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Assessment of public transport route: A Case of Lalitpur Yatayat

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Abstract

Lalitpur Yatayat, a public route from Patan Dhoka to Sukedhara round trip, is chosen for the study as a previous study has not been made on the public transportation on this route. The objective of this paper is to analyze the route characteristics, identify problems and put proposals for future improvements. It discusses the various key characteristics of the route such as travel time on weekdays and weekends, hour span of service, no. of trips in a day, headway time, and the major wards that it serves. The methodology and approaches followed for the execution of this work include etic observation in the site along with a collection of relevant documents and conduct literature review of public tr. The main methodology followed on the site was in-depth interview with the riders. Bilateral interactions, visual assessment and questionnaires were also some of the tools used. Moreover, the related articles, journals, reports acquired from the different sources, are briefly reviewed. This report also highlights the current scenario and provision of bus stops in the route and proposes additional bus stops in the route.

1. Introduction

Transportation has always been the major driver of development. There have been various modes and forms of transportation along with the advancement of technology and changing needs of people. Movement of people and freight is possible due to the availability of transportation such as roadways, airways and waterways. Throughout history, transportation has played a pivotal role in economic development [1]. Its importance is seen more in urban areas, where different kinds of economic activities take place. Urban public transportation infrastructure is a basic and necessary condition that ensures urban daily operation. The rise of urban public transportation infrastructure environmental benefit helps to improve urban environment [2]. Many countries, like in Europe, have more advance system where the public transport network is extensive and reliable, and the users have the flexibility to change their mode or route, or even their schedule if they are displeased with the service [3]. In context of Nepal, Nepal Transport Service started a local bus service between Kathmandu and Patan in September 1959, marking the beginning of public transportation in Nepal [4].

Public bus route of Patan Dhoka was started in 1993, and has been in operation since then. With time, the scenario of public transportation has changed, due to increasing population and congestion. With the acceleration of urbanization process, many developed countries have highly emphasized the construction and effective operation of urban public transportation infrastructure [2]. Patan Dhoka bus has been serving urban population of both Kathmandu and Lalitpur. This paper aims to asses various characters of Patan Dhoka public bus route and provides recommendation for the necessary improvement.

2. Rationale of the study

The bus route was introduced 25 years back, but not much has been done in intervening the service, with the pace of rapid urbanization and technological development. The features of public transportation such as bus stations, physical infrastructures, furniture in bus stops, headway, routs, frequency and bus fare, play a vital role in determining the efficiency of its service. This subject of research has been frequently accommodated in the papers at the international arena. In context of Nepal,

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research on the transportation sector is mostly focused on energy usage [5, 6] and greenhouse emission [7] But, less has been done in assessing of public transportation route.

3. Objective

- To analyze the key permanent and trip characteristics of the route of Lalitpur Yatayat
- To identify the problems of the study area and propose possibilities for improvement

4. Methodology

The research on the assessment of public transportation route is located within the post-positivist paradigm. The methods applied during the research were both quantitative and qualitative. The etic observation was carried out in weekdays and weekends, in three different intervals of time, during afternoon, morning, and evening office hours. The count of passengers in and out of bus was to find out the stops with maximum collection and dispersion. Similarly, time taken to reach the next station was noted, to find out the volume of traffic at different places throughout the route. GPS tracking system tool was used to track the route and time taken. In addition, assessment of bus stops regarding amenities and accessibility was done through visual observation. Finally, an in-depth interview was done with drivers of Lalitpur Yatayat, to give more value to the procedure of assessment of the route. The historical background of Lalitpur Yatayat, number of buses initially owned and present status of operation, capacity of bus, experience of driver in the route, hour span of services for weekdays and weekends, number of buses in weekdays and weekends, any purpose other than public transportation and their numbers, cost per trip, service frequency, missed trips, major trip generation and dispersion stops, passenger load during morning, afternoon and evening, bus stops sufficiency, causes of bus accidents, major issue faced, were the questions that were included in interview with the drivers and operators of the buses and they were also validated by the observation and analysis of the route. The obtained data was placed in Geographic Information System (GIS) for the systematic organization of the data. The route to and from Patan Dhoka was identified along with bus stops and characteristics of the trip such as busiest bus stop, population accessing the bus stops, time is taken and critical junctions on the route. GIS maps were then produced for the graphical representation of data and analysis of those data. Lastly, discussion and analysis of those data were done and major problems were identified. Recommendations on the improvement of infrastructure and policy interventions were done.

