IMPLEMENTING CYCLE LANE FACILITIES IN EASTERN PROVINCE IN A SUSTAINABLE MANNER

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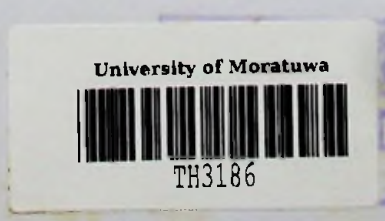

March 2016

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ACKNOWLEDGEMENT

I am glad to present this thesis for my Master degree in Highway & Traffic Engineering, University of Moratuwa, Sri Lanka. This report consists of the details of my research findings towards implementing cycle lane facilities in Eastern Province.

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ABSTRACT

Commuting by bicycle is a sustainable transport strategy and has advantages over other modes of transport, both for the commuter and for society. The social cohesion that can bring through recreational opportunities also promotes wellbeing. A diverse range of people choose to cycle, including school-aged children, regular commuters, weekend recreational cyclists and sporting cyclists. Cycling does not emit greenhouse gas, cause air or water pollution or rely on fossil fuels. Road Development Authority (RDA) has taken a policy decision to incorporate a separate lane as cycle lane to encourage the non-motorized transport of this country. But it is observed that these bicycle lanes are not used for its intended purpose. Especially in Colombo area, there are very few bicyclists on the roads and bicycle lanes are always empty. So, it is seen that the bicycle lanes are used to overtake vehicles in wrong side, for illegal roadside parking etc. While the situation is such, Road Development Authority is planning to extend its new policy to the areas where there are higher numbers of cycle users. Trincomalee is one of the districts in Eastern province having higher numbers of cycle users and the terrain condition also well suited for cycling. More than 50% of the road users are identified as cycle users and almost 60% of car, three wheel & motorcycle trips are less than 4 kms, a distance that is easily cycled in less than 20 minutes. These data were collected during field observation. Although cycling is an option for many commuters, a considerable number of them choose to use other forms of transport. Especially school children & office staffs, they use three wheel or motorbike as transport mode. In order to underpin policies that promote commuting by bicycle, this research investigates the determinants for commuting to work, school or their other purposes and studies about the public opinion in existing road conditions to use bicycles and their concern in cycling facilities to be provided in the future road developments. A questionnaire survey was conducted among 200 road users in different part of Trincomalee district. Accordingly, it was understood that existing road conditions such as non-availability of continue route network dedicated for Cyclists, mixed traffic without proper safety measures and parking facilities discouraged the commuters to use bicycle as their transport mode and commuters in Trincomalee district are really willing to use as a sustainable transport mode for the short trips up to 4kms, if the cycle lane facilities are provided with safety and comfort.

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LIST OF ABBREVIATIONS

Abbreviation	Description
RDA	- Road Development Authority
ADT	- Average Daily Traffic
LTA	- Land Transport Authority

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1.0 INTRODUCTION

1.1 General

Road Development Authority (RDA), the premier highway authority in the country and responsible for maintenance and development of the National Highway Network, comprising the Trunk (A Class) and Main (B Class) roads around 12,173.19 km length and 159.78 km length of Expressways. RDA has taken a policy decision to incorporate a separate lane as cycle lane and soft shoulder as pedestrian walkway. From this alteration of the existing system, safety of cyclist could be ensured while improving the speed of the other vehicles.

Cycling presents interesting advantages over other modes of transport for society & individual such as environmental sustainability, cheap infrastructure requirements, cheap form of transport and improvements in public health. It is a sustainable transport mode for School children, Workers, commuters and recreation activities for both local peoples and tourists. Sustainable mobility is a 'hot topic' when a country is getting developed with infrastructure. In terms of greenhouse gas emissions, the bicycle is 100 times more sustainable than the car and much more sustainable than public transport too.

It has been observed that very few bicyclists use the exclusive facility dedicated for them whilst the road agency invests millions of hard earned national budget for these schemes. With this, it is highly arguable whether actually such a requirement for bicycle lanes does exist in this country. With the fact that the world is fast moving into the greener technologies, non-motorized transport is an inevitable option. In such a context, the viability of promoting bicycles as a vehicle for low income groups as well as for short distance trips will be mandatory.

Road Development Authority is planning to extend its new policy to the areas where there are higher numbers of cycle users. Trincomalee is one of the districts in Eastern province having higher numbers of cycle users and the terrain condition also well suited for cycling. More than 50% of the road users are identified as cycle users and almost 60% of car, three wheel & motorcycle trips are less than 4 kms, a distance that is easily cycled in less than 20 minutes. In order to underpin policies

that promote commuting by bicycle, this research investigates the determinants for commuting to work, school or their other purposes and studies about the public opinion in existing road conditions to use bicycles and their concern in cycling facilities to be provided in the future road developments.

1.2 Problems and Research Objective

1.2.1 Problems identified

- Most of the roads in Sri Lanka are not provided with any special facilities to cycle users
- Certain facilities that have been provided to some roads are not in sustainable manner.
- Facilities provided to some roads are not functioning well

1.2.2 Objective of the study

- Identifying the existing issues at road infrastructure in Eastern Province for cyclist and investigate the determinants to promote commuting by bicycle to fulfill their daily transportation needs in a sustainable manner.

2.0 LITERATURE REVIEW

Bicycles were quickly adopted after their introduction in the 19th Century and remain popular with more than a billion worldwide used for recreation, transportation and sport. People have been riding bicycle to work since the initial bicycle heyday of the 1890s. Biking experienced sharp drop in part due to the growth of suburbs and the popularity of the motorbike and car. The updated information about fatalities by different transportation modes in Canada in 2009, including deaths of 1605 car drivers and passengers, 307 pedestrians, and 41 bicyclists. In 2009, the World Health Organization estimated that physical inactivity is responsible for the following global disease burdens; 27% of diabetes, 30% of ischemic heart disease, and 21 to 24 % of breast and colon cancers. Cycling is a great way to increase and maintain physical activity, and is associated with reduced risks of heart disease and all-cause mortality.

Normally, private cars & vans occupy the large area on the road corridor with carrying one or two passengers whereas the bicycle takes small space with same passenger capacity. Typically, ten bicycles can be parked into the space of one car. Thus, why would car parking provision be mandatory to building development but not bicycle parking provision? Table 2.1 shows the Space occupied by Car mode demonstrated with respect to the standing space required by the Cycle.

Table 2.1: Space occupied by each mode demonstrated with respect to the standing space required by the Cycle

Mode	Illustration	Area Required by the mode (m^2)	Area ratio of mode/ Cycle
Bicycle		0.6×2.0=1.2[1]	1
Car		2.4×4.8=11.52[2]	9.6

Space occupied by the mode (regardless of the number of passengers) with respect to the area occupied by a standing Cycle; [1]Denmark's Bicycle Parking Manual (Celis and Bolling-Ladegaard, 2008); [2]Vehicle Parking Provision (LTA, Singapore, 2011a)

Income plays a significant role in influencing transportation choices people have. People with low incomes face extremely limited transport choices. Where there is extensive poverty, it is most important to ensure that the modes used by the poor continue to remain available as travel options. Many low income people in Asian cities cannot afford even subsidized public transport fares and have no choice but to walk or cycle, even for travel distances of 10 to 20 km. For most poor households, walking accounts for the majority of all trips. When incomes are low, the value of time relative to cost for travelers is low as well. Although walking costs nothing, it takes a lot of time for all but short trips.

It has been efficient and unavoidable transportation mode from the earlier era in Sri Lanka. Because of its door to door accessibility most of the people are willing to use it. While most of the ns are not so poor to afford the subsidized public transport costs, cycling is dominant in many areas outside Colombo. Bicycle population is dominant especially in North Central, Northern and Eastern provinces. But no separate bicycle facilities are provided in these areas. However, as motorization increases, or as traffic congestion worsens, it becomes increasingly important to develop modal separation in high traffic flow corridors. This is particularly vital in mixed traffic cities where non motor vehicles use is declining due to competition from growing motorized traffic.

Most of the roads are not provided with cycle lane in Eastern province. But, number of Cycle users is comparatively higher than other provinces in Sri Lanka. Some of the roads in Sri Lanka have been provided with cycle lane facilities with adequate standards. But it is not successful in city like Colombo, because of high motor traffic capacity, less Cycle users and less space to provide cycle lane network.

The history with its development of bicycle usage was studied at the different countries like Netherland, Denmark, Australia, New Zealand, India, Japan, Singapore and Canada. The strategies adopted by them to promote cycle use in a sustainable manner were studied and the strategies are followings;

- Use the planning system to influence cycling orientated design
- Increase the number and convenience of parking facilities for cyclists
- Increase awareness of safety issues for cyclists
- Increase regulation and enforcement
- Provision and maintenance of infrastructure for cyclist safety
- Raise awareness of the cycling network and available facilities

The literature studies of the above countries are expressed the basic requirements and aspects from the infrastructure, cyclist & motor traffic to implement the cycle facilities in a sustainable manner. Figure 2.1 depicted the modal share of cycling compared to Australia with other countries in 2007. Netherland particularly in a city, they use bicycle as a transportation mode 40% among others. It has been achieved with their own bicycle policy, safety measures, parking facilities, action plan, information system, public awareness programs, road signs & marking, recreation facilities and proper road network with safety, comfort & connectivity. In most of the areas close to public transport modes to travel more distance, they have provided parking facilities to park the bicycle and travel by public transport.

