) in Panaji

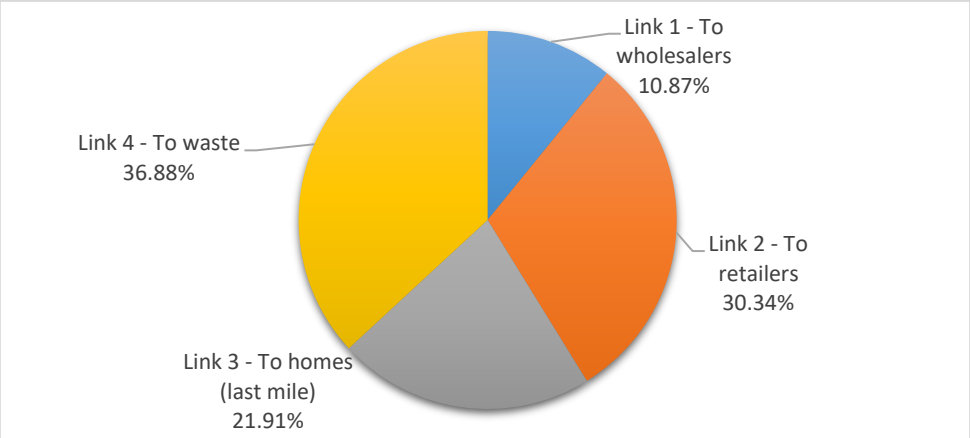

Figure 38: Link wise breakup of total freight delivery by tonne-km in Panaji – for portion of trip length within city boundary

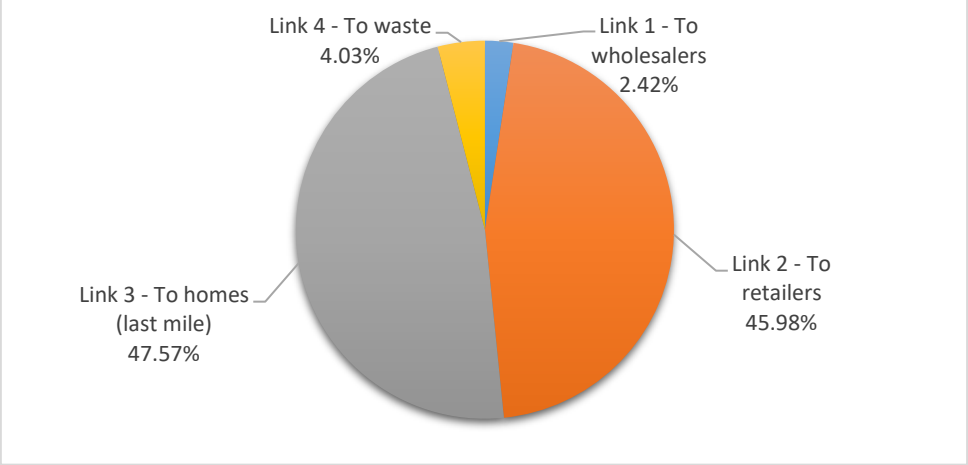

Figure 39: Link wise breakup of total freight delivery in terms of total distance covered (for portion of trips within city boundary) in Panaji

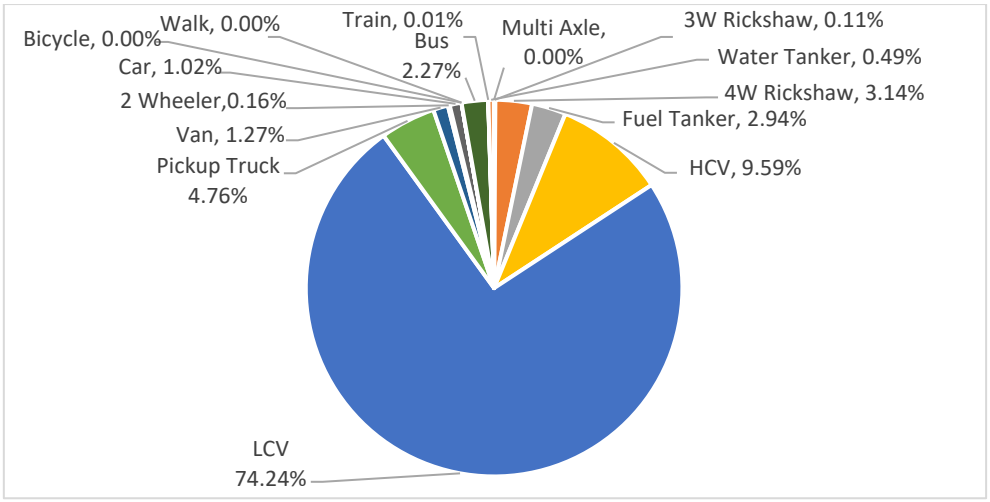

Figure 40: Mode wise breakup of total freight delivery by tonne-km in Panaji – for total trip length

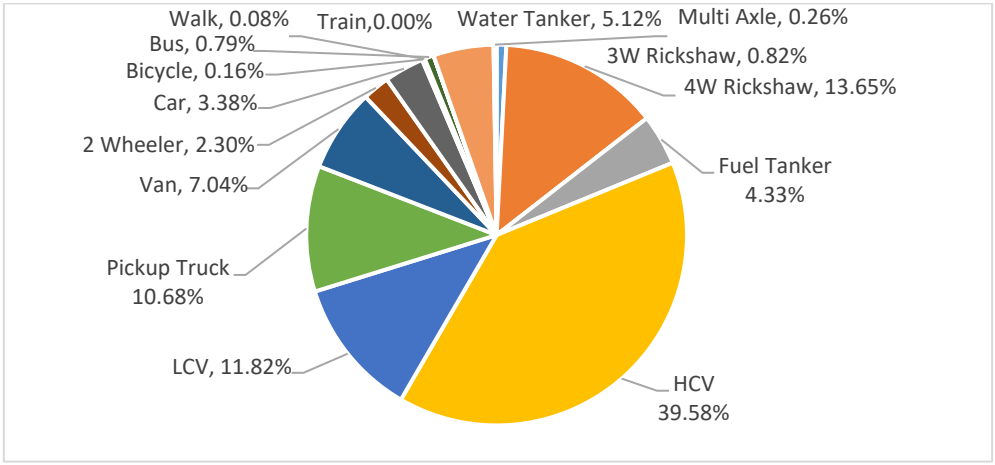

Figure 41: Mode wise breakup of total freight delivery by weight in Panaji

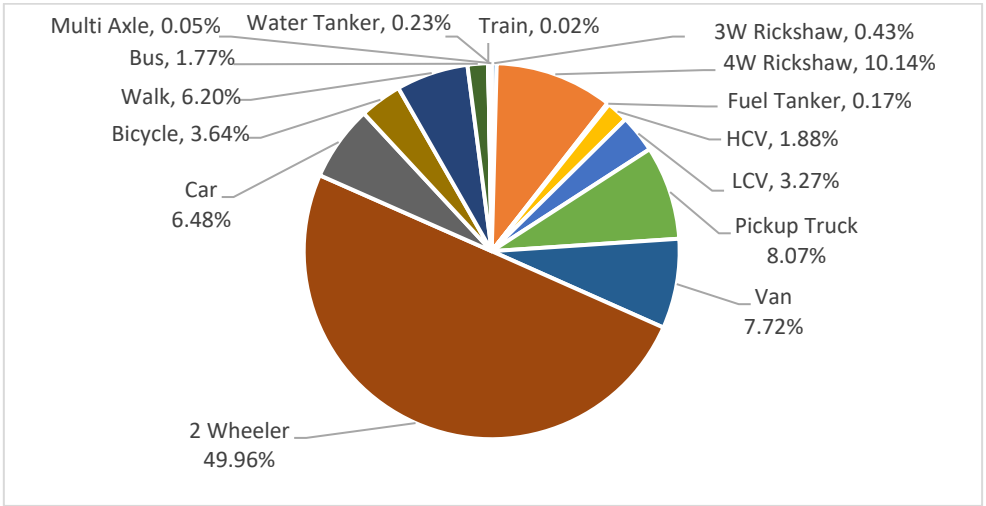

Figure 42: Mode wise breakup of total freight delivery by number of trips in Panaji