5. Existing situation and analysis

Established in 1990, Lalitpur Yatayat currently has 30 buses, out of which around 18 are currently running; the rest are defunct, owing to a lack of drivers. The current lot of buses was procured back in 2002 and has been running ever since. It is a 28-seater bus with the most passengers during peak office hours in the morning and evening. With the constant fare of Rs. 15 and Rs. 10 for student and elderly people, it is irrelevant to the distance travelled. The first Lalitpur Yatayat of the day leaves exactly at 5:45 in the morning and every other bus leaves after exactly 15 minutes until 8am, owing to the thin number of passengers in the morning. After eight, however, the buses depart every 10 minutes. The starting and end point of the routes of Lalitpur Yatayat is shown in Figure 1, a map generated after in roiute GPS tracking on the base map of KVDA and Open Street Map.

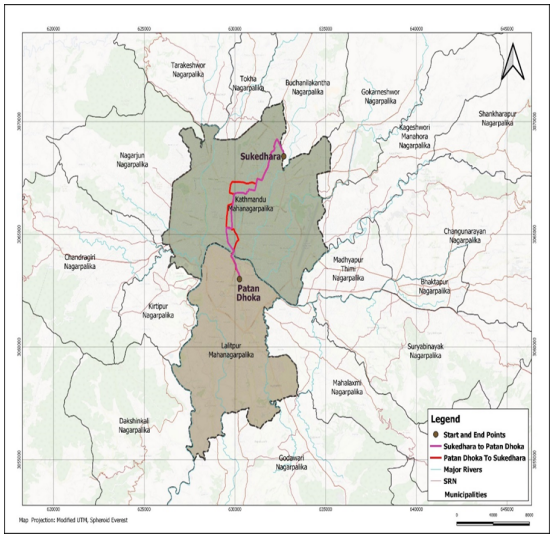

Figure 1: Start and end point of route

One Lalitpur Yatayat completes four to seven round-trips in a day. During festivals, VIP rides and national events such as South Asian Games, the number of trips sometimes reduces to 4 trips a day due to traffic congestion in major stops. Basic characteristics of the trip is given in Table 1 based on interviews with operators, bus drivers and GPs tracking.

Figure 2 shows the assessment of route R1 and R2 with propoer bus stops, bus terminals and bus with no proper amenities.

Comfortable walking distance from home to bus stop is considered to be 400m [8] so a buffer of 400m was

Table 1: Basic characteristics of the route

Basic Characteristics	
Route length in Km	R1 = 9.87Km; R2 = 10.51Km
Weekday Buses	5:30 AM to 1 PM = 18
	1:00 PM to 4 PM = 10 (5 For St. Mary School and 3 for Ideal Model School)
	4:00 PM to 6:45 PM = 18
Weekend Buses	10-18 Based on Reserved Buses
No of Trips	5-7 Trips (sometimes 4 on Festival and events -SAG)
(Weekday and Weekend)	
Span of Service	5:30 AM in Morning
	6:45 PM in Evening
Cost per Passenger Trip	Rs. 12 (Doesn't vary with distance)
	Rs. 10 (For students and elderly people)
	15 mins form 5:30 AM to 8:00 AM
	10 mins from 8:00 AM to 1:00 PM
	15 mins from 1:00 PM to 4:00 PM
	10 mins from 4:00 PM to 6:45 PM
Missed Trips	1 or 2 in a month
Bus Bunching	Occurs during peak hour in Thapathali & Keshar Mahal