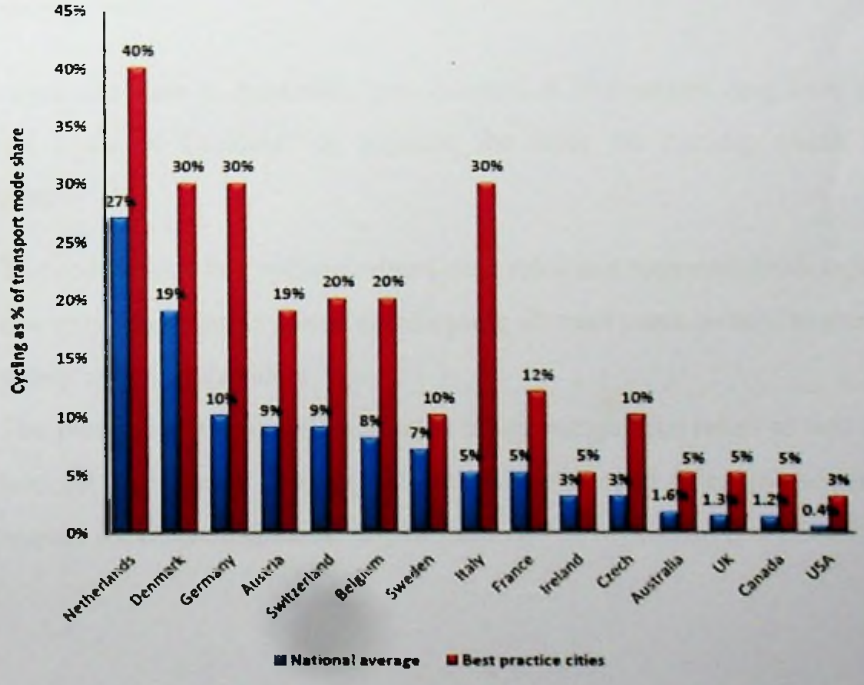

Figure 2.1: Modal share of cycling compared to Australia

2.1 Facility based infrastructure

VicRoads Design Guidelines puts the following aspects on Cycle lane facilities.
Cycling facilities can be provided in different ways such as;

- On road (Separate lane)

  As part of encouraging cycling, provisions should be made in the planning and design stages to facilitate this mode of transport. Such provisions should include identification of appropriate road widths links to the Main Routes network, Connector Routes and other off-road paths, and detailed arrangements that do not diminish the performance, function and safety of the facility. Cycle lane is a type of on-road trail for cyclists, delineated by paint, where motor vehicles are not permitted. Normally, hard shoulder is used as cycle lane. Cycle route is a course of direction for cyclists between two key locations or connecting a series of key locations. May comprise on-road and / or off-road sections.

- Mixed traffic
- Off road
- Bicycle path

Some countries such as Australia, New Zealand & Netherland, they have their own "Bicycle Code of Conduct" to regulate the rules for cycling which normally describes;

- The code brings key cycling related road rules and responsibilities together into one easy to use guide aimed at informing all road users on how to share spaces safely with bicycle riders
- The purpose of Codes of Conduct is to encourage bike riders to ride in a safer manner, to increase their compliance with the road rules and to show more respect for other road users.

2.1.1 On road (Separate lane) - Cycle lanes

- Cycle lanes are identified by cycle pavement marking symbols, and may have other distinguishing features such as different coloured surfaces. Cycle lane signs are currently optional.
- In general, cycle lanes are the preferred treatment for cyclists on urban roads.
- Cycle traffic is concentrated near schools or along major routes near city or town centres

2.2 Cycle network and Infrastructure

Master thesis for "The traffic safety of bicycle streets in the Netherlands", Rick Delbressine, [June 2013] with the reference from CROW publication 230 "Design manual for bicycle traffic" (CROW, 2007) describes the following aspects for the bicyclist requirements for high quality bicycle routes;

- Establish a comprehensive network of bikeways that are appropriately signed, marked and traffic-calmed and that provide convenient and direct connections to all of neighborhoods with safety, comfort and visibility
- The network could be either; On-street signed bicycle routes, Bicycle lanes, Traffic-calmed streets, Off-street bicycle and mixed-use paths and Shared roadway bicycle markings
- Ensure that the bicycle route network ; Provides bicycle access to all Railway station, Bus stands, schools, commercial and residential areas
- Parking facilities should be provided at the necessary or frequent distance close to the road wherever more cyclists like schools, markets and commercial buildings.
- At railway stations or bus terminals, Bicycle Park should be located to access the service from their home and then take bus or train from there.

Table 2.2: Bicycle network features

Route Feature	Comment
Safety	Minimal risk of traffic - related injury, low perceived danger, spaced to ride, minimum conflicts with vehicles.
Coherence	Infrastructure should form a coherent entity , link major trip origins and destinations, have connectivity be continuous, signed, consistent in quality, easy to follow and have route options.
Directness	Route should be direct, based on desire lines, have low delay through routes for commuting, avoid detours and have efficient operating speed
Attractiveness	Lighting, personal safety, aesthetics, integration with surrounding area, access to different activities.
Comfort	Smooth skid-resistant riding surface, gentle gradients, avoid complicated maneuvers, reduced need to stop, minimum obstruction from vehicles.

2.2.1 Bike riders behaviors when share the road

- Obey the road rules and stop at all red traffic lights and stop signs.
- Wear bright coloured clothing and use lights when cycling at night.
- Ride predictably and indicate to drivers when you intend to turn or change direction.

2.2.2 Drivers behaviors when share the road

- Be patient and give bike riders a clearance of at least one metre when passing them, more if travelling over 60km/h. If this clearance isn't possible don't overtake until it is safe to do so. Watch out for bike riders at intersections and roundabouts.
- Drive slowly and watch out for bike riders in residential streets.
- Check behind before opening your car door, use your mirrors as well as checking over your shoulder.
- Do not drive in bicycle lanes.
- Give way to bike riders in bicycle lanes if you are turning across the lane.

2.3 Bicycle Rider Requirements

Cycling Aspects of Austroads Guides [March 2011] expresses the followings regarding the bicyclist requirements.

The basic bicycle rider requirements are generally considered as convenient, efficient and safe travel by bicycle. A very important requirement of many cyclists, in addition to those described below, is separation from motor vehicles because it enhances their safety and comfort, provided that the treatment results in a satisfactory level of service and does not result in a loss of priority at intersections and driveways. Commuters have to take greater travel time with mixed traffic on roads than separated cycle lane.

In relation to path and road engineering all cyclists have six basic requirements whenever they ride, namely:

- A smooth surface
- Space to ride
- Speed maintenance
- Sight lines
- Connectivity
- Information.

These requirements apply equally on roads and on paths. By implication the important objective of a safe environment for cyclists must exist, given the provision of space to ride, a smooth surface, adequate sight lines and the ability of cyclists to maintain their speed.

2.3.1 Smooth Surface

Many bicycles have narrow tyres inflated to high pressure to reduce drag and have no suspension system. A smooth surface is therefore desirable for bicycles to be used effectively, comfortably and safely. Surfaces used for cycling should desirably be smoother than those acceptable for motor vehicles and persons responsible for road and path construction and maintenance should be made aware of this requirement.

2.3.2 Space to Ride

The bicycle design envelope and clearances shown in Figure 3.1 provide the basis for the design of the bicycle facilities. It is important for designers to understand the basis of the design including clearance requirements so that they can make judgments in difficult situations where knowledge of minimum space requirements is needed. The envelope is relevant to the design of lanes on roads, off-road paths and bicycle parking facilities.