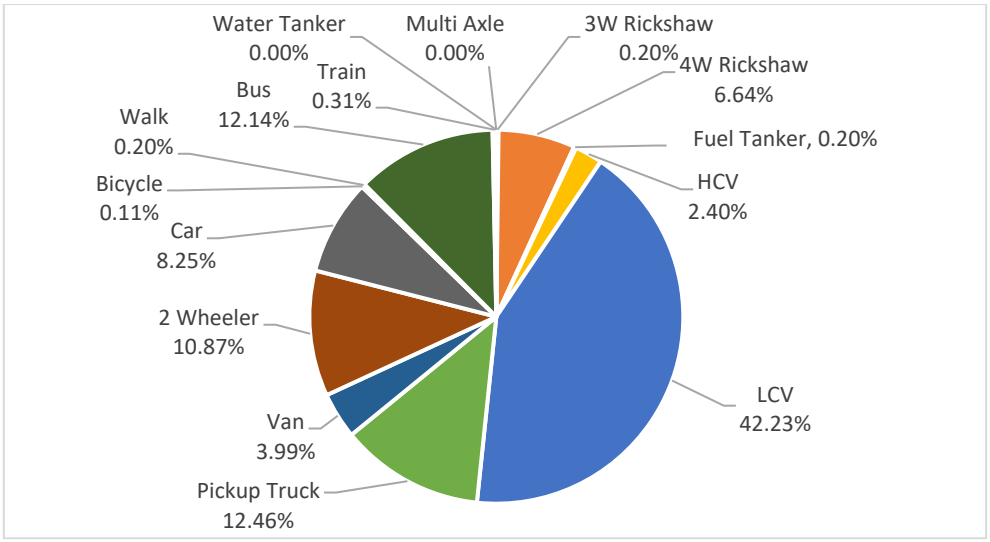

Figure 43: Mode wise breakup of total freight delivery in terms of total distance covered (entire trip length) in Panaji

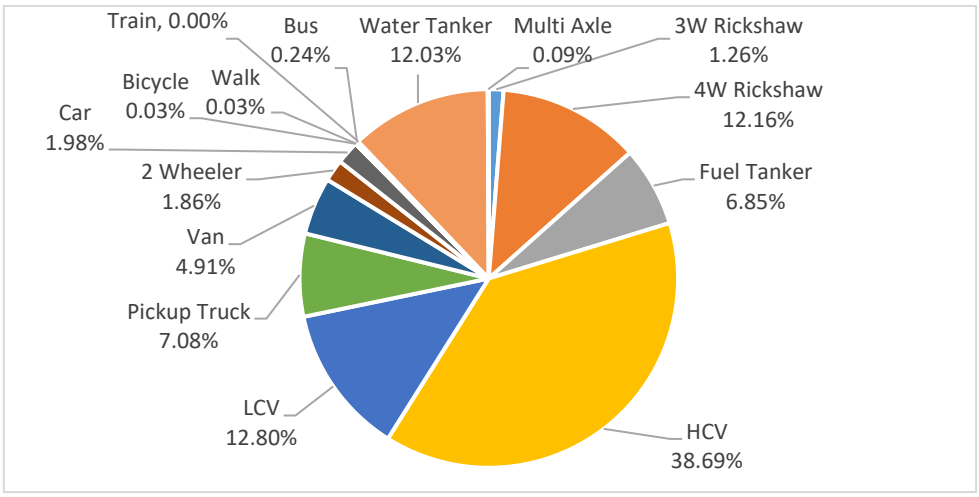

Figure 44: Mode wise breakup of total freight delivery by tonne-km in Panaji – for portion of trip length within city boundary

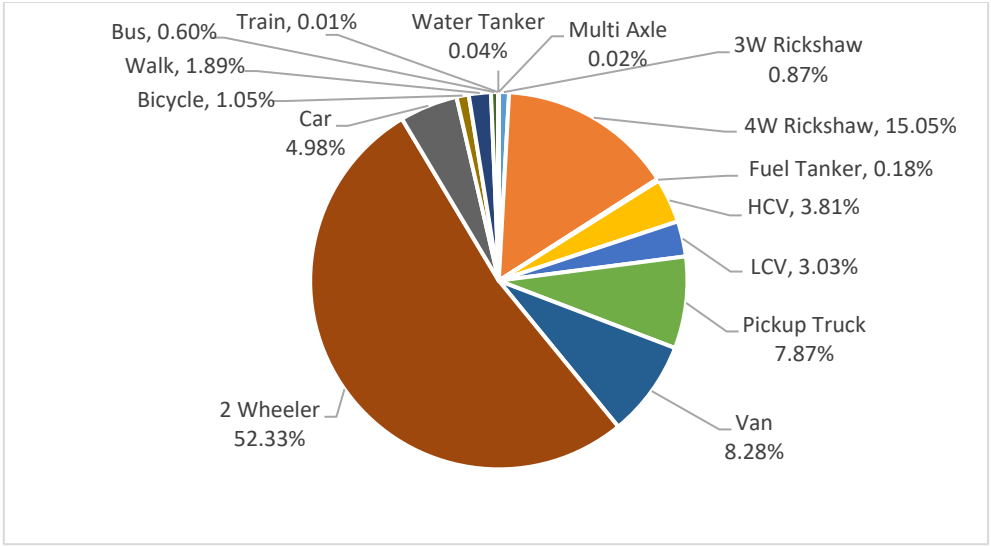

Figure 45: Mode wise breakup of total freight delivery in terms of total distance covered (for portion of trips within city boundary) in Panaji

5.1.6 Utilization of Freight Capacity

Analysis of data collected through primary survey suggests that most of the freight vehicles and freight trips operate at low utilization level, i.e. the capacity of the freight vehicle is not utilized leading to inefficiencies which results in additional (otherwise avoidable) trips. Table 121 Presents the average vehicle utilization of freight vehicles for both wholesale to retail trips and home deliveries (from retail establishments).

Table 121: Average Vehicle Utilization of Freight Vehicles for both wholesale to retail trips and home deliveries

	Inward delivery to retail			Home delivery from retail		
Vehicle Type	**Average estimated journey weight (Kg)**	**Maximum journey weight achievable (Kg)**	**Average efficiency (%)**	**Average observed journey weight (Kg)**	**Maximum journey weight achievable (Kg)**	**Average efficiency (%)**
3W Rickshaw	83.00	472.00	17.58%	-	-	-
4W Rickshaw	165.82	750.00	22.11%	118.38	750.00	15.78%
Fuel Tanker	4,400.00	9,000.00	48.89%	NA	NA	NA
HCV	1,193.83	9,000.00	13.26%	NA	NA	NA
LCV	598.45	2,250.00	26.60%	NA	NA	NA
Pickup Truck	226.23	1,040.00	21.75%	82.84	82.79	7.96%
Van	116.57	385.00	30.28%	88.37	88.37	22.95%
2-Wheeler	7.10	75.00	9.46%	10.69	14.54	19.39%
Car	133.24	385.00	34.61%	95.86	96.19	24.72%
Bicycle	7.50	60.00	12.50%	7.49	7.46	12.44%
Walk	2.50	18.00	13.89%	2.26	2.15	11.97%
Water Tanker	NA	NA	NA	2330.00	2330.00	25.89%

It is observed that the efficiency levels of last mile delivery freight trips in Link 3 (from retail establishments) are much lower than inward retail trips (Link 2). As a result, last mile delivery (including home delivery) network delivers around 66% of the daily freight load of all retail distributor network (to and from retail establishments) but uses an equal number of freight trips to do so. In addition, efficiency levels of freight trips in 'inward retail' (Link 3) distribution network is also low (less than 35%) for all modes except fuel tankers. There is thus scope for improving the overall utilization of existing freight inventory in order to reduce the number of freight trips (freight traffic) and emissions from freight in the city.