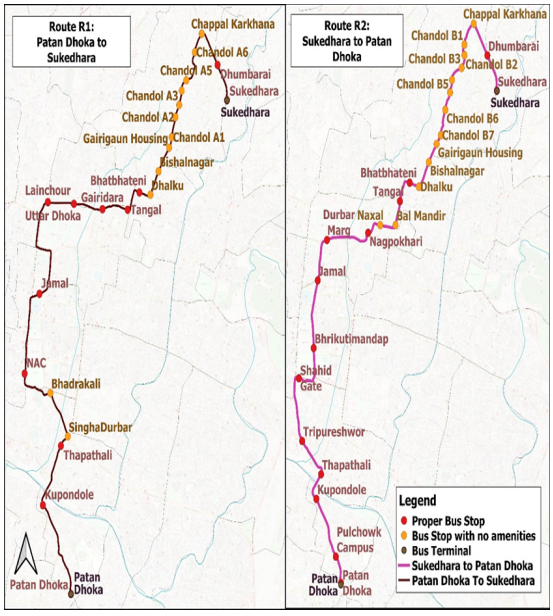

Figure 2: Route R1 and R2 with formal and informal routes

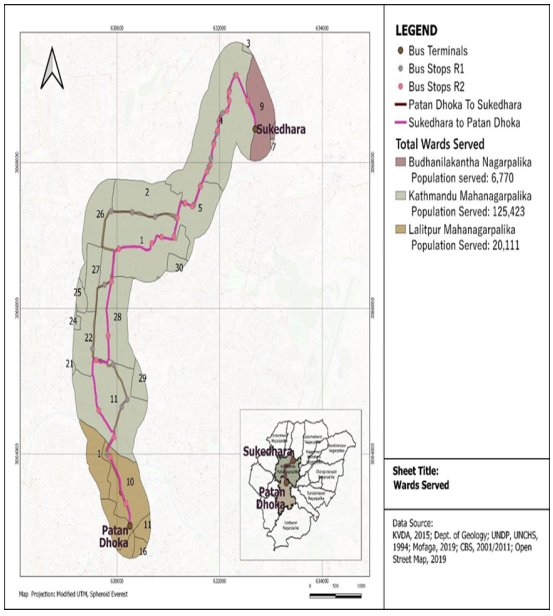

Figure 3: Buffer of 400 m from the route

created in the route of Lalitpur Yatayat to analyze the wards and the population it served as given in Figure 3. From the figure and the data of CBS, number of populations served was calculated residing in the buffer area which is represented through Figure 4 for wards of both Kathmandu metropolitan city and Lalitpur metropolitan city.

6. Analysis of the trip

6.1. Stops with more trip generation in weekdays

During morning office hour form Patan Dhoka to Dumbarahi, largest number of trip generation were found to be from Patan Dhoka, followed by Kupondole, Thapathali, Jamal and NAC, which is represented in Figure 5. The trip generation can be related with the character of the land use. Residents from Patan Dhoka, mangal bazar area use Lalitpur Yatayat, for their work and college trip toward the institutional, commercial areas that falls on