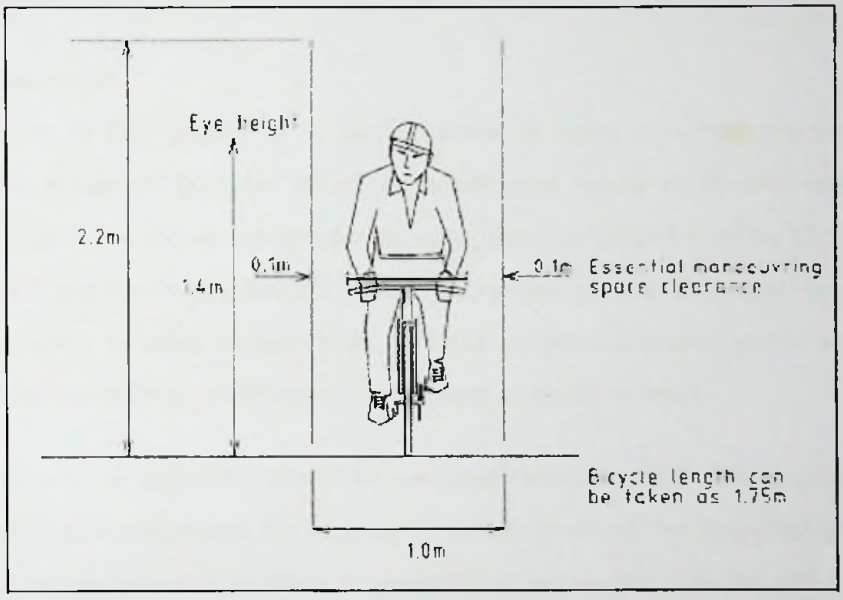

Figure 2.2: Cyclist envelope

2.3.3 Speed Maintenance

For bicycles to be most effective as a means of transport cyclists must be able to maintain speed without having to slow or stop often. Cyclists typically travel at speeds between 20 km/h and 30 km/h although they may reach in excess of 50 km/h down hills. Once slowed or stopped it takes considerable time and effort to regain the desired operating speed. Bicycle routes, especially off-road, should be designed for continuous riding, minimizing the need to slow or stop for any reason including steep gradients, rough surfaces, sharp corners, obscured sight lines, intersections, or to give way to other people because the width available is too narrow. On many roads cyclists are confined to the extreme left-hand side by motor vehicles and a rough surface prevents cyclists from maintaining an acceptable speed.

2.3.4 Sight Lines

It is important that appropriate sight lines are provided between a cyclist's eye height and pedestrians to assist in minimizing conflict, and between a cyclist's eye height and the path surface so that cyclists can stop in the event that a hazard exists on the path (e.g. mud deposited during inundation, potholes due to washouts, broken glass, and fallen tree limbs).

Designers should ensure that roads are designed to meet the sight distance requirements

2.3.5 Connectivity

Connectivity is that quality of a bicycle route or route network, describing the continuous nature of facilities or of the continuous nature of desired conditions. Cyclists need to be able to undertake and complete meaningful trips by bicycle. For recreation it may be from a residential area to a picnic spot, or for a specific purpose trip from home to work or the shops. Bicycle routes comprising roads and paths should combine to form an effective, convenient and safe network.

Connectivity is an important aspect of the construction of effective bicycle routes. Before a route is constructed the purpose of the route should be identified as well as the routes which cyclists are likely to use in travelling to and from the paths, bicycle lanes and roads forming the network.

A route for cyclists which starts and ends abruptly is undesirable and may be hazardous as it may lure inexperienced cyclists to a point where they are at risk, perhaps having to ride along or across busy roads to complete their intended trip.

2.3.6 Information

Bicycle routes should be signposted to indicate both destinations and the distances to them. Maps should be available showing the route, facilities and points of interest along it, its relationship to the surrounding road system, and its relationship to relevant community facilities. The map and the signposting should be consistent in terms of destination names and other information.

2.4 Design aspects for Cycle Infrastructure

2.4.1 Design concept for Bicycle lanes

Road Development authority has developed some design strategies to implement cycle lane along the new road design. Especially, it has already been implemented at Colombo and some adjacent cities.

The following factors should be considered in design aspects;

- Provide exclusive space for bicyclist
- Encourage cycle users by design facilities
- Awareness to motorist users
- Provide visual guidance to cyclist at intersections.
- Sufficient lane width to accommodate the bicycle to split from motorist vehicles
- Proper road marking & signs
- Providing facilities when turning at the junctions or opposite sides

Roads with low moving vehicles may not necessary the cycle lane separately.

2.4.2 Cycle lane width

The width of cycle lanes will vary depending on;

- Presence or absence of parking;
- Parking turnover;
- Road gradient;
- Volume of cyclists;
- Speed and volume of motor traffic;
- Volume of large vehicles; and/or
- Ability to make road space available given the needs of
- Other road users, budgetary and physical constraints.

Road Development Authority adopts normally 1.0 m width for cycle lane.

As per the Austroads guidelines, typical standard width for cycle lane when sharing with motor traffic is given in Table 2.2(a) and 2.2(b). Guide to choice of facility type for cyclists in urban areas is a basic guide to identifying an appropriate type of facility for different combinations of traffic speed and volume within an urban area.

Table 2.3(a): Design standards

Speed Environment	Bicycle lane width	Traffic lane width
60km/h	Desirable 1.5m Minimum 1.2m	Traffic lane where volume of heavy vehicles/ buses is high Desirable 3.5m Minimum 3.3m Other lanes Desirable 3.3m Minimum 3.0m

Table 2.3(b): Design standards

Detail	Cycle lane width (m)		Parking width
Speed limit (km/h)	≤50	70	
Desire minimum width (m)	1.5	1.9	2.0
Acceptable range	1.2-2.2	1.6-2.5	1.9-2.5

Table 2.3 shows the ADT data which was collected on the main corridor of A6 road. Predicted ADT data in the road network at town areas is between 3000 and 10,000 and suitable solution for the cycle users from the Fig.2.3 is Cycle lanes for the average speed of 50km/h. The operating space required for cycling is shown in Fig.2.4.

Table 2.4: ADT data of A6 road corridor

Location	ADT 2014
Kantale to Thampalagamam	5868
Thampalagamam to A15 Junction	6343
A15 Junction to A12 Junction	13416
A12 Junction to Trincomalee	18737

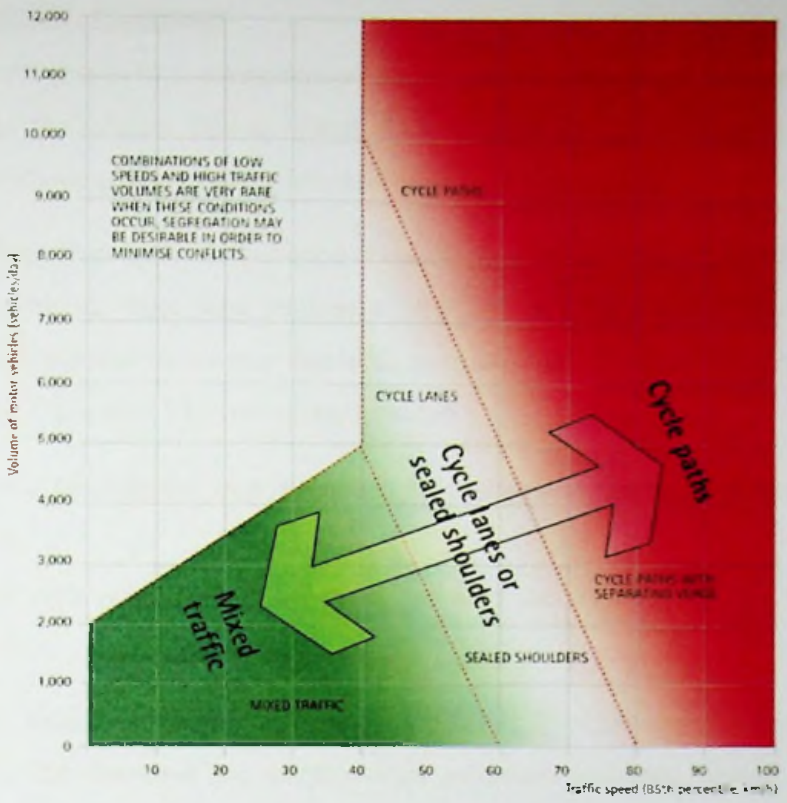

Figure 2.3:.Options for Cyclist

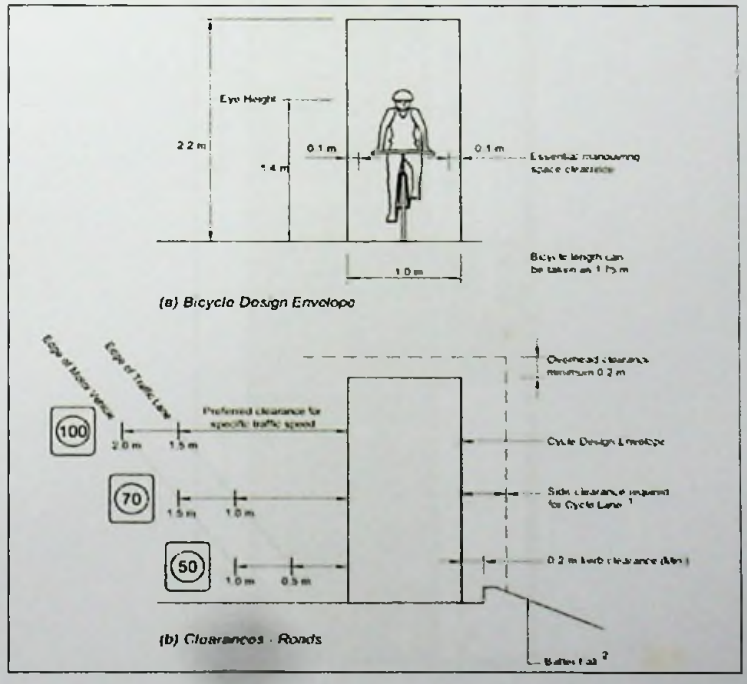

Figure 2.4: Bicycle operating space

2.5 Intersection Treatment

Bicycle lanes should be a component of a network of bicycle lanes that maintains the integrity of the system. Toronto Draft Bicycle Lane Design Guidelines [2004:13] proposes following lane marking in non-signalized intersections.

