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From Farm to Table, Faster and Fresher: A Case Study of Optimising Shared Delivery for Urban Vegetable Distribution in Kozhikode

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Introduction

- Urban freight transport is vital for maintaining urban economies by ensuring timely delivery of goods.
- Urban freight transport faces unique challenges due to dense cities, increasing demand, complex deliveries, infrastructure constraints, and environmental concerns.
- Good policies and advanced technologies are essential for sustainable and efficient urban deliveries.
- Kozhikode in Kerala mainly uses roads for urban deliveries.

Objectives of the study

- To assess the feasibility of implementing shared delivery services among vegetable retailers in Kozhikode.
- To enhance the efficiency of urban vegetable distribution through the promotion of shared delivery services.
- To quantify the effects of shared delivery in terms of vehicle kilometres travelled and fuel consumption.

Methodology

- Literature survey.
- Questionnaire design.
- Data collection through face-to-face interview.
- Assessing retail traders' willingness in shared delivery.
- Modelling of optimal shared delivery route network.
- Formulation of alternate scenarios.
- Scenario analysis.

Questionnaire

Freight Transport Survey of Retail Traders

CENTER FOR TRANSPORTATION RESEARCH DEPARTMENT OF CIVIL ENGINEERING

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT

Freight transport plays a crucial role in day-to-day life of the people. Efficient urban freight transport minimizes the transportation cost, time and traffic congestion. The efficiency of urban freight contributesto the competitiveness of the economic fabric of a city, its attractiveness to visitors and the well-being of the citizens. An understanding of the preferences of retail traders will enable transportation planners to develop strategies to reduce the cost and distance of transportation. This survey is organizing to determine and assess retail traders' willingness for shared delivery of goods and develop an optimal freight route network for efficient delivery of goods between traders. We request your wholehearted cooperation and to provide the necessary details. The data collected will be used solely for academic purposes.

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Establishment details:

Name of the establishment			
Address		GPS Coordinates	
Phone			
Age of owner			

→Type of business:

Independent Retail store	Part of co-operative	Retail chain
☐	☐	☐

→Number of years of trading at above address:

a) 1 year or less
b) 5 years or less
c) 10 years or less
d) Over 10 years

→Total number of all staff and employees working in your establishment: .....

→Gross floor area of the establishment: .....

→Do you dispatch goods to your customers? (Yes or No)

→Do you buy from the same supplier all times? (Yes or No)

→ How do you choose your supplier?

(Give ranking from 0 to 7, 0 means it has no impact, 7 means it has high impact)

- Some suppliers deliver only on certain days.....( )
- Suppliers decides delivery date, you have no control.....( )
- Suppliers will not deliver earlier or later than a certain time of day.....( )
- Suppliers deliver before there is anyone to receive the goods and the goods are left outside your premise.....( )
- Quality of items.....( )
- Price of items.....( )
- Credits.....( )

→ How you are placing your orders:

Through phone call ..... ☐
Using mobile application (APP) ..... ☐
Representatives ..... ☐

→Do you use a smart phone? (Yes or No)

→Do you like to use your smart phone for placing order? (Yes or No)
If No why:

→How you are receiving goods now:

a) By supplier vehicle (full load or shared)
b) By 3PL (3rd party logistics)
c) On my own vehicle
d) Hiring vehicle
e) Taking it on (bus or auto)
f) Any other.....

→Are you willing to receive goods by shared mode? (Yes or No)

→Indicate the delivery frequency in each of the following periods of weekdays:

Before 8 AM	
8:00 – 9:30 AM	
9:30 – 12:00 AM	
12:00 – 2:00 PM	
2:00 – 5:00 PM	
5:00 – 6:00 PM	
After 6:00 PM	

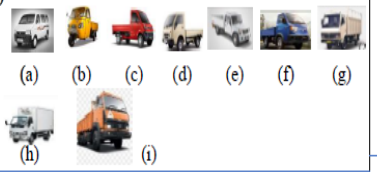
a) Most
b) Many
c) Few
d) None

→What type of vehicle deliver your goods and how long does it take for unloading.

1	2	3	4	5

1) Items received
2) Vehicle type
3) Deliveries received per week
4) Unloading time
5) Quantity received in each delivery

2)



(a) (b) (c) (d) (e) (f) (g)

(h)

(i)

→ Where do delivery vehicles park when unloading is taking place?

a) On establishment premises
b) On a public road in front of establishment
c) Away from the premises

→ Do you have any loading/unloading restrictions at your premises? (Yes or No)

a) Timings
b) Vehicle type restrictions
c) Weight limits
d) Others (.....)