5.1.7 Impact of Freight Movement on Congestion in Panaji

Primary survey of mode and direction wise traffic count has been conducted between 2017 and 2019 at 29 different locations in and around Panaji. Of these, 16-hour traffic data has been accessed from secondary sources for 15 locations, while for another 15 locations (with two common location) 10-minute sample traffic data each has been recorded three times a day. Analysis has been conducted for a total of 20 locations of which 15 are from the secondary 15-hour data while 5 are from primary 30-minute data. Of these 20 locations, 6 locations are not within Panaji Municipal boundary but mainly on highways on the outskirts, while 12 are located within the city. Of these two locations are common, these are Dona Paula (Junction no.'s TV-14 and PA-JN-8) and Miramar Circle (Junction no.'s TV-15 and PA-JN-7) (Table 122). This data has been presented in Section 4.6. The objective of analysing freight data is to understand the composition of freight traffic in overall traffic. The two common junctions allow comparison of this percentage to verify that 10-minute traffic counts (for each sample time period) can be taken as an indication of the overall freight traffic composition (and not numbers).

Table 122: Freight traffic composition from traffic counts

Junction No.	Junction Label[6]	Morning Peak hour composition of Freight Traffic	Off peak hour composition of freight traffic	Evening peak hour composition of freight traffic	Weighted average composition for 10-hour traffic
1	TV-7	3.08%	4.86%	9.73%	5.48%
2	TV-9	1.39%	10.85%	5.10%	7.81%
3	TV-14	7.90%	12.39%	4.86%	9.99%
4	TV-15	6.70%	14.38%	8.49%	11.67%
5	TV-17	9.82%	3.13%	4.22%	4.69%
6	TV-13	14.28%	15.55%	12.21%	14.63%
7	TV-1	1.94%	10.66%	10.45%	8.87%
8	TV-8	12.18%	9.88%	8.79%	10.12%
9	TV-16	0.00%	0.00%	0.00%	0.00%
10	TV-2	8.29%	7.59%	2.96%	6.80%
11	TV-4	8.86%	4.66%	2.09%	4.98%
12	IC-PA-IC_1	6.32%	6.49%	8.48%	6.86%
13	IC-PA-IC_2	19.93%	26.07%	17.65%	23.16%
14	IC-PA-IC_3	6.93%	9.17%	4.93%	7.88%
15	IC-PA-IC_4	11.61%	18.13%	17.87%	16.77%
16	IC-PA-IC_5	16.17%	18.85%	15.29%	17.60%
17	PA-JN-1	11.98%	13.62%	8.50%	12.27%
18	PA-JN-2	6.13%	6.87%	4.70%	6.29%
19	PA-JN-3	5.90%	8.13%	5.72%	7.20%
20	PA-JN-4	10.60%	10.71%	7.71%	10.09%
21	PA-JN-5	6.09%	9.55%	10.36%	9.02%
22	PA-JN-6	11.75%	11.38%	9.62%	11.10%
23	PA-JN-7	16.16%	15.44%	12.28%	14.95%
24	PA-JN-8	9.19%	9.23%	6.47%	8.67%
25	PA-JN-9	8.64%	9.05%	6.55%	8.47%
26	PA-JN-10	16.80%	19.58%	15.21%	18.15%

The 10-minute traffic count suggests that freight traffic (in terms of PCU) is 9.99% of total traffic (in terms of PCU) at Dona Paula and 11.67% of total traffic at Miramar Circle. This number from 16-hour traffic count is 6.57% for Dona Paula and 10.99% at Miramar Circle. On the whole, since 10 minute traffic data counts were designed to carefully capture freight traffic (while 16 hour counts focused on vehicle size and not function), it is probable that 16 hour counts missed a percentage of freight traffic such as two wheelers (which constitutes significant number of freight trips in Panaji). It is estimated (from estimate of freight trips by different modes as discussed above), that such trips (including two wheelers, walk and bicycle) are about 22% of the total freight traffic (in terms of PCU) in the city. Applying this percentage change in total PCU (both overall and freight traffic) at these 2 locations for the 16-hour traffic counts, the estimate of composition freight traffic at Dona Paula is 8.13% while that at Miramar circle is 13.74%. The difference between these values from the two surveys in this case is less than 20%. Therefore, this correction has been applied for all 16-hour traffic count locations. The mean composition of freight traffic in Panaji City is derived from 9, 16 hour data locations (junctions and mid-block locations) and 3, 10 minute junction locations (Data from junction locations TV-14 and TV-15 is not used) in the city (Table 92).

There are three peak hours for overall traffic in the city of Panaji. These are 9am to 10am, 1pm to 2pm (school traffic peak) and 5pm to 6pm. Overall the peak freight hour does not appear to overlap with peak passenger journey hour. The composition of freight traffic (as an overall mean of traffic data

[6] All 'TV' series junctions are based on total 30-minute primary traffic data while 'IC' and 'PA' series junction data is based on 16 hour count secondary data.

from all 18 locations) is higher in off-peak hour than in the peak hours (excluding single afternoon peak hour). The average composition of freight traffic between 11am to 5pm is 8.95%, while this is 8.13% for 9am to 11am and 7.08% between 5pm and 7pm.

The daily mean composition of freight traffic out of total traffic (including non-motorized traffic) at different locations in the city varies between 4.69% to 14.95%. The weighted mean value of freight traffic composition in Panaji city throughout the day (mean of all analysed locations) is 8.41%. This mean value for highways/arterials on the outskirts of the city is 15.07%. The total population of Panaji, including floating population is (Section 1) 55,499. Assuming a per capita trip rate (including walk) of 1.4[7], the total number of trips per day in the city are 77,699. The total freight trips (including walk) in the city have been estimated to be 14,705[8] per day. Hence total trips including freight in the city is estimated to be 92,404 per day. Thus, the total composition freight trips in the city from other primary surveys (discussed above) is estimated to be 15.91% (including walk and bicycle). However, when only motorized trips are accounted for the mean daily percentage of motorized freight trips out of total freight trips in the city is estimated to be 25.60%[9]. Therefore, from these findings it can be said that the composition of freight trips in and around Panaji city is in the range of 9% to 16%, when all trips (including walk and bicycle) are accounted for and close to 26% when only motorized trips are accounted for. However, one needs to account for the comparative average trip length between freight and passenger traffic in the city (portion of freight trip length limited within city boundary). This is between 6.3 km (for last mile delivery) to 7.5 km (for inward retail delivery), and in the range of 2 km[7] for passenger traffic.

The estimated composition of freight traffic in the overall traffic in Panaji city appears significantly lower than the globally accepted norm of 40%. Estimated for Panaji suggest a much lesser share at no higher than 26%. This may be attributed to lower consumption (because of relatively lower income levels in India) and a still evolving e-commerce and home delivery sector in the country. Commodities in different households is still transported by residents and not the shopkeepers/retailers/e-commerce.