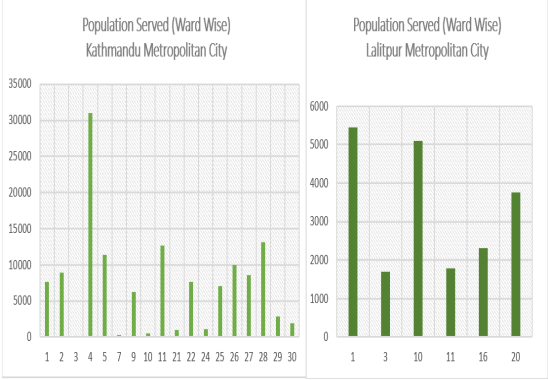

Figure 4: Population served ward wise in Kathmandu and Lalitpur

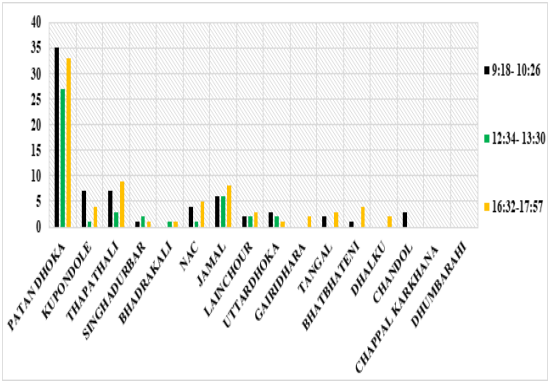

Figure 5: Number of trips generation in week days R1

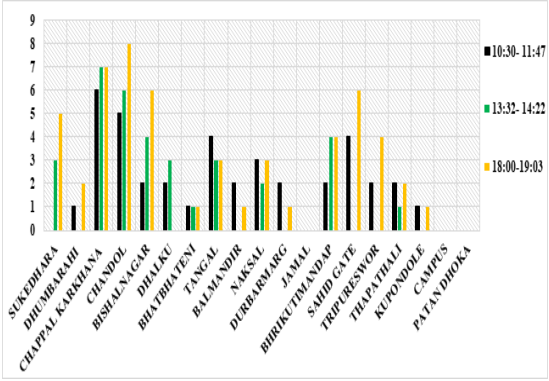

Figure 6: Number of trips generation in week days R2

the route.

Similarly, students from Thapathali Engineering College, engineering prepeartion institutions located in thapathali areas were seen to be mostly generating trip from Thapathali bus stop. Passengers getting on bus from Jamal and NAC were mostly, from the group who had jobs around bishalnagar, naxal areas. During evening office hours, more trip generation were seen to be from Patan Dhoka, Thapathali, Jamal, NAC and Bhatbhateni areas, represented through Figure 6. The students studying at pulchowk engineering campus, Patan multiple campus, offices around Pulchowk and Patan Dhoka were found to be generating trip from Patan Dhoka. Thapathali area has more instiotutional and office areas, and passengers returning to home towards Chandol areas, or need to take next trip from NAC or jamal, were found to be generating trip from Thapathali.

6.2. Stops with more trip dispersion in weekdays

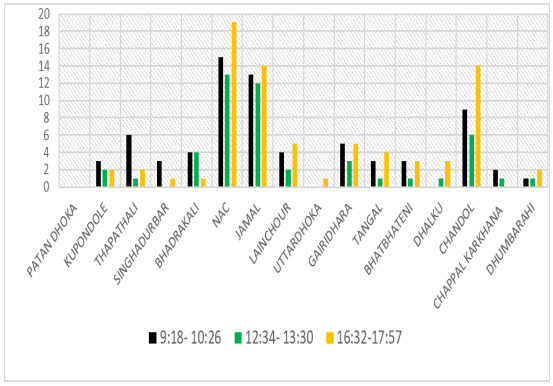

Figure 7: Trip dispersion in weekdays R1

The stops with trip dispersion in R1 is weekdays is shown in the Figure 7. During morning office hours from Patan Dhoka to Dumabafrahi, largest number of trip dispersion was found to be in NAC, Jamal, Chandol and thapathali area. NAC is near to the market and bus park area. People were seen to be dispersed to the market areas or heading towards next trip generation to their destination from NAC. Similar was the case with Jamal, which is near to the market area, Ason, institutional and commercial areas. Chandol was more of residential areas with some educational institutions, due to which trip dispersion was significantly seen.