→Rank the following factors with respect to selection of mode of delivery?

(Fill in the boxes with numbers ranging from 0 to 4, 0 means it has no impact, 4 means it has high impact)

- Transportation cost ( )
- Based on order quantity ( )
- Because of vehicle restrictions ( )
- Lack of loading/unloading spaces ( )

Any other reasons.....

→ Please give your suggestions to improve urban freight transportation?

Establishment based freight survey

Establishment Survey Outcomes

- 62 vegetable retailers in Kozhikode City participated in the questionnaire survey.
- Only 11.3% of deliveries are fulfilled through shared supplier vehicle deliveries due to concerns about potential delays impacting the quality of goods.
- 80.6% of retailers are willing to use shared delivery transport, provided that faster delivery, a guarantee quality, and easy replacement in case of damages are offered.

Capacitated Vehicle Routing Problem (CVRP)

CVRP consider the maximum capacity of each vehicle

Need for CVRP

- **Minimize Resource Utilization:** By optimizing routes and minimizing total distance traveled, suppliers can maximize the use of their vehicles and drivers, leading to improved operational efficiency.
- **Increase Cost Efficiency**: Minimising transportation costs and fuel consumption by optimising the allocation of vehicles and routes.
- **Reduce Environmental Impact**: Reduce fuel consumption and exhaust emissions.

Sensitivity Analysis of Shared Delivery

Scenarios:

1. Do-nothing (no additional shared delivery)
2. 20% new shared delivery
3. 50% new shared delivery
4. 90% new shared delivery

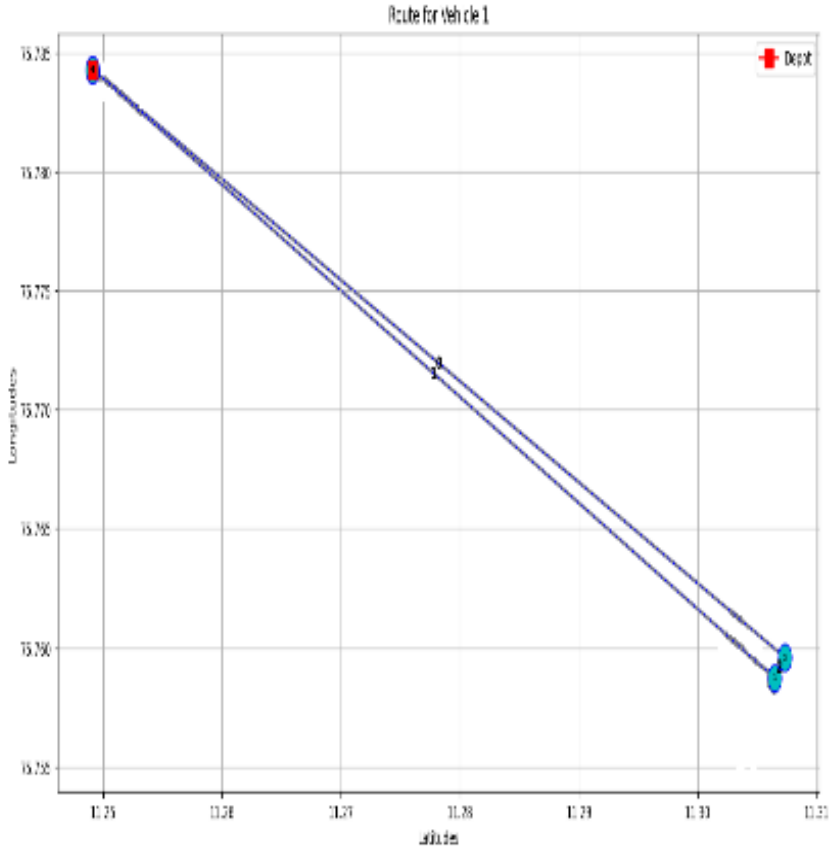
- Optimum routes for different scenarios were found.
- Vehicle kilometres travelled and fuel consumption was determined.
- The main category of vehicles considered for urban freight transport of vegetables in Kozhikode is Ashok Leyland with a 1500kg capacity.
- A Python program was developed for solving the CVRP.