It is known that the of the total freight vehicle parking demand of close to 2,260 parking/docking per day in the city of Panaji, nearly 45% (1016) is undertaken in the core market area i.e. Zone 1. Overall in the city, out of close to 2,260 freight vehicle parking that take place daily, 78% are short term (less than 4 hours), nearly 12% are medium term and close to 10% are long term (Figure 46). However, the highest short-term parking demand (as a percentage of total parking demand) is in Zone 1 at 85% (Zone 2 has a very small parking demand however all of that is short term parking demand). This is why the total parking bay requirements in terms of ECS, in Zone 1, is about 40% (383 ECS) of the total parking bay requirement (ECS) in the city, which is estimated as 946 ECS. This suggests that freight vehicle parking demand (and activity_ in the city is mainly concentrated in the relatively small but dense core city/market area, defined as Zone 1. However, the parking undertaken by freight vehicles is relatively or efficient short-term parking, with only a small number of vehicles parking for medium and long term.

Clearly the overall impact of freight traffic in terms of vehicular trips and parking demand, on the vehicular congestion in Panaji city is not very high. The analysis of vehicle counts in the city also suggests that this impact is even lower in peak hours when the traffic volumes in general is higher.

[7] Trip rate between 1.1 and 1.3 is derived for most urban centres such as Delhi, Bangalore, Udaipur, since Panaji has high floating population a higher trip rate of 1.4 is considered

[8] Total return freight trips estimated in the city are 7,352.52 trips to wholesalers/distributors thus total one-way trips are expected to be twice the same.

[9] Estimated motorized daily freight one way trips in the city are 13,366, while the total non-motorized passenger trips in the city are expected to be about 50% of all trips (based on understanding from other Indian cities), thus total daily motorized passenger trips in city are expected to be 38,850 and total daily motorized trips including freight are estimated to be 52,216.

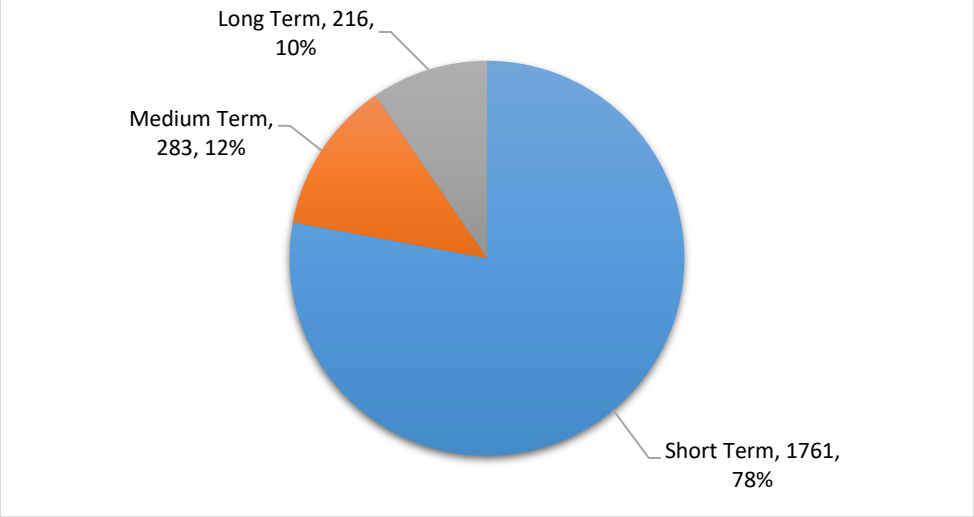

Figure 46: Parking Requirement in Panaji City

5.1.8 Emission findings from 'EcoLogistics - Self-monitoring Tool'

EcoLogistics self-monitoring tool for urban freight transport was developed by ICLEI SA through 'EcoLogistics: Low carbon freight for sustainable cities' project in 2019. The tool helps in estimating the greenhouse gas (GHG) emissions from urban freight transport at the city level. This is an excel-based tool which takes city specific baseline data inputs like demographic profile, total urban freight (in million tonnes), air quality index and the targeted emission reduction in each transport sector. The tool also requires sector specific inputs which includes load factor, litres per 100km and fuel consumption. As an output, the result of calculating the CO_2 and CO_2e is generated which allow users to make meaningful comparisons over time and with other cities in terms of urban freight emissions.

As part of the objective of this project, that is to develop and finalize the baseline report related to urban freight in Panaji, one of the tasks included assisting the project team in validating the self-monitoring tool (developed as part of EcoLogistics project) in the context of Indian cities.

Hence, in order to validate the self-monitoring tool, inputs related to Panaji city freight road transport were inserted in the tool.

The data collected from primary and secondary sources for this study (as presented earlier) has been used to derive the input values for estimating annual carbon emissions from freight in the EcoLogistics Tool. These values have been provided in the tool for Light Good Vehicle <3.5t (680), Rigid Truck 7.5t-12 (240) and Rigid Truck 12t-20t (150). Values for 3-wheeler, 2-Wheeler and Tempo equivalent vehicles have been derived[10] and used for estimation of annual carbon emissions from urban freight in Panaji. These are 193.17 g/km for gasoline based Motorized Rickshaw/Tuk-Tuk, 68.71 g/km for gasoline-based Motorcycle/2-Wheeler and 121.68 g/km for diesel-based Tempo equivalent <0.75t. For these values average one tonnes total weight (for each mode) is assumed i.e. the values are considered in g/tonnes km. The output generated after inserting the above values into the self-monitoring tool derived the emissions in terms of CO_2 for total freight trip length for each mode, and for segment of trip length within city boundary. These have been presented in Table 123 and Table 124 respectively.

Table 123: Panaji CO_2 and emissions for total trip length

Mode	Total Distance in Million Km per year	Emission per day (Tonnes of co2)
2-Wheeler	15.12	2.33
3-Wheeled Rickshaw	0.27	0.19
4-Wheeled Rickshaw, Pickup Truck, Van, and Car (<0.75t Tempo equivalent)	43.58	39.32
LCV <3.5t	58.73	76.44

[10] Source https://calculator.carbonfootprint.com/calculator.aspx?tab=4

Mode	Total Distance in Million Km per year	Emission per day (Tonnes of co2)
HCV 3.5t-12t	3.62	6.68
Multi Axle 12t-20t	0.003	0.01
Total		124.97

Table 124: Panaji CO_2 and emissions for segment of trip length within city boundary

Mode	Total Distance in Million Km per year	Emission per day (Tonnes of co2)
2-Wheeler	7.63	0.01
3-Wheeled Rickshaw	0.13	0.09
4-Wheeled Rickshaw, Pickup Truck, Van and Car	5.28	4.19
LCV	0.44	0.50
HCV	0.59	0.94
Multi Axle	0.003	0.01
Total		5.74

Outputs of self-monitoring tool suggest that the Green House Gas (GHG) emissions generated by light commercial vehicles <3.5t is the highest from urban freight (road) transport sector when total trip length of freight trips is accounted whereas within the city boundary, the highest emissions are being generated by light commercial vehicles (<0.75t Tempo equivalent) such as Car, '4 wheeled rickshaw', pickup truck and Van. It accounts for 61% (from LCV <3.5t) of total emissions from all modes when total trip length of freight trips is accounted for, and 73% (from 4-Wheeled Rickshaw, Pickup Truck, Van and Car (<0.75t Tempo equivalent) when only the length of the trips within the city boundary is accounted for. Mode wise breakup of emissions from total freight trip length and segment of trip length within city boundary has been presented in Figure 47 and Figure 48 respectively.