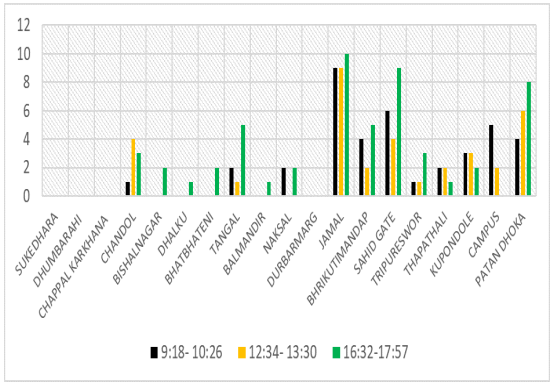

Figure 8: Trip dispersion in weekdays R2

Similarly trip dispersion for R2 in weekdays is represented in the Figure 8. During evening office hours, more trip dispersion was seen in Jamal, Sahid Gate, Patana Dhoka and Bhrikutimandap area. This describes the passengers with work to home trip, where, Jamal, Sahid Gate and Bhrikutimandap act as the transition to their destination, through next route, as routes towards outskirt residential areas can be found in these places. Patan dhoka can be explained as the stop for people from Mangal Bazar areas.

6.3. Trip character during weekend

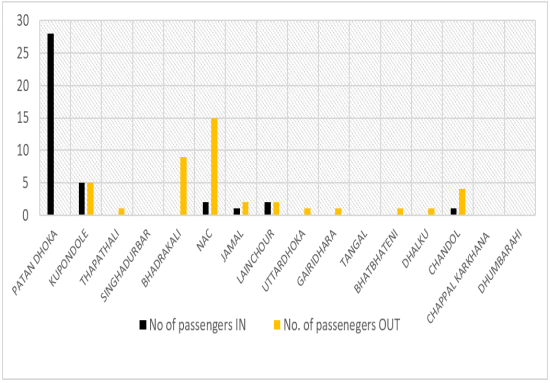

Figure 9: Passengers flow during weekend R1

In weekend, more trip generation was found to be from Patan Dhoka and Kupondole, with more dispersion at NAC, Bhadrakali and Kupondole, on the way from Patan Dhoka to Dumbarahi area.

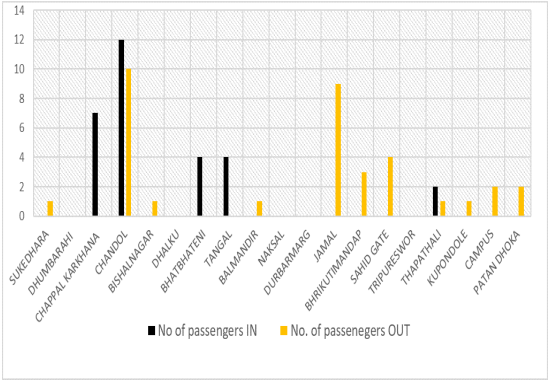

Figure 10: Passengers flow during weekend R2

Similarly, more trip generation was seen to be from Chappal Karkhana, Chandol, Bhatbahteni and tangal area and more dispersion was seen to Chandol, Jamal and Shahid gate area. Most of the trip generations are from the residential areas and dispersion is towards the market area. The passengers flow in R1 and R2 during weekend is represented in Figure 9 and Figure 10 respectively.

6.4. No. of passengers in weekdays and off days

Table 2: Number of passengers in weekdays and off days

Day Type	Patan Dhoka Dhumbarahi	Sukedhara Patandhoka	Total ridership at the trip
Thursday (9:21-12:00)	71	39	110
Friday (12:24-14:22)	48	34	82
Friday (17:10-19:38)	48	34	82
Saturday (14:18-16:21)	39	29	68

The total ridership as given in Table 2, was found to be more in evening office hours than in morning office hours. Similarly, the number of passengers were less in afternoon and in weekends.