The bike lane striping is discontinued across the leg of the intersecting street. If the approach with the bike lane features a stop line and crosswalks, the bike lane continues all the way to the stop line with, in most cases, the final 15 m demarcated by a broken white line. The two exceptions are:

- where a nearside bus stop is present, the broken line begins 20 m from the stop line &
- where right turns are not permitted, the solid line continues all the way to the stop line.

The solid lane line should resume immediately downstream of the far side crosswalk. The diamond and bicycle logo pavement marking should be placed within the first 15 m of the lane.

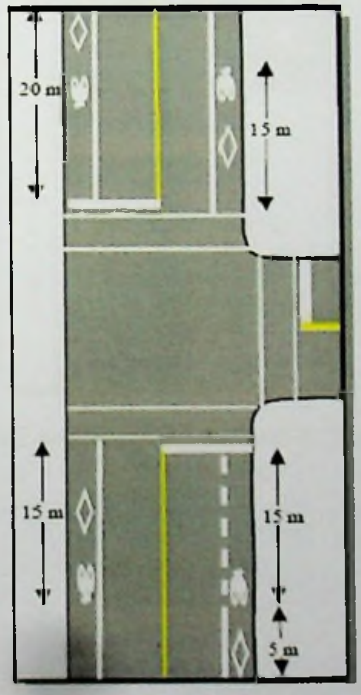

Figure.2.5 Intersection Lane Marking with a Stop Line in a Non Signalized Intersection

If the approach with the bike lane does not feature a stop line and crosswalks, the bike lane continues to the beginning of the turning radius with, in most cases, the final 15 m demarcated by a broken white line. The two exceptions are:

- Where a nearside bus stop is present, the broken line begins 20 m from the bus stop; and,
- Where right turns are not permitted, the solid line continues all the way to the beginning of the turning radius.

The solid lane line should resume 5 m downstream of the of the projected far side edge of the intersecting street. The diamond and bicycle logo pavement marking should be placed within the first 15 m of the lane.

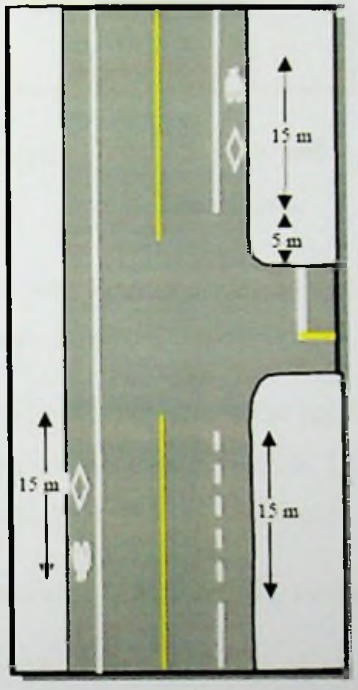

Figure.2.6 Intersection Lane Marking without a Stop Line in a Non Signalized Intersection

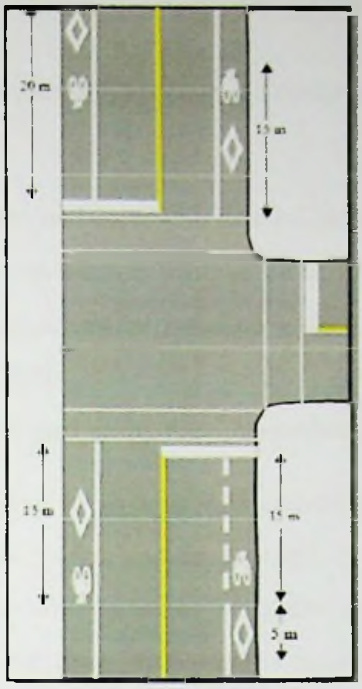

Figure.2.7 Intersection Lane Marking with a Stop Line in a Signalized Intersection

Further, Toronto Draft Bicycle Lane Design Guidelines proposes following lane marking in signalized intersections.

The bike lane striping is discontinued across the leg of the intersecting street. The lane continues all the way to the stop line with, in most cases, the final 15 m demarcated by a broken white line. The two exceptions are:

- Where a nearside bus stop is present, the broken line begins 20 m from the stop line; &
- Where right turns are not permitted, the solid line continues all the way to the stop line.

The solid lane line should resume immediately downstream of the far side crosswalk. The diamond and bicycle logo pavement marking should be placed within the first 15 m of the lane.

2.6 Bike Boxes

Innovative Bike Lane Treatments [1] proposes a concept called 'Bike Box' in intersections.

It reads: Bike boxes can be combined with dashed lines through the intersection for green light situations to remind left turning motorists to be aware of bicyclists travelling straight. Bike boxes can be installed with stripping only or with colored treatments to increase visibility. Use of coloration substantially increases costs of maintenance over uncolored (stripping, bicycle symbol and text only) treatments.

Bike boxes should be located at signalized intersections only and left turns on red should be prohibited. Bike boxes should be used at locations that have a large volume of cyclists and are often utilized in central areas where traffic is usually moving slowly. Reducing left turns on red improves safety for cyclists and does not significantly impeded motor vehicle travel (Words in italic are inserted by the author)

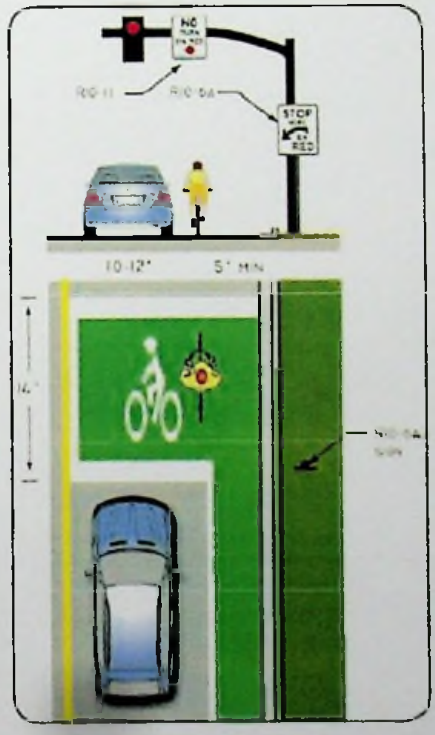

Figure.2.8 Recommended Bike Box Design

Figure.2.9 Bike Box in Portland

2.7 Right Turn for Bicyclists

Right turning is always problematic for the bicyclists, as well as for the motor traffic. In such situations, special provision should be made to make cyclists feel safe at intersections. NCC Cycling Design Guide [2006:30] proposes the 'Splitter Island for a Cycle only Lane' method. Figure shows a photo of that method.

Figure.2.10 Cycle Only Turn Protected by a Splitter Island

NCC Cycling Design Guide [2006:30] lists following advantages in this method.

- Provide a short cycle lane right turn pocket, which can be protected by a traffic island
- Can be used where traffic speeds are 40mph or below
- Can be used for allowing cycles to turn into a cycle only gap/street or track

2.8 Necessity of Bicycle Parking Places

The safety of bicycles is a major issue when it comes to theft and vandalism. As the bicycle is the poor man's vehicle, necessary safety measures are mandatory. Also, shelter for bicycles when parking should also be taken into account. NCC Cycling Design Guide [2006:55] reads: Unless cycle parking is provided in the correct location, it will not be used.

There are 2 main types of cycle parking short term and long term.

- For short term, the cycle parking should be placed as close as possible to the trip end point such as entrance to shops, leisure centre, town centre etc as cyclists prefer not to walk long distances once they have parked. Sheffield Stands are ideal for this purpose (see Fig. 2.11)

Figure.2.11 Sheffield Stand with Cross Bar, Signing and Reflectorized Bands

- For longer term parking (i.e. all day) cyclists may be prepared to walk further for the facility. These facilities may take the form of more secure cycle parking such as lockers or undercover stands at workplaces and rail stations.

2.9 Identification and signs for the Cycle users

Traffic signs and road marking for bicycle facilities provides the information to assist all road users to move safely and conveniently on the road and bicycle network. The main categories of signs and road marking are:

- Regulatory signs – regulate and advise the type of facility within the context of the overall road system, e.g. whether a facility is shared with pedestrians or for the exclusive use of cyclists
- Warning signs – warn users of identifiable potential hazards within the riding environment
- Guide signs – guide users around the network.
- Pavement Markings
- Colored surface

Figure.2.12 shows the Basic signs providing along the roads and Fig.2.6 shows the pavement marking & Colour surface demarcated along the cycle lanes.