Sensitivity analysis of shared delivery

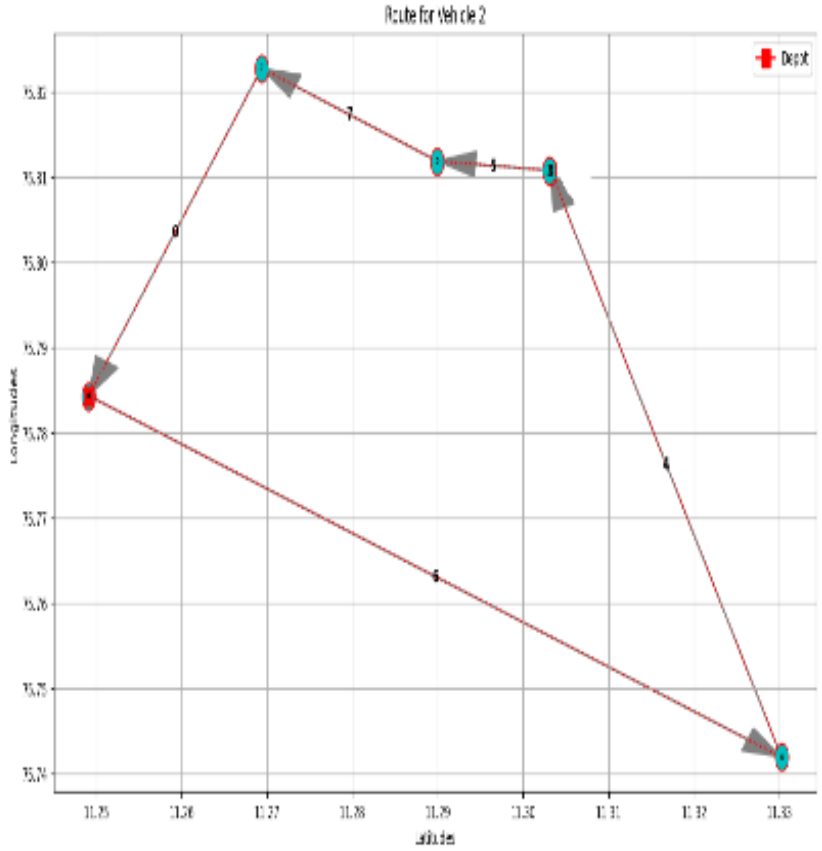
Scenario	1 (Do-nothing)	2	3	4
Percent of retailers considered for new shared delivery	0%	20%	50%	90%
Number of retailers served by shared delivery	7	7+11 = 18	7+28 = 35	7+50 = 57
Number of retailers relied on independent transport	55	44	27	5
Total retailers	62	62	62	62
Actual proportion of retailers included in the scenario	11.3%	29.0%	56.5%	91.9%
Optimal Vehicle Fleet Size determined by CVRP	2	3	5	6
Vehicle kilometres travelled by each shared vehicle	18.2, 35	18.2, 38.9, 21.7	51.4, 18.2, 25, 25, 21.6	58.3, 17, 34, 25, 15.4, 13
Vehicle kilometres travelled by all shared delivery vehicles	53.2	78.8	141.2	162.7
Vehicle kilometres travelled for all non-shared deliveries	853.0	715.9	429.0	120.1
Total Vehicle kilometres travelled	906.2	794.7	570.2	282.8
Percentage reduction in Vehicle kilometres travelled in relation to a Do-nothing scenario	-	12.3%	37.1%	68.8%