6.5. Passenger on the basis of gender

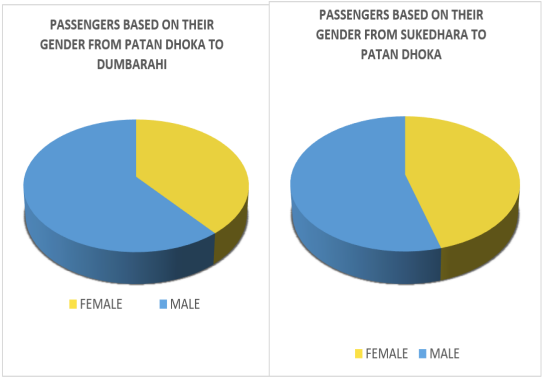

Figure 11: Passenger on the basis of gender

Passenger count on the basis of gender was also taken to study the compositions and mobility of the people from places around the route area, which is graphically represented in Figure 11. 39% of the passengers from Patan Dhoka to Dumbarahi were female, while that from Sukedhara to Patan Dhoka were 45%. This data can be interpreted as the number of mobility of female from Sukedhara is more than that from Patan Dhoka area. More women of Chandol Bishalnagar are found to be making more trips than that from Patan Dhoka. Patan Dhoka is ancient Newari town and still, majority of people are Newars. Most of the female of Patan Dhoka travel to Lagankhel as a market center. Most people from Chandol and Chappalkharkhana area doesn't belong to a single ethnic community as the area is not ancient as of Patan Dhoka and contains new settlement. New housing and apartments could be found prominently in Chandol area. The demographic character of

these two different areas can be taken as a reference for the percentage of women travelling in the route.

6.6. Time taken for the trip

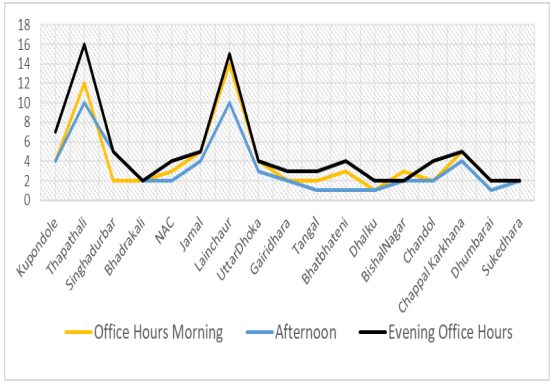

Figure 12: Time taken for the trip R1

Service Area Characteristics	
Population Served (Buffer 400m)	152,304
Municipalities Served	**Budhanilakantha Nagarpalika - 6,770** **Kathmandu Mahanagarpalika - 125,423** **Lalitpur Mahanagarpalika - 20,111**
Museum and Tourist Attractions	Narayanhiti Museum, Patan Durbar Square, Basantapur Durbar Square
Major Government Offices	Singhadurbar, Nepal Police Headquarters, Indian Embassy, Chinese Embassy
Schools, Universities and Hospitals	Pulchowk Campus, Thapathali Campus, IEC
Temples	Bhadrakali, Mahakal,
Passenger Load (Round Trip)	100-120 in Morning 50-80 in Daytime 120-150 in Evening
Major Trip Generator	R1- Patan Dhoka, Kupondole, Thapathali, Jamal R2- Chappal Karkhana, Chandol, Bishalnagar, Shahid Gate
Major Trip Distribution	R1- NAC, Jamal, Chandol, SinghaDurbar R2- Jamal, Shahid Gate, Pulchowk Campus, Patan Dhoka

Figure 13: Time taken for the trip R2

On the way from Patan Dhoka to Sukedhara, the maximum time was seen to be from Kupondole to Singhadurbar and from Jamal to Lainchour. Maximum traffic was seen in Thapathali Bridge junction and in Kesharmahal Junction. The traffic congestion is due to the high traffic flow and less infrastructure. Figure 12 shows the time taken for trip in R1 derived from the in route field study.