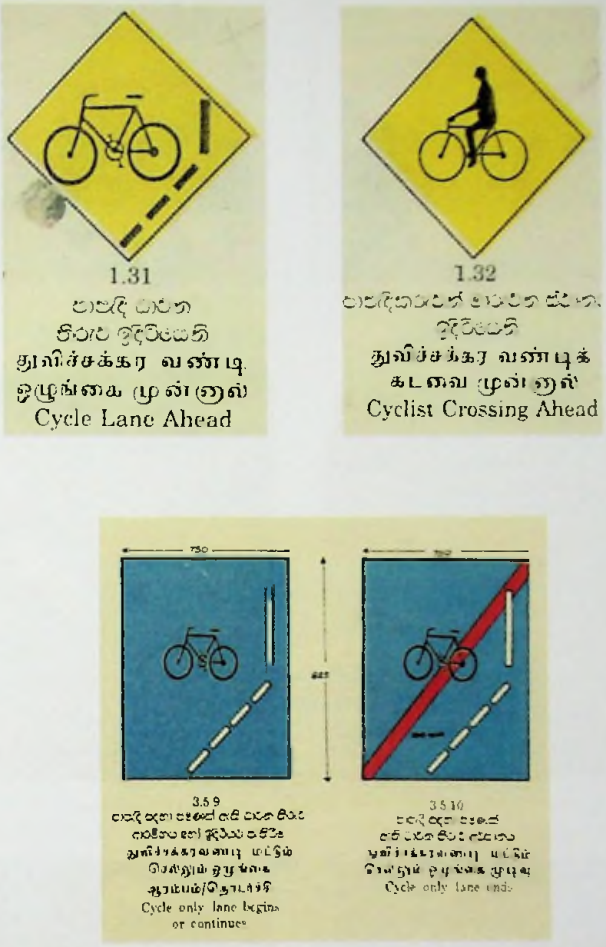

Figure.2.12: Traffic signs for Cyclists

Figure 2.13: Road marking and Colour surface demarcated for cycle users

3.0 LOCATION OF THE STUDY AREA

Figure 3.1: A part of road network in Trincomalee district

Figure 3.2: A View of Intersection at Sea View road

Figure 3.3: A Map of Intersection at Sea View road

4.0 METHODOLOGY

The literature reviews on cycling improvements of the countries like Netherland, Denmark, Australia, New Zealand, Singapore, India, Japan and Canada were studied. History from the beginning state till achieved the sustainable implementation of cycling was analyzed. The strategies behind the successful implementation of cycling facilities were identified. Accordingly, it was understood that how the existing road conditions give negative impacts to cycle users for their transportation needs. Further, main aspects necessary for improve the Cycling facilities, basic road infrastructure requirement and way of implementing the facilities to attract cycle users were investigated. The experiences gained from some road projects which have been already implemented with cycle lane in Srilanka also were studied. It was necessitated to get the details on existing conditions and facilities for bicycle users and public perceptions to improve the cycling facilities. Collecting the relevant data from the cycle users is the suitable option to get a full picture of it.

Data Collection was done through:

- Questionnaire survey from cycle users
- Counting cycle users along the road network

This Questionnaire survey was done to identify the existing condition of cycling facilities, the factors put off cycling on roads, actual necessity of providing cycle lane, cycling demand, the features that cycle users really expecting to implement the cycle lane facilities, determinants encourage cycling for commuting to work, school or their other purposes through public perceptions. Questionnaire survey was done among 200 different kinds of cycle users in Trincomalee town and adjacent divisions. The survey form is attached as Appendix-A. The school children, workers and other commuters were selected for this study from Trincomalee town, Thampalagamam, Kinniya, Mutur and some adjacent villages. The survey form was interpreted to Tamil language and distributed among them. The collected details are tabulated as Appendix-B and summary is given under Data analysis section.

Cycle count was done at Sea View road intersection. Because, within 4 km perimeter there are around 10 schools, more than 15 tuition centers, many Temples, government offices, private offices, private institutes and commercial buildings located. Cycle count at the Sea View Road Intersection is tabulated as Appendix-C. The total movements of 785 counted at the intersection during peak hour 7.00am to 8.00am.

5.0 DATA ANYLYSIS AND DISCUSSION

The data analysis was carried out according to the details gathered from questionnaire survey. Questionnaire survey was done among 200 road users including 150 students and 50 Employers. Out of 150 students 75 Nos of Girls and 75 Nos of boys are included. Out of the Employers, 39 male and 11 female are participated. The raw data is attached as Appendix-B. The summary of the data is tabulated below by individual questions & results along with bar charts. It is observed from the survey results that average of 3.8 km distance is preferred by Cycle users to travel by bicycle for their transportation needs. But, it varies upon gender and age category. The Boys use bicycle for school are willing to use up to 4.0 km whereas girls up to 3.4km. Gents use to cycle for their work are observed that they are willing to use up to 4.3km whereas ladies are willing to cycle for their work up to 3.8km. The survey further indicates that 142 peoples say parking facilities are not enough at Trincomalee district and 157 people are mentioned that cycling facilities in the road is not satisfactory. Hence more than 75% of the cycle users in the above survey pointed out the existing facilities are not satisfied.

Ladies have more concern in safety while they cycling along the road. Fig 5.1 shows how gender influence in road accident with its severities. Eight among the two hundred have met Major accident, 83 of them met minor accident and balances 109 have not faced any accident. It shows the safety is not enough in the roads in Trincomalee District.

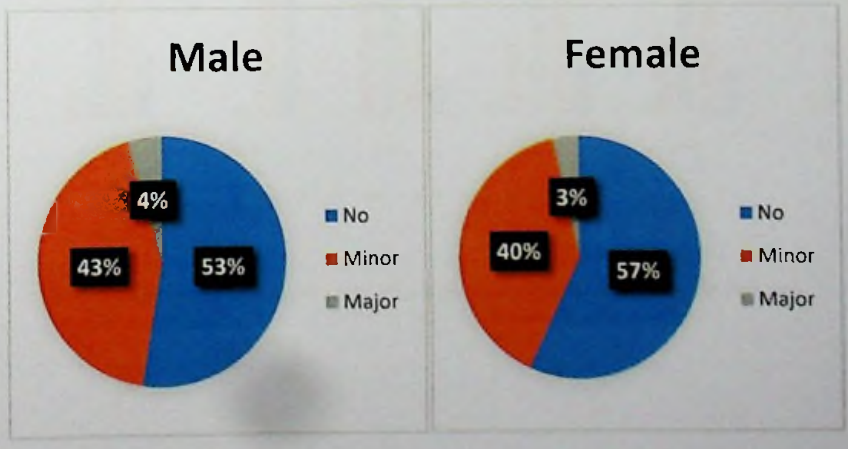

Figure 5.1: Accident pattern history of Bicyclists by Gender category in Trincomalee

The results are further analyzed by getting the Mean value of the individual items and plotted in the bar chart below; The Question number is used the same as mentioned in Questionnaire survey form.

14. Which of the following do you find important when providing a new cycle route. Please rank in order of importance:

Description	1 (Low)	2	3	4	5 (High)	*Mean*	*% of Mean*
a. Clear signage	0	16	78	71	35	***3.63***	***72.50***
b. Continuous route with little or no stopping	0	0	6	61	133	***4.64***	***92.70***
c. Wide cycle paths/cycle lanes	1	57	81	42	16	***3.03***	***60.60***
d. Hard surfaces	8	36	73	59	24	***3.28***	***65.50***
e. Reducing vehicle speed/volume	4	38	67	69	22	***3.34***	***66.70***
f. Maintenance of routes	0	10	49	74	67	***3.99***	***79.80***

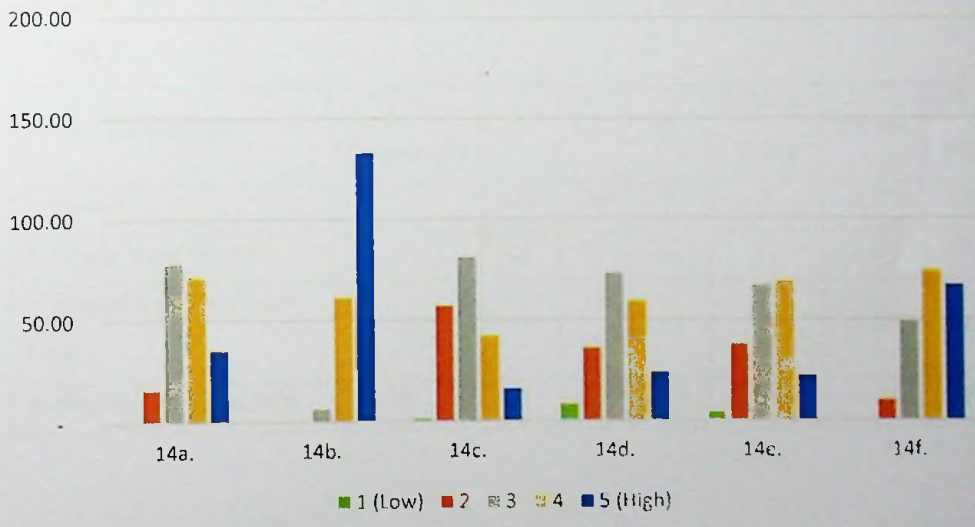

Figure 5.2: Important criteria when proving new cycle routes

Figure 5.3: Mean values of the above criteria for providing new cycle lane

Figures 5.2 & 5.3 illustrate that for each criteria mean values are more than 3 out of 5. Especially, for Clear signage, Continuous route with little or no stopping & Maintenance of routes the mean value is around 4 out of 5.