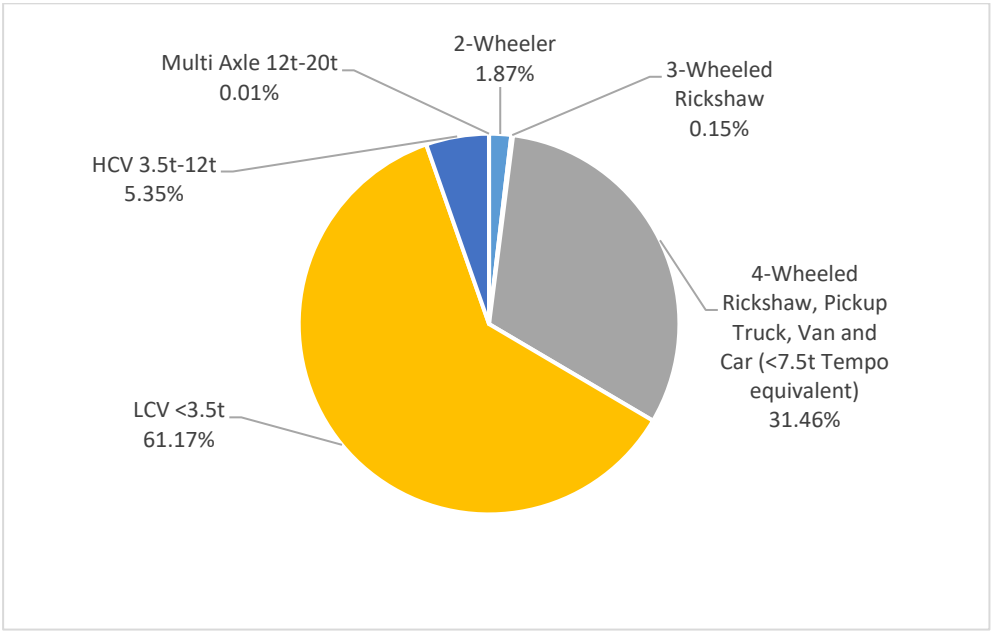

Figure 47: Panaji mode wise distribution of CO_2 emissions by mode for total trip length

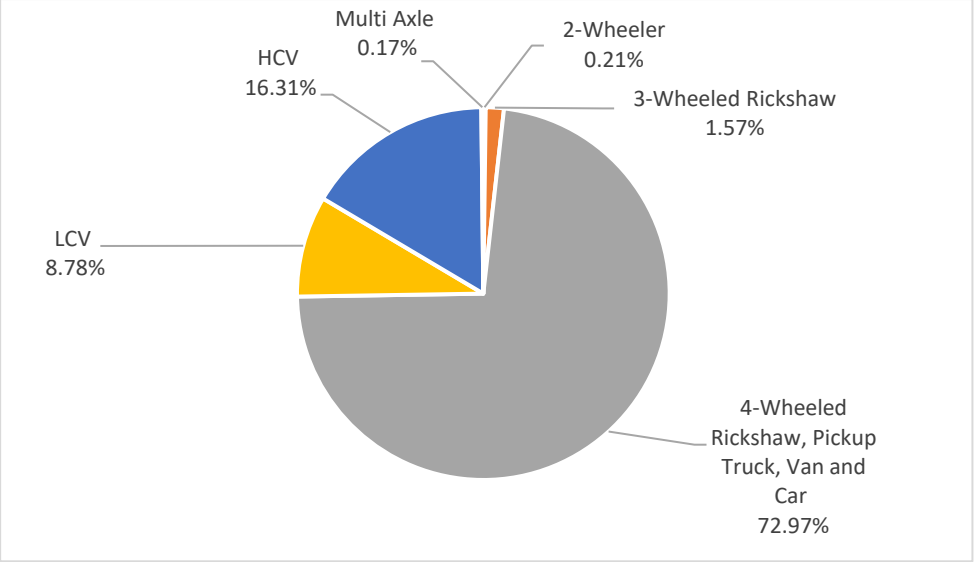

Figure 48: Panaji mode wise distribution of CO_2 emissions by mode for segment of trip length within the city boundary

As mentioned earlier, the emission intensity values for 3-wheeler, 2-Wheeler and Tempo are derived from secondary sources. These values are general values which have been calculated over a period and are not country specific and hence may differ slightly in Indian context. Additionally, emission intensity values in g/tonnes km may need to be derived specifically low weight carrying capacity modes such as motorized two wheelers, for a more accurate estimate of emissions from the freight sector in Indian cities. Also note that fuel consumption used in tool inputs have been derived from primary survey data and average vehicle utilization from survey data have been assumed as load factor (for different modes).

5.2 Recommendations and Low Carbon Action Plan

Based on the findings of this study, five broad recommendations are made, and a low carbon action plan is suggested. These recommendations are directed towards achieving long term decarbonization of urban freight sector in the city of Panaji, and also to address negative externalities of this sector on the broader region in general and on the traffic conditions of the city in particular. These recommendations include:

- Policy and technology intervention - Electrification (along with non-motorization) of freight trips in the city.
- Infrastructure intervention - Freight parking and logistics infrastructure development inside and on the periphery of the city.
- Operations intervention – Using freight aggregator model and temporal restrictions on movement of certain type of freight traffic within the city limits.

Each of these recommendations have been explained with a broad action plan below.

5.2.1 Policy and Technology Interventions

The total load of freight transported to and within the city of Panaji per day is estimated to be 2,038.85 tonnes. Of this only 7% or about 172.62 tonnes of delivery is to wholesalers/distributors/ centres in the city and comprises mainly of trips from outside the city. 670.35 tonnes of freight is delivered every day to retailers/commercial establishments in the city. This translates to about 97.53 kg of average freight delivered to each commercial/retail establishment every day. We also know that weighted average (for all freight transport modes and all commodities) per trip (total) weight

delivered in the wholesale distribution link is 1000.99 kg, while this value is 179.00[11] kg and 128.27 kg per trip, respectively for retail and residence/last mile distribution network. Weighted average of return journey length required for delivery of goods in retail and residence/last mile distribution network is 47.54 km and 31.23 km respectively. Therefore, more than 80% of freight transport trips in the city (majority of which is within city boundaries) are within the weight and range limits of most (currently) commercially available small electric vehicles (such as E-rickshaw and E-autos). Also, in north India a payload of 250 kg or more is frequently transported over distances in excess of 30 to 40 km by regular cycle rickshaw. **Hence it is recommended that the city consider introducing low carbon modes for freight delivery serving (both inward and outward) all retail establishments in the city.** These modes can include a mix of E-rickshaw, Cycle Rickshaw and Electric Cycle Rickshaw (current specification or manufacturers not known). This will allow reduction of carbon footprint from freight sector (especially when combined with renewable energy-based charging infrastructure).

The weighted average of peak load carried for Link 2, by Auto Rickshaw, Car and Van is less than 470 kg and the average return journey distance is less than 120 km. Similarly, the weighted average of peak load carried for link 3, by 'Auto Rickshaw, Pickup Truck, 4 Wheeled rickshaw, Van and Car is less than 370 kg (weighted average of peak load) for a distance of less than 120 km. Typical freight E-rickshaw has a capacity of 550kg and a range of 120 km at full charge and operates at a speed of 25 to 30 km/h[12]. It can therefore be considered feasible that at least 2/3rd of the freight trips undertaken (both to and from retail establishments) by these modes can be shifted to low carbon modes in the medium term (in the next 10 years). Additionally, at least 1/3rd of two-wheeler trips may also be shifted to low carbon modes such as e-rickshaw, while another 1/3rd can be shifted to zero carbon modes such as bicycles (or e-bicycles). Thus, it is estimated that a total of about 1,300 freight trips can be shifted from motorized modes such a Car, Van, 3 Wheeled Rickshaw, 4 Wheeled Rickshaw and Pickup Truck to Freight E-Rickshaws and about 1,000 trips can be shifted from motorized two wheelers to E-rickshaw while another 1,000 trips can be shifted from motorized two wheelers to bicycle. If an average 1.5 trips are considered per low carbon/e-vehicle in the city, a total of around 700 bicycles and around 1,500 e-rickshaw (or a combination of e-rickshaw, cycle rickshaw or e-cycle rickshaw) may be required to be inducted in the freight delivery fleet for the city.