Do-nothing scenario

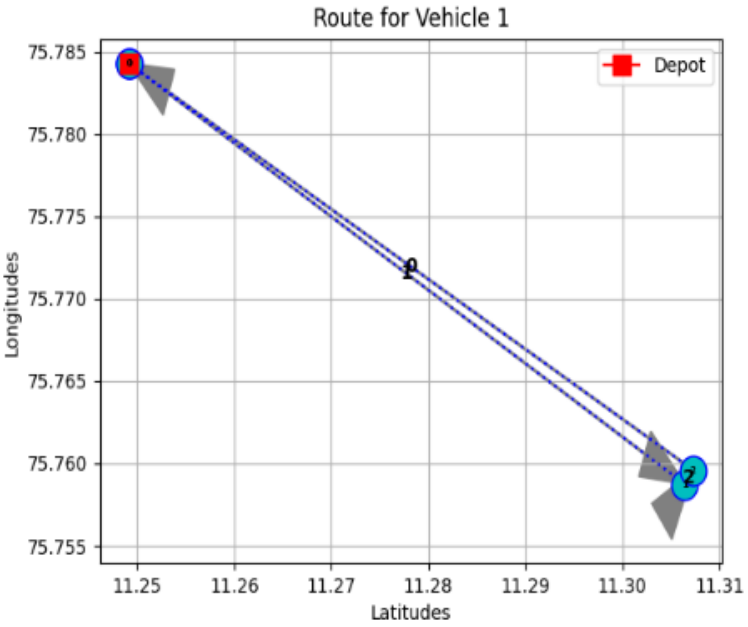
Route for vehicle 1

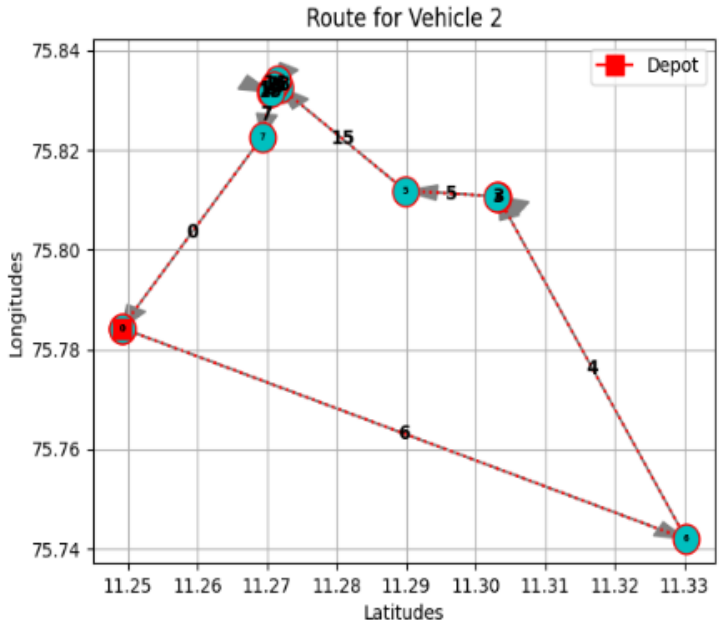


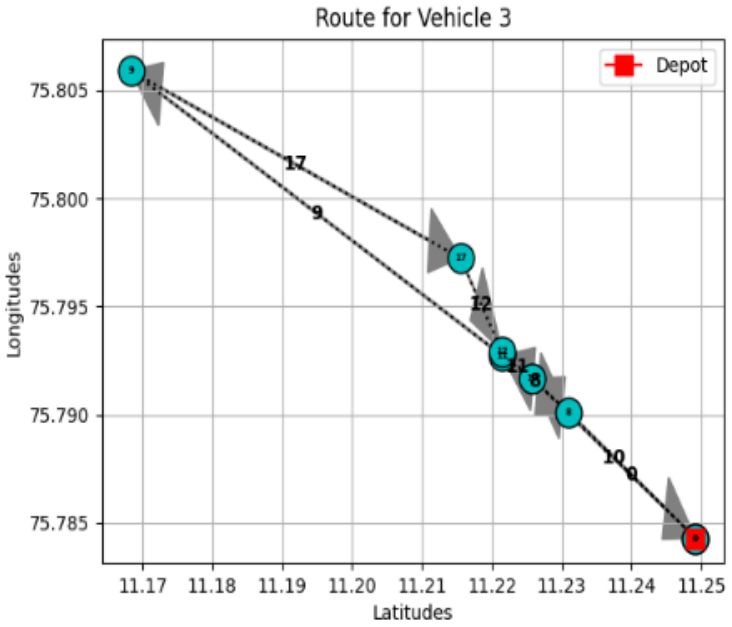
Route for vehicle 2



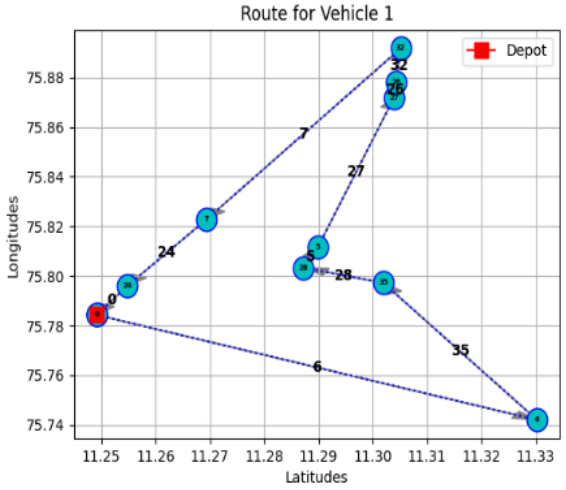
20% new shared scenario

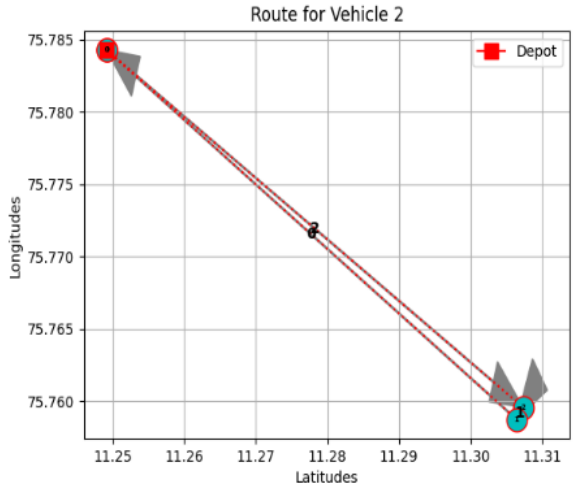


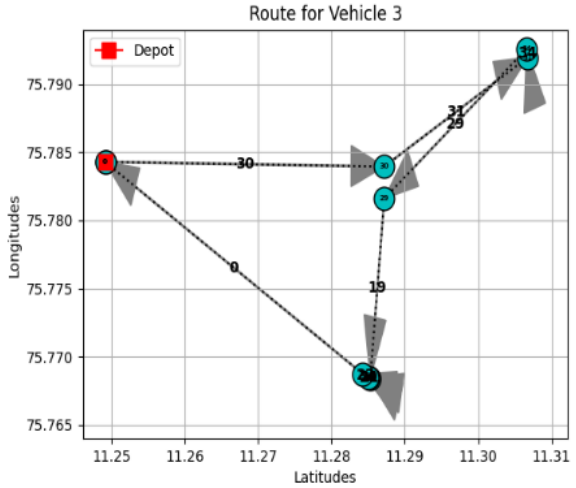