While returning from Sukedhara to Patan Dhoka, maximum time was taken from Chappal Kharkhana to Bishal Nagar, from Nagpokhari to Jamal and from Tripureswor to kupondole as shown in Figure 13. The area of Chandol is full of residential areas and some educational institutions. There are 5 bus stops in between Chappal Kharkhana and Bishanagar and thus the time taken is more. The traffic congestion in Durbarmarg area, due to which the time taken is more. Similarly, the traffic congestion in thapathali junction is responsible for the time taken

6.7. Service area characteristics

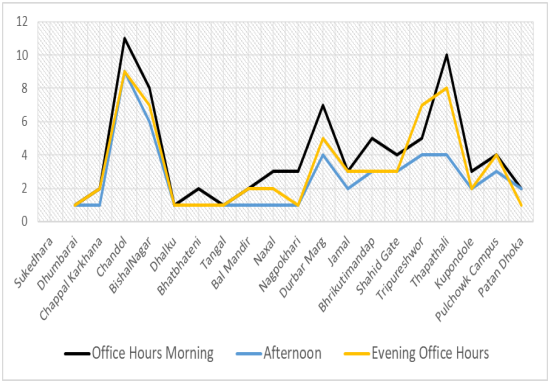

Figure 14: Service area characteristics

Figure 14 describes the service area characteristics such as major landmarks, presence of educational and health institutions, commercial and religious spaces and major trip generator and distributor within the 400 m buffer of the routes R1 and R2.

6.8. Problem identified

After the assessment of public transportation route of Lalitpur yatayat, through literature review, in site etic observations and in-depth interview regarding areas mentioned in the methodology section with the drivers travelling the route on daily basis, following problems have been identified.

- Narrow lanes were found in the residential areas of Chandol, where two buses from the opposite direction, find difficulty in passing the road. The interaction with school buses, heavy vehicles had created a significant problem in smooth flow of traffic in the narrow lane.
- Most of the roads away from CBD did not include pedestrian infrastructures such as sufficient footpath for the pedestrian to walk by. They were seen walking on the road track without any physical separation from the vehicular track, which can be taken as the major reason for many accidents taking place.
- Separate bus bays were available only in Kupondole and Thapathali area. This absence of a separate bay, had resulted in on-street parking, created traffic congestion on the one hand and also unsafe

for the pedestrian crossing, as the visibility of the passing vehicles is obstructed due to the bus stop on the same lane. The bus stops in Chandol area were not defined that bus were stopped haphazardly without any fixed points.

- Bus Park amenities such as sitting bench with cover, bus stop signage and directions, trash can, bus pad, sidewalks, wheelchair accessibility, street lightings were not seen in many of the bus stops.
- Awareness of traffic rules was seen less among pedestrians as many of them were not using zebra-crossings and sometimes also crossing the road from under the pedestrian bridge. On the route, drivers were also seen not following the traffic rules such as crossing the lanes, speeding over in zebra-crossing and overtaking other vehicles, which can lead to traffic accidents. The drivers also noted the improper driving of private vehicles.
- Due to the bunching of bus as a result of traffic congestion on the way, even if the buses leave Patan dhoka on time, they don't reach the next stop on expected time. This decreases the promptness of the bus and questions the reliability. Passengers can find it hard to be dependent fully due to inconsistent timing of the buses in different stops of the route

7. Proposal for improvement

As the existing public transport route of Lalitpur Yatayat is inefficient, there is an urgent need to reform on infrastructures and policies, to improve mobility, decrease dependency on private vehicles, and improve accessibility, air quality and road safety. Here are the key recommendations for improving the public transportation system:

i Proposal of bus stops

On the way from Patan Dhoka to Sukedhara, there were many places where formal bus stops were not present, but the bus had to stop, due to the demand of trip generation and dispersion. This had compromised the safety and realibaility of bus at the particular place. So, Bus stops are proposed at Jwagal Chowk, Bhadrakali, Bishalnagar, Chandol and Sukedhara. The placement of the proposed bus stop is based on the literature reviews, and site condition, with the buffer of 400m, in between the bus stops which is shown in Figure 15.