Of the approximately 2,300 trips which can be shifted to electric vehicles (e-rickshaw, e-auto or e-bicycle), an estimated close to 600 trips may be shifted from current fossil fuel based Auto Rickshaws in the city (currently an estimated 26 trips are made by freight auto rickshaws on a daily basis, to, from and within the city). The study findings suggest that each 3 wheeled rickshaw (auto rickshaw) makes an estimate of 2.71 trips (Table 110) trips per day. This suggests that approximately 10 auto Rickshaw are delivering goods both to retailers (as well other commercial establishments) and households in the city. The current average age of these carriers is estimated to be 12.43 years (Table 110). This indicates high inefficiency and emission load on account of old age of these vehicles. Therefore, it is recommended that in the short term (over the next 2 to 3 years) the city should target to replace the fleet of more than 10-year-old Auto rickshaws operating and entering the city to e-rickshaw or e-auto. It is also known that three pickup trucks operated by CCP have an average age of 12 years. These vehicles do not ferry more than 130 kg of peak load and operate less than 40 km in a day (Table 96). Since these vehicles may be beyond their operational age limit, it is recommended that CCP initiate replacing these vehicles with suitable E-rickshaw/e-auto within this year, as a pilot and a technology demonstrator phase, in order to encourage private operators (especially auto rickshaw owners in the city) to transition to e-loaders.

The impact of LCVs is the highest on emissions from freight sector (as discussed earlier), and this mode carries the maximum share of total load transported in the city and the distance over which this load is transported (discussed earlier). It is known from the primary surveys that a total of

[11] Weighted average of weight delivered to retail establishments per trip is 119.33 kg and each delivery vehicle is expected to serve on average 1.5 establishments in a return trip.

[12] Source IndiaMart: https://www.indiamart.com/proddetail/e-rickshaw-loader-9125187048.html

approximately 285 LCVs carry freight to/from and within the city (Table 3, Table 96 and Table 110). It is also known that the average age of LCVs transporting goods within as well to/from the city is 9.4 years (which is the second highest amongst all freight modes being used in the city). This indicates that the majority of LCVs used in the freight sector are close to or more than 10-year-old, suggesting an increased emission burden on account of old age of this fleet. It is therefore recommended that the city introduce policies to encourage transition of old (more than 10 year old) LCVs to Euro 6 Diesel vehicles in the short and immediate term (over the next 10 years) and Electric (such as Tata Ultra T.7 Electric - Figure 49) in the medium to long term (over the next 10 to 20 years).

Figure 49: Example of electric LCV that are soon to hit Indian market

To encourage this transition from fossil fuel based internal combustion engine (ICE) modes to more efficient (Euro 6 Diesel) and greener (electric) modes, the city will need a policy to incentivize cleaner freight vehicles while disincentivizing old ICE based vehicles. It is recommended that the city/State develop and implement an EV policy for Panaji/Goa (in the short term, i.e. within the next 3 years) with special focus on freight transport. The policy may also include the recommendations listed here as a part of the action plan for decarbonizing freight sector in the city. The policy can build in incentive mechanism for e-freight vehicle users. This may include subsidized or free charging facility (to be provided by CCP) along with concessions on registration charges, insurance, etc. Additionally, the incentive mechanism may facilitate tie ups with financial institution for easy availability of loans. In order to disincentivize the use of older (10 year or older) ICE based modes, the city may initiate restriction of movement of such vehicles at specified times and/or specified locations in the city. For example, movement of old ICE based goods vehicle in the core market area of Panaji may only be allowed between 10pm and 6am[13]. The current impact of freight traffic in the overall vehicular congestion in Panaji city is not very high (average share of freight trips in the traffic is 8.41%), and it is lower in peak hours when the traffic volumes in general is higher. Therefore, any general restrictions on freight traffic movement during peak hours throughout the city may not produce significant

[13] Such measures may be feasible in the medium term (after 3 to 10 years).

positive or desired results and may not be recommended till the transition of current ICE fleet of freight vehicles has been initiated to an e-fleet.

5.2.2 Infrastructure Interventions

Freight traffic is not known to produce a significant parking demand (800 ECS). This is for two reasons. One, the share of motorized freight trips in overall motorized trips in the city is less (around 26%), and two, majority of parking demand (78%) is for short term, which means that the same bay can be used at least 3 to 4 times, or the parking requirement for freight vehicles per bay is about 30% to 40% of passenger vehicles (majority of which is known to be for 8 hours or more). Thus, it can be estimated that while the freight trips constitute 26% of total motorized trips in the city, parking demand by freight vehicles (including private freight vehicles) is expected to be in the range of 10% to 15% of the total parking demand in the city. However, in order to maximize efficiency and to reduce obstruction from any parked vehicles, it is recommended that the city adopt a parking policy, and gradually all street parking (especially near commercial areas) should be converted from free parking to paid parking, with marked parking bays and strategically located, reserved spots for freight delivery vehicles.

CCP has already initiated payment for parking in the core market area of the city. It is recommended that it be expanded to the rest of the city in a phased manner. Additionally, the streets with paid parking provisions should have defined and demarcated parking infrastructure, with reserved spaces for freight vehicles. Defined freight parking bays will allow CCP to provide provisions for (public) charging infrastructure for freight vehicles. Thus, planning of streets with parking provision for both passenger and freight vehicles, should be taken up especially in areas with high parking demand. Thus, this intervention should be taken up in a phased manner in Zone 1, 3 and 4 as a part of an urban development and rejuvenation effort.

Reserved parking for goods rickshaws has been defined by CCP on the road between Mahatma Gandhi Road and the Indoor Market (Figure 50). There also exists a DPR with plans for roof top solar at the indoor market. Additionally, there are loading and unloading bays (for goods vehicles) behind the indoor market. It is recommended that this 'market street' and/or the loading bays behind the indoor market (Figure 51), should be taken up for redevelopment in the immediate phase. As a part of this redevelopment this street can be planned for freight vehicle parking along with public charging infrastructure (to be developed and maintained by CCP). In the immediate term, i.e. within this year, a total of 8 charging stations (4 slow and 4 fast) be provided in this area (these can cater to more than 40 vehicles in a day). These can be energized by the proposed roof top solar at the indoor market to ensure, truly green freight deliveries in Panaji. As the demand for e-freight vehicles grows in the city, CCP may collaborate (over the next 3 to 10 years) with other private or government properties to explore more options of roof top solar, and roof top solar charged public charging stations – initially in the core market area, followed by Patto and Fontainhas.

Figure 50: Goods rickshaw stand near indoor market at Panaji

Figure 51: Location of indoor market and designated goods rickshaw parking

Observations made on freight delivery network in Panaji suggest that goods being shipped to wholesalers and retailers in the city transition from large trucks to smaller vehicles such as pickup trucks, at the city boundary. This operation takes place informally along the highways connecting the city. This operation leads to parking of large and small vehicles along the highway for extended periods of time, leading to both congestion and unsafe conditions. There has thus been a demand from many stakeholders for a logistics hub or a Transport Nagar on the periphery of the city. One such location identified for the same is 'Kadamba Platue' area. It Is recommended that CCP in consultation with Government of Goa (and/or relevant department), take up the development of the proposed Transport Nagar on the periphery of the city. This infrastructure is expected to not only improve the efficiency of freight delivery operations in Panaji (as well wider region) but will also facilitate other intervention (such as aggregator model, discussed below) necessary of decarbonizing urban freight in the city.