15. How safe do you feel cycling on the following provision at any time of the day?

Description	1 (Not Safe at all)	2	3	4	5 (Very Safe)	***Mean***	***% of Mean***
a. Roads	21	102	76	1	0	***2.29***	***45.70***
b. Cycle lanes in roads	0	25	86	72	17	***3.41***	***68.10***
c. Shared footpath/Cycle way	2	19	117	59	3	***3.21***	***64.20***
d. Segregated cycle path	0	2	19	111	68	***4.23***	***84.50***

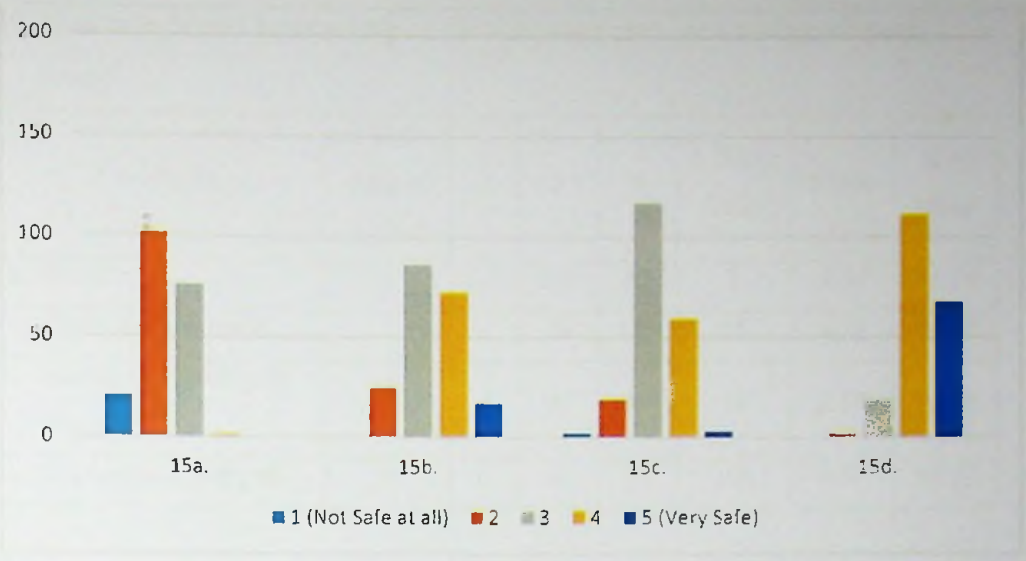

Fig 5.4 Safety concerns of cyclists when cycling on different provisions at any time of a day

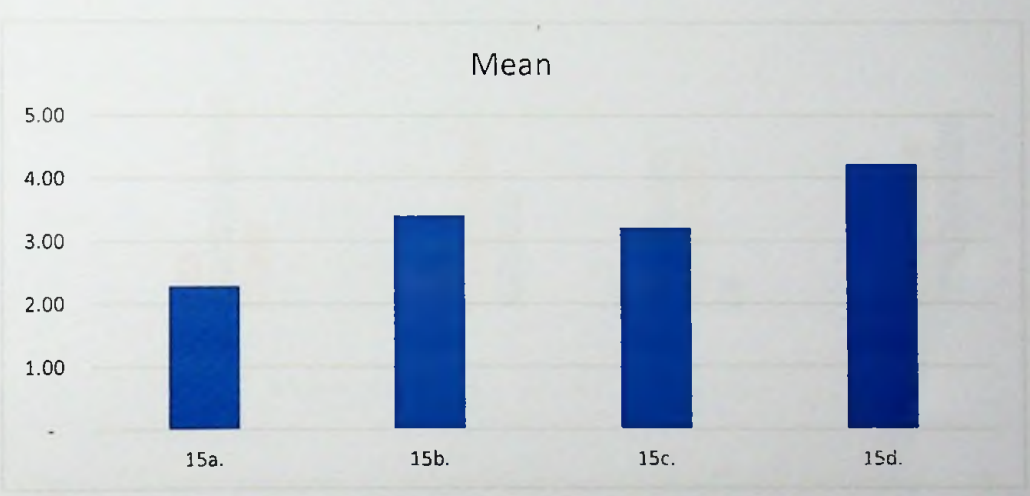

Figure 5.5 Mean values of Safety concerns of cyclists when cycling at any time of a day

Figures 5.4 & 5.5 shows that cyclist mostly prefer to ride on Cycle lanes in roads than Shared footpath/Cycle way or share with other vehicular traffic in road at any time of the day. The mean value of providing Cycle lane is 3.41 which equal to 68.10%. Though, segregated cycle path is mostly preferred by cyclist, it is not practicable due to land acquisition problems and other infrastructure cost for implementation.

16. How safe do you feel cycling on the following provision during off-peak times?

Description	1 (Not Safe at all)	2	3	4	5 (Very Safe)	***Mean***	***% of Mean***
a. Roads	1	32	119	47	1	***3.08***	***61.50***
b. Cycle lanes in roads	1	2	29	103	65	***4.15***	***82.90***
c. Shared footpath/Cycle way	2	4	90	86	18	***3.57***	***71.40***
d. Segregated cycle path	0	0	2	93	105	***4.52***	***90.30***

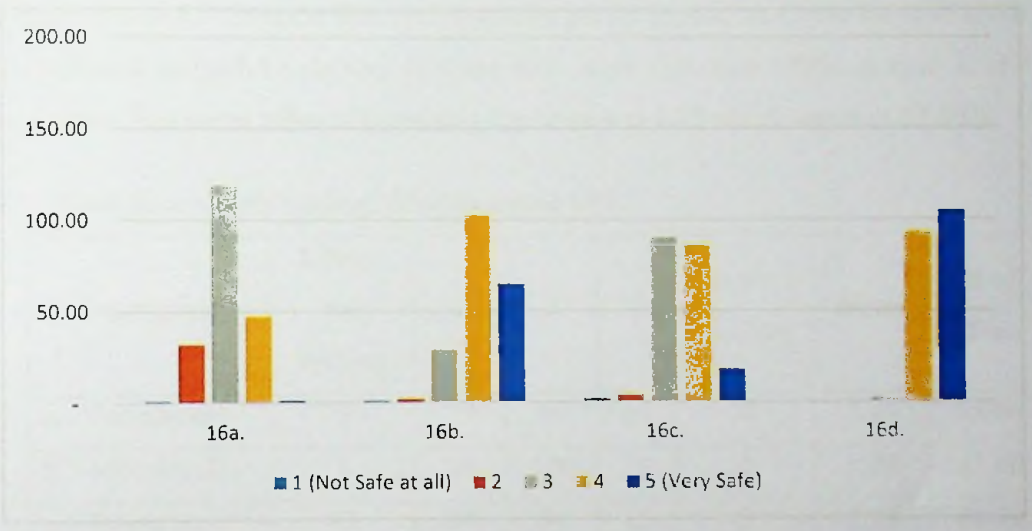

Figure 5.6 Safety concerns of cyclists when cycling on different provisions at off-peak time

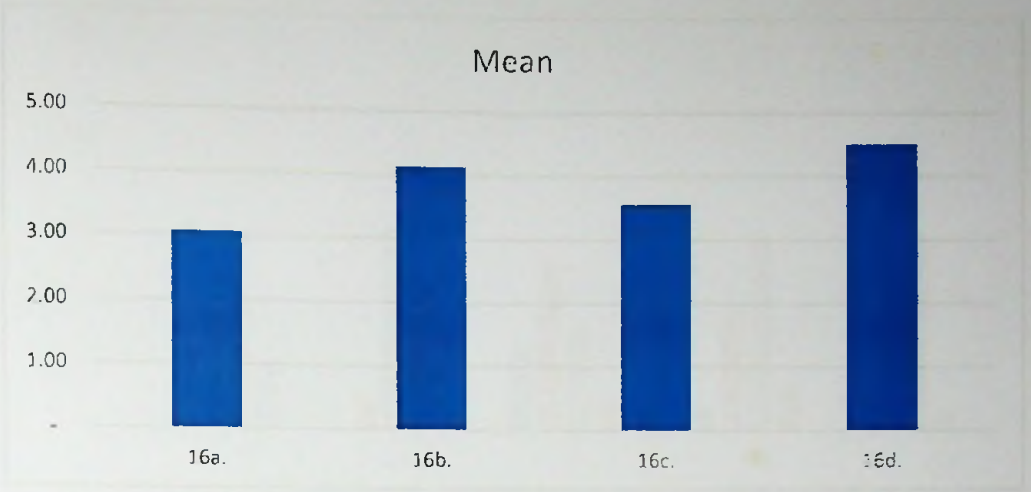

Figure 5.7 Mean values of Safety concerns of cyclists when cycling on different provisions at off-peak time

Figures 5.6 & 5.7 describe that cyclist mostly prefer to ride on Cycle lanes in roads than Shared footpath/Cycle way or share with other vehicular traffic in road at off-peak time. The mean value of providing Cycle lane is 4.15 which equal to 82.90%.