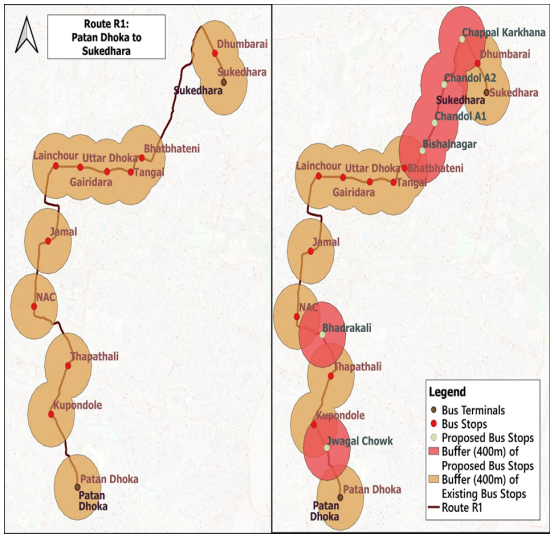

Figure 15: Bus stops proposed at R1

Similarly, formal bus stops were not present in Chandol area and Chappal Kharkhana, for which four bus stops has been proposed. The bus stops are proposed on the similar way of literature study and site analysis. This proposal of new bus stops as shown in Figure 16, will help in defining the fixed stops for passengers in and out, which in turn increase the safety of passengers, reliability of the public bus and management of the public transportation service in those areas.

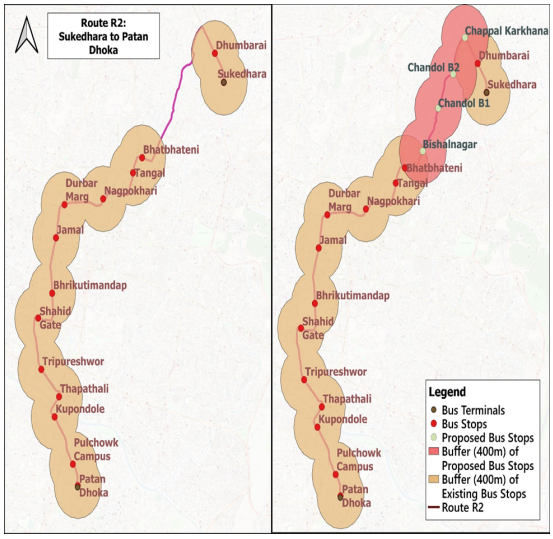

Figure 16: Bus stops proposed at R2

ii Enforcement of traffic rules and regulations

Problems arising from violation of traffic rules and regulation is seen in the route, which can be

solved through strong enforcement of traffic rules, such as usage of zebra-crossing, maintaining the lane discipline, and discourage vehicular overtaking. Vehicle users need to be motivated to respect the pedestrians and other vehicles using the road track.

iii Increasing pedestrian friendly infrastructures

Roads from Bishalnagar to Chandol and from Jwagal to Patan dhoka area lack the basic infrastructure on the road, ie. Foot path. Drivers had explained about difficulty in driving on road, shared by pedestrian. Increasing pedestrian friendly infrastructures can help safety of pedestrian as well as smooth operation of public vehicles.

iv Addition of bays for bus stops

Lack of extra bays for stop stops have created congestion on the lane, obstructed visibility of the vehicles and pedestrians. Extra bays on each bus stops need to be added in order to increase safety, efficiency of the bus stop and smooth flow of traffic on the lane.

v Development of real time information system

In order to increase reliability and credibility of the Lalitpur yatayat, development of application, which gives real time information can be recommended. This will help effective trip generation, time saving and increasing credibility on the public transportation, which will attract more people to use public transport over private.

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