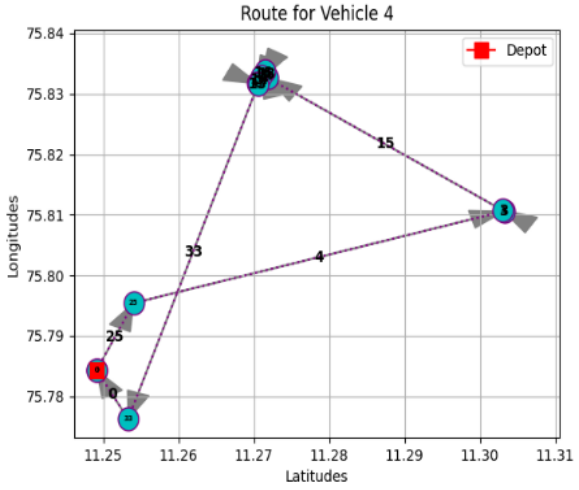


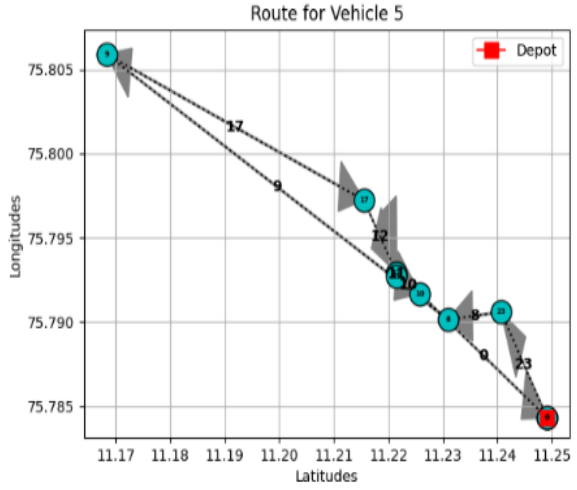
50% new shared scenario



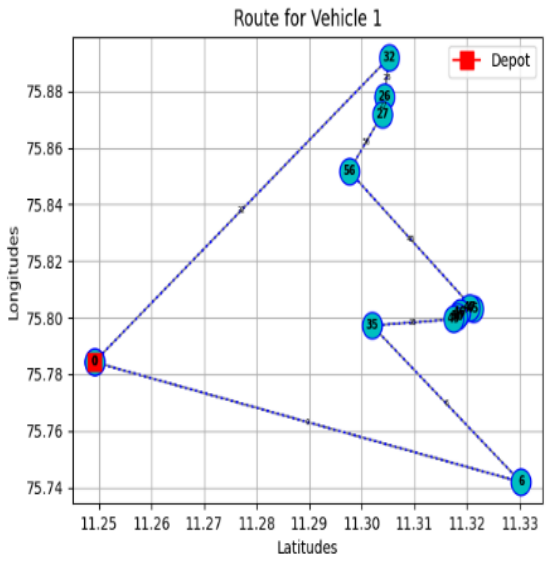


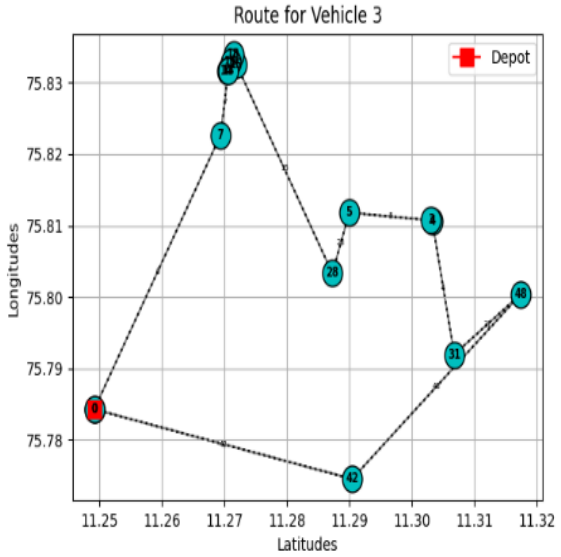


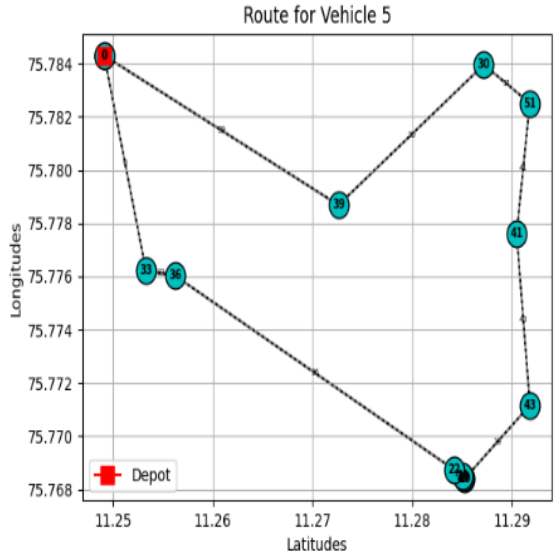


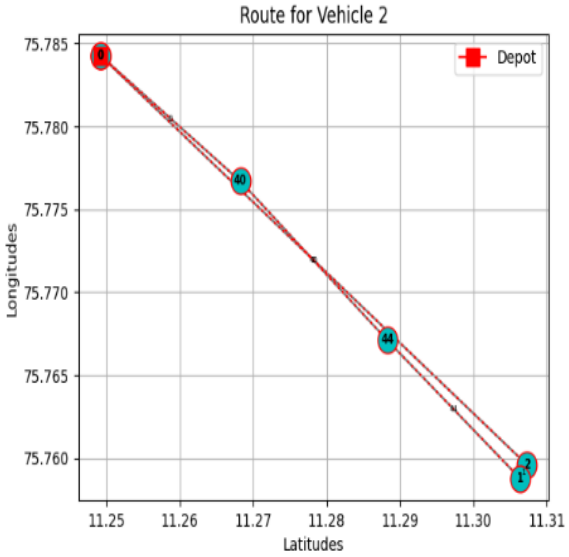


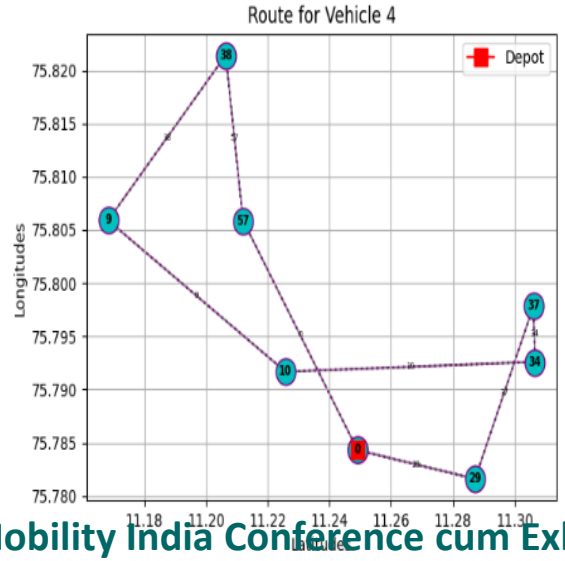