17. What puts you off cycling? Sharing space with:

Description	1 Stops me cycling	2	3	4	5 Is not a problem	***Mean***	***% of Mean***
a. Pedestrians	0	39	60	65	36	***3.49***	***69.80***
b. Motorcycles	1	18	106	74	1	***3.28***	***65.60***
c. Buses/taxis	43	88	54	15	0	***2.21***	***44.10***
d. Cars/vans	11	64	101	24	0	***2.69***	***53.80***
e. HGVs	88	101	11	0	0	***1.62***	***32.30***

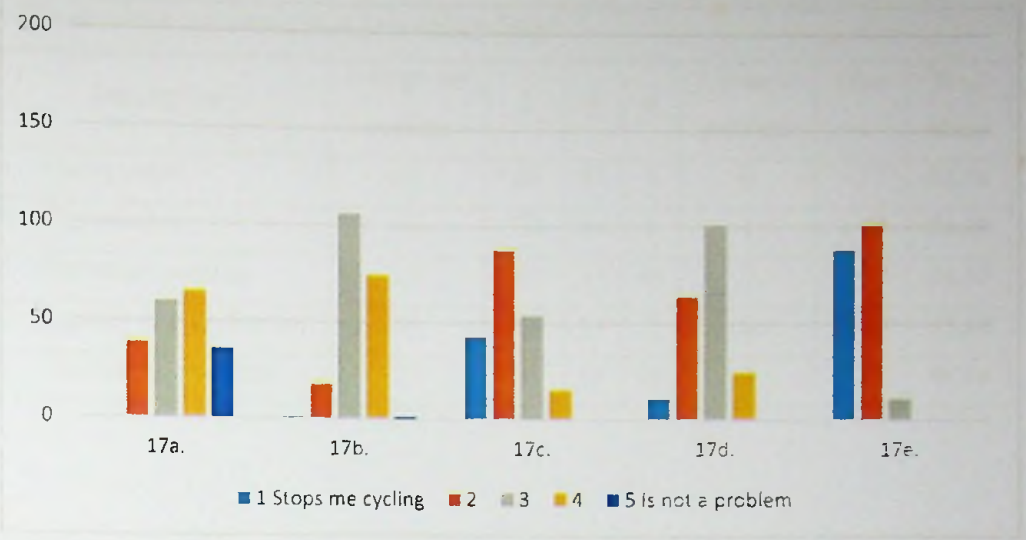

Figure 5.8: Effect of sharing space with other traffic category

Figure 5.9: Mean value for Effect of sharing space with other traffic category

Figures 5.8 & 5.9 depict that how much effect to cyclist to puts off cycling on sharing space with other vehicles. It is clearly observed cyclist do not prefer to share the road with Buses, Cars & Heavy vehicles and some users only accept to share with Motorcyclist & pedestrians. Especially, all the road users will puts off cycling if share with heavy goods vehicle. So, from the above, we can come to the decision that cyclists are not willing to share the roads with other vehicles and they prefer the cycle lane.

18.0 Which of the following puts you off cycling?

Description	1 Stops me cycling	2	3	4	5 Is not a problem	*Mean*	*% of Mean*
a. Going uphill	85	80	35	0	0	***1.75***	***35.00***
b. The weather	80	104	14	1	1	***1.70***	***33.90***
c. No secure parking	21	63	73	43	0	***2.69***	***53.80***
d. Journey is over five km	54	82	51	13	0	***2.12***	***42.30***
e. Uneven road surface	27	83	64	26	0	***2.45***	***48.90***

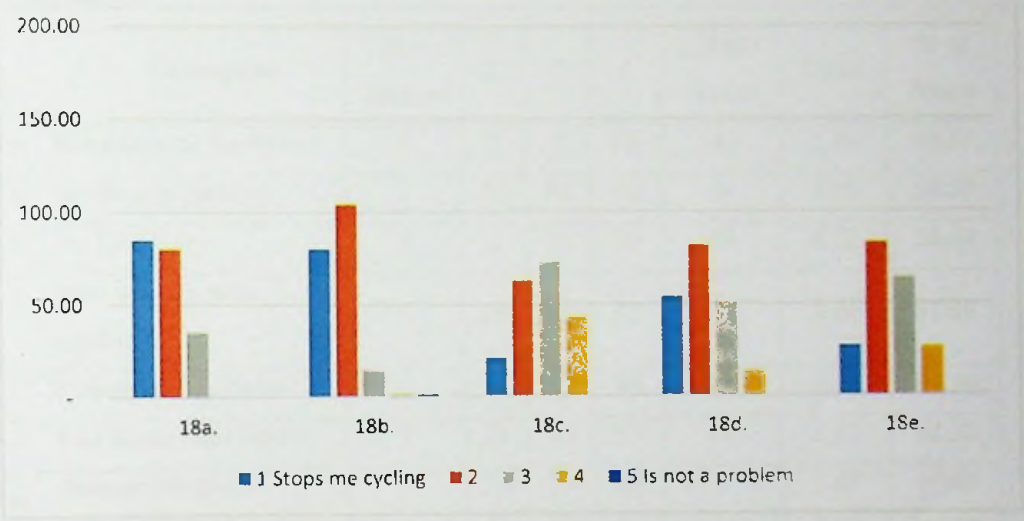

Figure 5.10: Type of factors puts off cycling

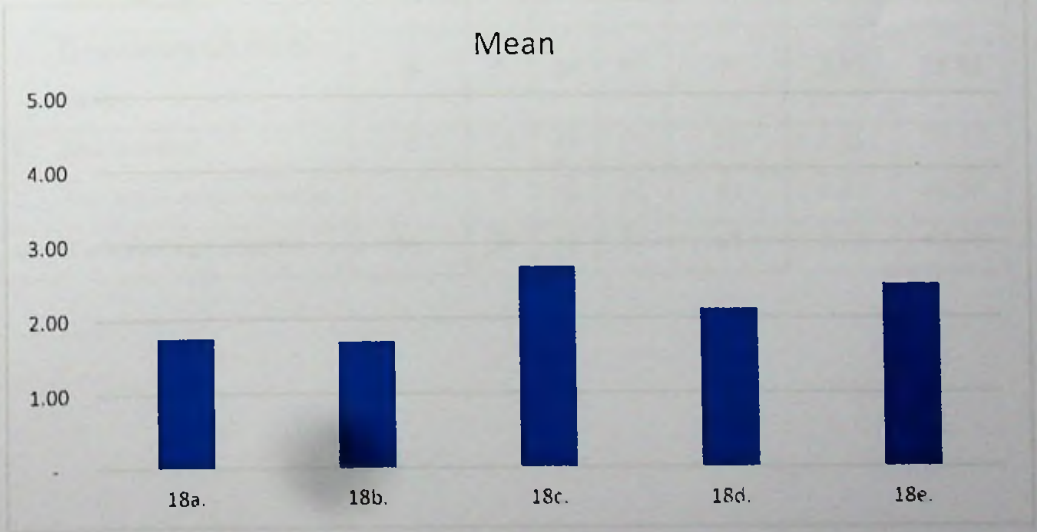

Figure 5.11: Mean value for type of factors puts off cycling

Figures 5.10 & 5.11 show how cyclists expect the cycle lane infrastructure when implementing the cycle lane. Some adverse criteria in the road environment mentioned in the above table (Qn.18.) puts off them to use cycle. The average mean value is towards puts off cycling. They are not willing to ride on uphill & adverse weather. Also they are looking for secure parking, good road surface & travelling distance less than 5km.