5.2.3 Operational Intervention

While a large proportion of freight trips have a potential to be shifted to low carbon or zero emission modes, yet others have the potential to reduce emission by increasing utilization and thus overall efficiency. The overall utilization of motorized freight delivery vehicles (including two wheelers) to retailers (from wholesalers) is estimated to be 22.73% while the same is estimated as 514.86% for home deliveries. Majority of freight vehicles return empty, a significant number only carry between 20% to 60% of the payload capacity and almost all of them carry freight in one direction, while the return trip is empty. It is recommended that the city explore a freight vehicle aggregator model for freight deliveries. This should allow scheduling of deliveries so that trips can be combined and efficiency per trip increased. It is expected that an average efficiency of between 30 to 50% should be achievable by such efforts. A number of freight and logistics aggregators are currently operational in India (example, 'freightbro,' 'freight bazaar', 'vamaship', etc.), however they are currently mainly dealing with non-urban freight. It is recommended that CCP may engage with one or more of these aggregators to develop solutions specific to freight movement in Panaji and undertake a pilot in the next 1 to 3 years. This may initially focus on establishments in core market area or CBD and Pato and may initially focus on non-perishable commodities such as e-commerce, FMCG and electronics. The learnings from this pilot may be used to expand the operations to entire Panaji and the outgrowth area over the next 3 to 10 years. CCP and the Government of Goa may need to facilitate such aggregator operations by providing adequate investments and support, such as that for development of proposed logistics hub in the Kadamba Platue area.

6 Annexure

6.1 Meeting Minutes

6.1.1 Kick-off Meeting Minutes

Meeting Date and time: 30th October 2019, Wednesday @ 12:00pm
Attended by:

- Mr. Ashish Rao Ghorpade, ICLEI - SA, New Delhi
- Mr. Vijay Saini, ICLEI - SA, New Delhi
- Mrs. Avantika Arjuna, ICLEI - SA, New Delhi
- Mr. Sandeep Gandhi, SGA, New Delhi
- Ms. Kanica Gola, SGA, New Delhi

Venue: ICLEI - SA Office, Green Park, New Delhi
Minutes:

- Meeting initiated with the introduction of "EcoLogistics - Low Carbon Freight for Sustainable Cities" project to the SGA team.
- ICLEI – SA team explained the Urban Freight Scenario in Panaji followed by the EcoLogistics Self-monitoring tool.
- During the meeting, the role of SGA was elaborated to the team. As per current situation, at government level there is minimal or no documentation on capturing freight sector. Hence, as per the objective of the project, primary surveys are required to validate the data which ICLEI – SA has collected so far.
- Major role of SGA in this project would be to consolidate and review the urban freight data and to highlight the important gaps along with measures to address the highlighted gaps and their implementation strategies for priority projects if any. Also, to assist ICLEI - SA in validating the self-monitoring tool (developed as part of EcoLogistics project) in the context of Indian cities.
- It was discussed that SGA will develop the survey formats to conduct various primary surveys in Panaji city. The aim of these surveys would be to capture all missing information which is essential to capture the urban freight scenario in the city. Another task would be to develop and finalize the methodology to quantify the issues and impacts associated with urban freight in the city.
- Meeting with CCP Commissioner

Meeting Date and time: 5th November 2019
Attended by:

- Mr. Sanjit Rodrigues – Commissioner, Corporation of the City of Panaji
- Mr. Ashish Rao Ghorpade – Deputy Director, ICLEI SA
- Dr. Sandeep Gandhi – Principal, Sandeep Gandhi Architects
- Mr. Vijay Saini – Deputy Manager, ICLEI SA
- Mr. Amar Kulkarni – Project Officer, ICLEI SA
- **Venue:** Corporation of the City of Panaji

Minutes:

- ICLEI SA and SGA team explained the objective of the EcoLogistics project and the need and requirement of primary surveys for the same to the commissioner. The team also explained the tentative survey plan and the details that are to be collected through the survey. It was brought to the commissioners notice that the co-operation of traffic police is important because the drivers need to be surveyed.
- ICLEI SA team introduced the SGA team to the commissioner and informed him that SGA will be leading the primary data collection effort in Panaji.

- The commissioner asked the project team to present him the detailed timeline for the survey, along with the survey form or the details of the data to be collected. He also suggested that the project team, provide him with a list of stakeholders that need to be surveyed, and he will then help us organize the meeting with the same.
- The project team also brought to his notice that a workshop with all stakeholders including the trader's association is planned as a part of the project. The project team also shared the tentative list of stakeholders with the commissioner.
- The ICLEI SA officer gave a brief presentation to the commissioner on the topic of introduction to the urban freight in Panaji and explained the research carried out in Panaji.
- The commissioner suggested that this stakeholder meeting be organized at the end of November after ICLEI's national-level meeting in Delhi on November 26 and 27. He also asked for a suggested list of stakeholders to be included in the stakeholder committee, for this project.
- ICLEI SA invited and requested the commissioner to participate in the National Level Meeting at Delhi.

6.1.2 Meeting with Mr. Shrikant Lavande, Municipal Engineer (Grade III), CCP

Meeting Date and time: 5th November 2019
Attended by:

- Mr. Shrikant Lavande – Municipal Engineer (Grade III), Corporation of the City of Panaji
- Mr. Ashish Rao Ghorpade – Deputy Director, ICLEI SA
- Dr. Sandeep Gandhi – Principal, Sandeep Gandhi Architects
- Mr. Vijay Saini – Deputy Manager, ICLEI SA
- Mr. Amar Kulkarni – Project Officer, ICLEI SA

Venue: Corporation of the City of Panaji
Minutes:

- ICLEI and SGA team explained the objective of the EcoLogistics project and the need and requirement of primary surveys for the same to Mr. Lavande. The team also explained the tentative survey plan and the details that are to be collected through the survey.
- ICLEI team introduced the SGA team to Mr. Lavande and informed him that SGA will be leading the primary data collection effort in Panaji.
- The project team also explained to Mr. Lavande about the plan for forming the stakeholder committee and organizing a stakeholder workshop for this project.
- Mr. Lavande offered his complete assistance to the project and suggested to SGA team that any need for assistance on the projector for data collection may be conveyed to him through Mr. Amar Kulkarni, i.e. ICLEI SA's local representative.

6.1.3 Meeting with Charles Correa Foundation (CCF)

Meeting Date and time: 5th November 2019
Attended by:

- Mrs. Nandita Correa – Principal, Charles Correa Foundation
- Mr. Tahir Norhona – Researcher, Charles Correa Foundation
- Mr. Ashish Rao Ghorpade – Deputy Director, ICLEI SA
- Dr. Sandeep Gandhi – Principal, Sandeep Gandhi Architects
- Mr. Vijay Saini – Deputy Manager, ICLEI SA
- Mr. Amar Kulkarni – Project Officer, ICLEI SA
- **Venue:** Charles Correa Foundation

Minutes:

- ICLEI and SGA team introduced the EcoLogistics project and explained the objective of the same along with the need and requirement of primary surveys for the same to the CCF team. ICLEI team explained the purpose of the current visit to CCF, i.e. to explore if ICLEI SA and CCF can collaborate in any way on the project, and to explore if any freight-related data may have been collected by CCF as a part of any of their studies.
- CCF team explained to the project team that they are interested in working on mobility for Panaji but are currently focusing on passenger mobility. They explained the work done in this regard on the shuttle bus service in Panaji as well as on a proposal for water-based passenger mobility on the Mandovi river.
- The project team discussed issues and possible solutions as well as methodologies for the same with the CCF team.
- CCF team also explained about their studies in the Greater Panaji City area (urban planning studies).
- The meeting concluded with both the teams agreeing to remain in touch and share any information, as well as contribute through idea sharing on the current EcoLogistics project as well as any mobility studies that CCF may be undertaking.