90% new shared scenario

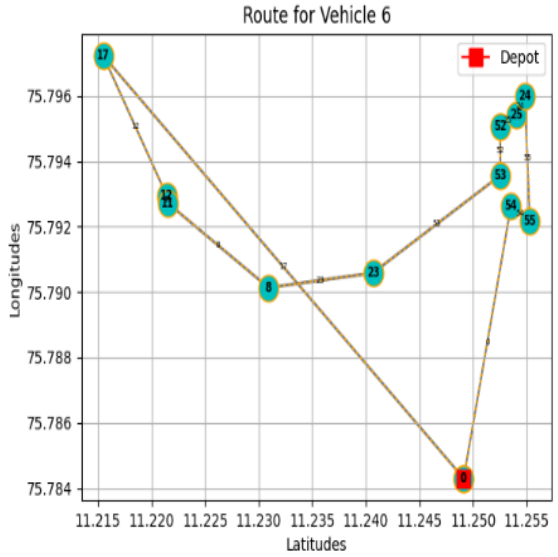




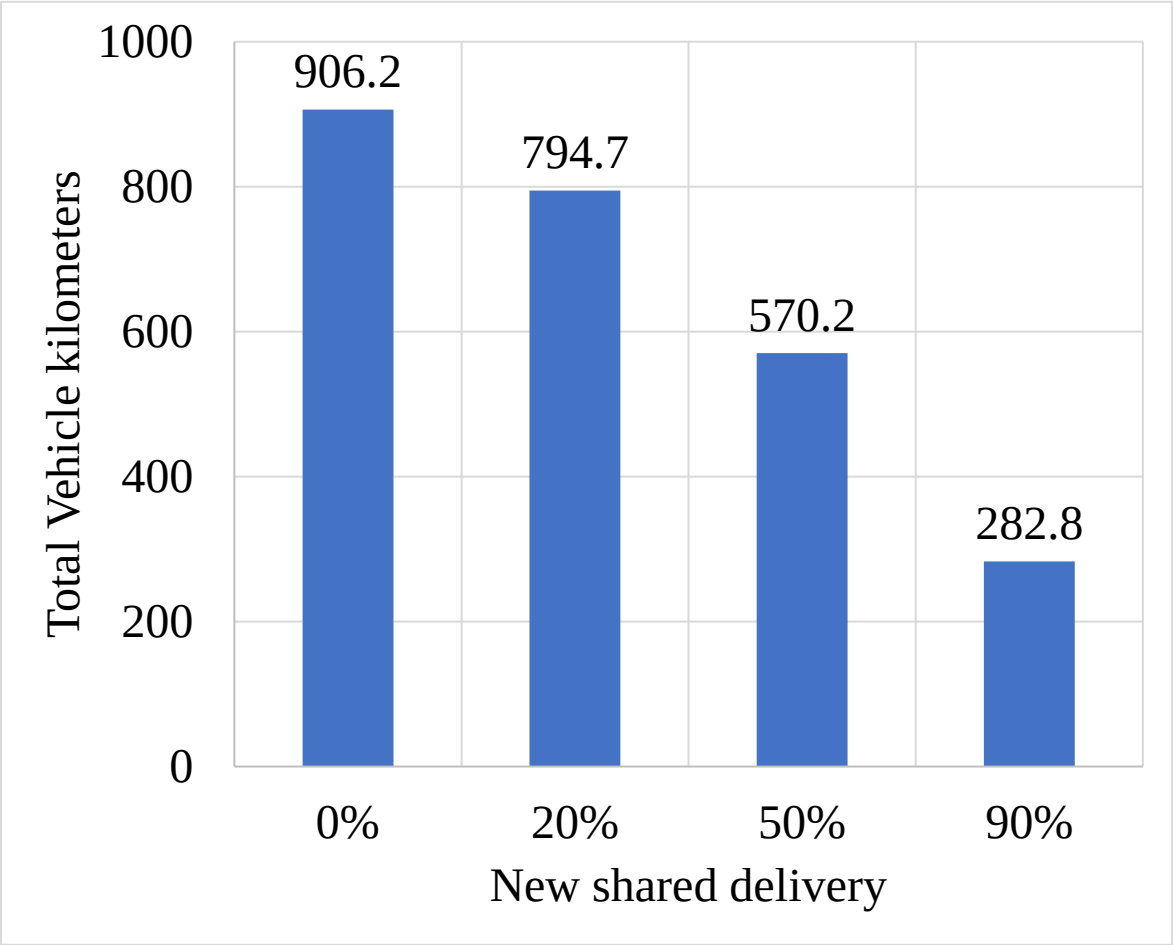






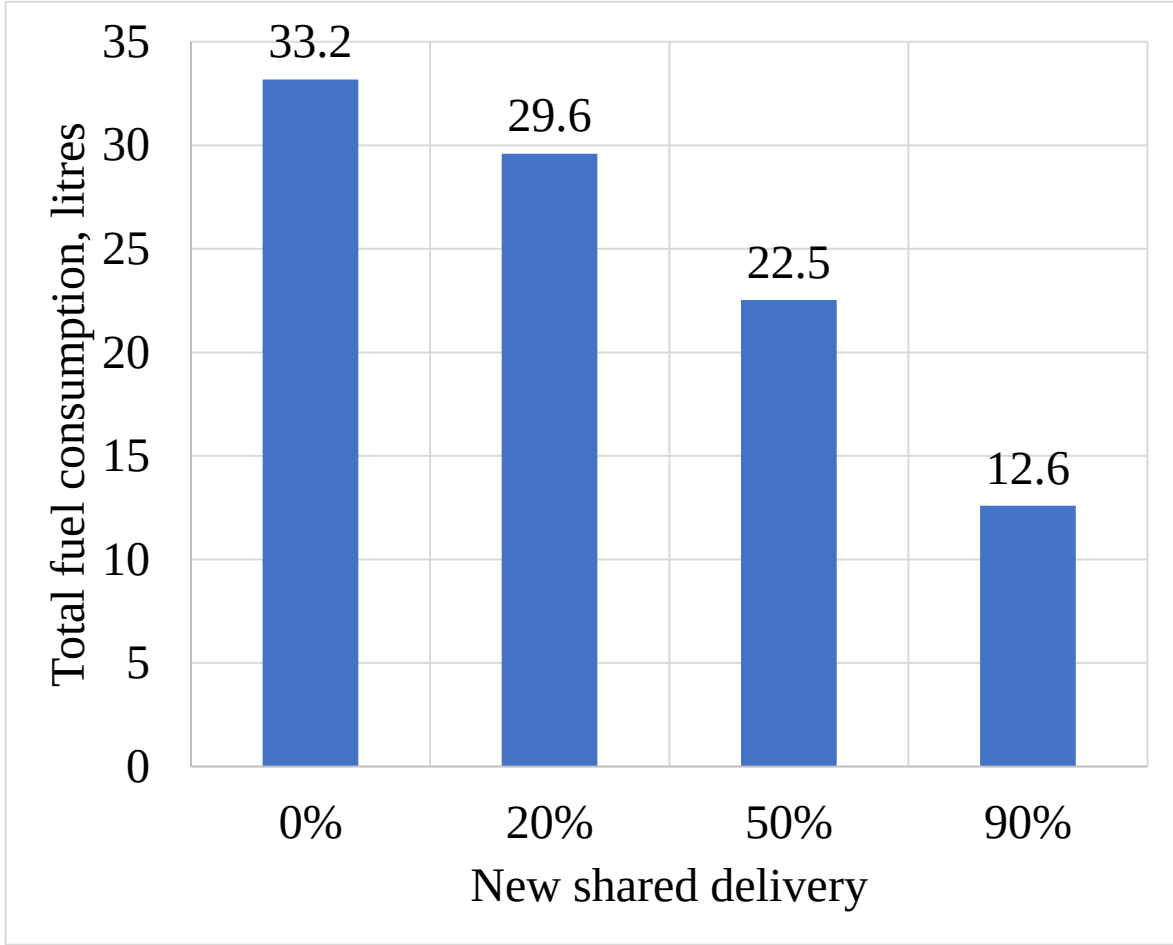


Total vehicle kilometers travelled for different scenarios



Reduction:	12.3%	37%	69%

Fuel consumption for different scenarios



Reduction	11%	32%	62%

Conclusions

- At present, only 11.3% of vegetable deliveries in Kozhikode are through shared supplier vehicles.
- 80.6% of vegetable retailers would consider shared delivery services if they offered faster delivery times, high-quality produce, and a streamlined process for handling damaged goods.
- Implementing new shared delivery services by 20%, 50%, and 90% of retailers could achieve :
  - Vehicle kilometres travelled reductions of 12%, 37%, and 69%.
  - Fuel consumption reductions 11%, 32%, and 62%.
- Reducing vehicle kilometers traveled can reduce traffic congestion, fuel consumption, and environmental impact.

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Thank You