6.1.4 Meeting with Mr. D. G. Angle, DYSP, Traffic Division, North Goa

Meeting Date and time: 6th November 2019
Attended by:

- Mr. Dharmesh Angle – Deputy Superintendent of Police, Traffic Division, North Goa
- Mr. Ashish Rao Ghorpade – Deputy Director, ICLEI SA
- Dr. Sandeep Gandhi – Principal, Sandeep Gandhi Architects
- Mr. Vijay Saini – Deputy Manager, ICLEI SA
- Mr. Amar Kulkarni – Project Officer, ICLEI SA
- Meeting with Dy.SP. D G Angle, Traffic Police (North Goa)

Venue: Traffic Police Headquarters, North Goa
Minutes:

- ICLEI and SGA team explained the objective of the EcoLogistics project and the need and requirement of primary surveys for the same to Mr. Angle. The team also explained the tentative survey plan and the details that are to be collected through the survey.
- The project team explained that one of the most important surveys for the project is freight vehicle driver interviews. The team explained that through this interview the team will collect a picture of the weight bridge report, waybill, vehicle details, etc.
- Mr. Angle inquired as to what help is required from the police to conduct these surveys.
- The project team explained that traffic police personnel will be important for this survey as they will make the data collection official, and in their absence freight vehicle drivers are unlikely to share any information.
- Mr. Angle agreed to provide the required assistance but informed the team that his staff will be busy from Nov. 18 onwards as Goa is witnessing the film festival from Nov. 20 following which tourist rush will begin in the State.
- The team agreed to initiate the driver survey at the earliest and conveyed that Mr. Amar Kulkarni from ICLEI will be in touch with him to finalize the date and other details of this survey.

6.2 Survey Forms

6.2.1 Freight Establishment Survey Form, Panaji (Urban)

Surveyor _____ Date _____, Location/Zone_____ Time _____

Food Grains	Perishable Food	Liquor	FMCG	Couriers & E-comm.	Cash	Pharma	Hotel & Restaurant	Solid Waste	Construction & Demolition	Oil & Natural Gas	Others	Others	Others

6.2.2 Freight Parking Survey Form, Panaji (Urban)

Surveyor _____ Date _____, Location/Zone_____ Time _____

Walk	Cycle	2W	Auto Rick.	Tempo (<0.75t)	Van	LCV (1-3.5T)	Truck (3.5-7.5T)	HDT (7.5-18T)	Tanker	Sewage & Sullage	Garbage	Others	Others	Others

6.2.3 Freight Driver Survey Form, Panaji (Highway)

Surveyor _____ Date _____, Location_____ Time _____

Veh. Number Or (for private)	Vehicle Type												Fuel type	Make	Year	Odo Read	Origin	Dest	Weight	Commodity
	Multi Axle	HCV	LCV	Van	Auto	Pickup Truck	Dumper Tanker	Cycle Rick	E Rick	Cycle	Foot	Other								

6.2.4 Freight Household Survey Form, Panaji (Urban)

Surveyor _____ Date _____ Location_____ Time _____

Owner details	Type	Connec.	No. of Veh. owned	HH Income	No. of trip/ week (W), Month (M), Year (Y), Kg or Rs, Mode (delivery-D, Self-S). Dist to source/shop									
					Perishable	Liquor	FMCG	Clothes & Acces.	Water	Sewage	Solid Waste	Couriers & E Comm	Const.	Pharma
Add	Plotted	Sewage	Car P	<10K	Trips	Trips	Trips	Trips	Trips	Trips	Trips	Trips	Trips	Trips
	Multi St.	Water	Car D	10 to 30K	Kg/Rs	Kg/Rs	Kg/Rs	Kg/Rs	Kg/Rs	Kg/Rs	Kg/Rs	Kg/Rs	Kg/Rs	Kg/Rs
Tel.	Basti	Electric	2 W	30k to 1L	Mode	Mode	Mode	Mode	Mode	Mode	Mode	Mode	Mode	Mode
Fam. size	Other	Gas	Cycle	>1L	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.	Dist.

6.2.5 Freight Retail Survey Form, Panaji (Urban)

Surveyor _____ Date _____, Location_____ Time _____

Shop Name/Add.	Comm. Type	Helpers (no.)	Total daily value or weight of good home delivered	How many home delivery trips in a day (Avg. Dist. in km)						Inward delivery avg. daily cost/kg & trips (Avg. Dist. In km)						Average daily Walk-in customers
				Walk	Cycle	Cycle Rick.	2W	Pickup Truck/ auto	Others	Bicycle	Cycle Rick.	2W	Pickup Truck/ auto	Truck >3T	Others	
			<7,500 (<100 kg)													
			7,500 - 20,000 (100 - 250 kg)													
			20,000 - 40,000 (250 - 500kg)													
			>40,000 (>500 kg)													

6.3 Categories Under Commodity Type

S. No.	Commodity type	Variety of products and retail establishment involved
1	Food Grains	Rice, Wheat, Pulses, Ration and Flour mill shops (mostly all shops which deals with FMCG like grocery stores, general stores and departmental stores which also carries food grains is involved in this commodity type)
2	Perishable Foods	Eggs, Milk, Bread, Other dairy products, Poultry, Fish, Fruits, Vegetables, Baked goods, and Flowers (this will include both formal and informal shops)
3	Liquor	Alcoholic beverages including ready to drink (RTD) mixed spirits (this will include all kind of wine and beer shops including General, Departmental stores, Supermarkets, Hotels, Bars, and Restaurants)
4	FMCG	Packaged food, toiletries, beverages, over-the-counter medicines, cleaning and laundry products, plastic goods, personal care products, (this will include Grocery, General and Departmental stores, Supermarkets, and all other informal shops)
5	Couriers & E-commerce	It includes all sorts of Parcels, Documents, Electronics, Food Products, University Document Courier Services, Medicine, Home Appliances, Lifestyle, Clothing, Accessories, Personal care products, Stationary, Plastic Products, Cleaning and Laundry Products etc.
6	Cash	ATMs (inside and outside banks)
7	Pharmacy	Medicines, Medical instruments, Personal care products (individual Pharmacy/Chemists shops within and outside hospital premises)
8	Hotel & Restaurant	FMCG, Perishable Goods, Poultry, Dairy Products, Water (this will include shops like juice, bakery, café, informal tea shops etc.)
9	Solid Waste	It includes all bio and non-biodegradable waste from household, shops, factories, restaurants etc. (collected by hand driven and pushcart, 4W Rickshaws and pickup trucks by Municipal Authority)
10	Construction & Demolition	Debris, construction waste, Bricks, hardware and sanitary products, furniture, and al kind of lifestyle products etc. (including interior, paints shops etc.)
11	Oil & Natural Gas	LPG Gas Cylinders, Petrol Pumps, CNG Pumps etc.
12	Clothes and Accessories	It includes Clothing shops, Boutiques, Dry cleaners, Jewellery, Shoes, Purse, Caps and Belts etc.
13	Electronics	It includes Televisions, Refrigerators, Mobiles, ACs, Heaters, Vacuum Cleaners, Cameras, Audio devices, Smart phones, Tablets, and many such other electronic goods.
14	Printing & Publishing	It includes all stationary items, Fax, Photostat, Printers, Scanners etc.
15	Sewage	Sewage Treatment Plant
16	Others	It includes toys, utensils and all kind of household products which are different from above mentioned categories.

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