19.0 How would you rate the following as reasons that you do not BICYCLE more frequently?

Description	1 Not a reason	2	3	4	5 Major reason	*Mean*	*% of Mean*
a. Not adequate facilities	0	0	2	85	113	***4.56***	***91.10***
b. No bicycle parking	5	55	88	48	4	***2.96***	***59.10***
c. No bike lanes	0	2	31	68	99	***4.32***	***86.40***
d. Bike lanes in poor condition	0	29	91	73	7	***3.29***	***65.80***
e. Unsafe intersections	0	1	35	84	80	***4.22***	***84.30***
f. Bad driver behaviors	1	51	83	55	10	***3.11***	***62.20***
g. Automobile traffic	0	58	75	60	7	***3.08***	***61.60***
h. Personal safety concerns	0	2	82	79	37	***3.76***	***75.10***
i. Visually unappealing surroundings	0	20	86	72	22	***3.48***	***69.60***
j. Destinations are too far away	0	0	58	95	47	***3.95***	***78.90***
k. Bad weather	0	14	48	87	51	***3.88***	***77.50***
l. Too many stops to make	0	5	50	82	63	***4.02***	***80.30***
m. It's a Prestige concern	99	39	18	27	17	***2.12***	***42.40***

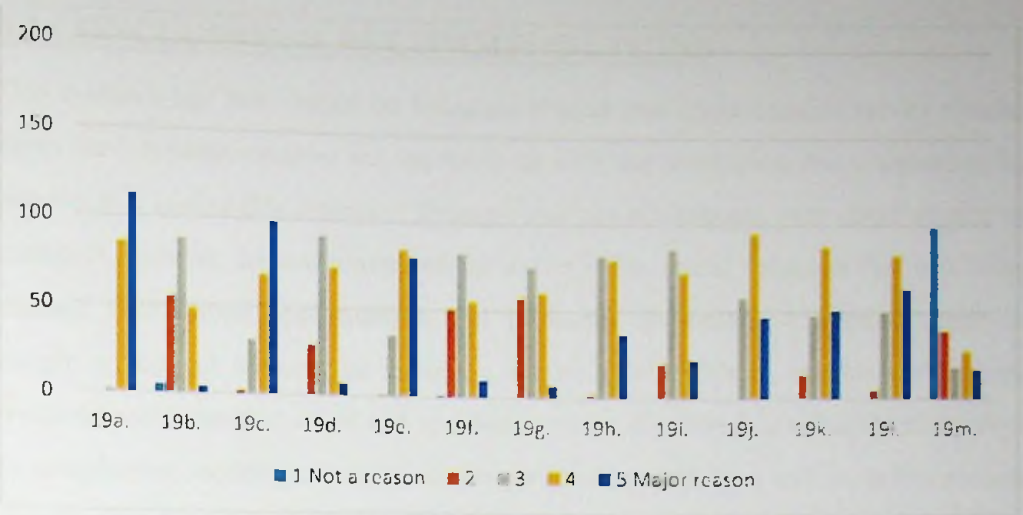

Figure 5.12: Factors influence in cycling more frequency

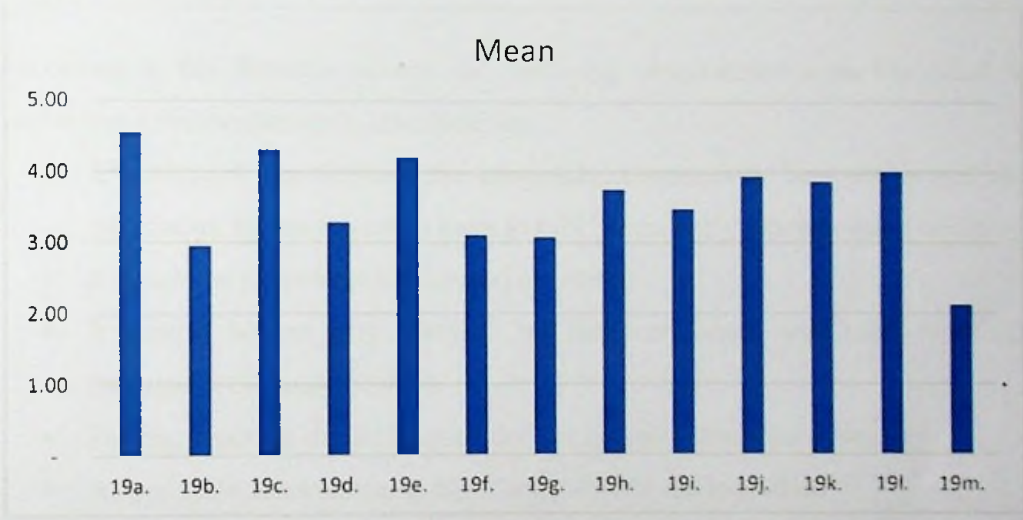

Figure 5.13: Mean value for factors influence in cycling more frequency

Figures 5.12 & 5.13 depict about the factor influence in cycling more frequency. Most of them mentioned that major reason for not cycling more frequent due to non adequate facilities, no bicycle parking, no bike lanes, bike lanes in poor condition, unsafe intersections, bad driver behaviors, automobile traffic, personal safety concerns, visually unappealing surroundings, destinations are too far away, bad weather and too many stops to make. The average mean value for the above as a major reason is more than 4.0 out of 5.0. Most of them are not considering "Prestige concern" as a major reason for not cycling more.

6.0 CONCLUSION & RECOMMENDATIONS

This research has been based on literature studies and questionnaire survey results. From the Literature reviews we can come up with the conclusion that commuting by bicycle is a sustainable transport strategy and has advantages over other modes of transport, both for the commuter and for society. The social cohesion that can bring through recreational opportunities also promotes wellbeing. A diverse range of people would get advantages including school-aged children, regular commuters, weekend recreational cyclists and sporting cyclists. Cycling is a valuable alternative to complement existing transport modes up to short distances and its infrastructure should grow to accommodate the sustainable development. Bicycle lanes should be used for its intended purposes and it should be implemented where there is more demand for cycling.

According to the literature review the following observations were identified to implement a sustainable cycle lane facilities.

- The network should have the continuity, connectivity between origin and destination for easy to cycle users to fulfill their daily transportation needs
- It should be provided with comfort and safety
- It should be properly directed by the road signs and road markings throughout the route network
- Parking facilities should be provided for bicycles wherever necessary
- As per cycle users concern, they should follow the road rules
- As per other vehicular traffic concerns, they also obey the traffic rules
- Awareness programs for enforcing the road rules would help for successful implementation.

The questionnaire survey results give a basic understanding of the public perceptions in providing cycle lane and it provides useful information on origin-destination, characteristics of cyclists, crash history and the adequacy of bicycling facilities.

Through the Questionnaire survey the followings are observed;

- Almost all the cyclist are expecting that Clear signage, Continuous route with little or no stopping, hard surfaces, reduced vehicle speed/volume and proper maintenance of routes are the important factors when implementing new cycle routes.
- The mean value of the cyclist consider as safe when cycling on cycle lane is 3.41 which is equal to 68.10% at any time of the day
- The mean value of the cyclist consider as safe when cycling on cycle lane is 4.15 which is equal to 82.90% during off-peak times.
- The Cyclist don't like to share the road with Car, Van, Buses or other heavy goods vehicles and the average mean value shows that, it puts off cycling. Some road users only accepted to share with Motor bikes & pedestrians.
- Some adverse criteria in the road environment such as ride on uphill & bad weather puts off cyclist from using cycle. Also they are looking for secure parking, good road surface & travelling distance less than 5km.
- Most of the cycle users mentioned that major reason for not cycling more frequent are due to non adequate facilities, no bicycle parking, no bike lanes, bike lanes in poor condition, unsafe intersections, bad driver behaviors, automobile traffic, personal safety concerns, visually unappealing surroundings, destinations are too far away, bad weather and too many stops to make. The average mean value for the above as a major reason is more than 4.0 out of 5.0. Mean value for not cycling due to "Prestige concern" is only 2.12 out of 5. So, public are really willing for cycling, if adequate facilities and infrastructures are provided.

By summarizing the above literature review and data analysis from questionnaire survey, we can come up with the conclusion that the people are really expecting the cycle lane facilities with the above considerations to full fill their daily transportation needs. So, it is observed that there is a need for formalizing bicycle lane. Commuters in Trincomalee district are really willing to use as a sustainable transport mode for the short trips up to 4kms, if the cycle lane facilities are provided with safety and

comfort. The same strategy should be extended to other areas in Eastern province also to make benefited to cycle users.

It is the right time that the highway design engineers in Road Development Authority (RDA) and other relevant organizations to think seriously of these benefits and incorporate safe and effective bicycle facilities by a separate lane as cycle lane to encourage the non-motorized transport of this country in their highway designs. The standard guidelines for the bicycle lanes should be adopted by the designers. The future road infrastructure should be designed as the Cyclist could be attracted to use bicycle and get hope that they can safely and efficiently achieved their transportation needs by cycle. So, the implementation of cycle lane incorporated with these facilities in Eastern province would give sustainable benefits to the public.

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Appendix-A

QUESTIONNAIRE SURVEY ON CYCLE LANE FACILITIES IN EASTERN PROVINCE

1. Home Town/Area :
2. Sex :
3. Age :
4. Location of work/School :
5. Distance between accommodation and work/school?
6. Do you ever use a bicycle?
7. If not, please specify the reason for that?

8. Which of the following reasons for cycling applies to you?

	Frequently	Often	Sometimes	Rarely	Never
Going to work, school etc					
To access services e.g. shops					
For leisure/fitness					
Other(Please specify)					

9. Up to how long do you wish to have cycling for the activities?
10. Do you find parking for cycles adequate? Either in terms of location, design or the amount of parking available - please comment.

11. Do you feel cycle facilities of roads in Trincomalee district is in satisfaction level?
12. Please mention the reason for the above answer (Qn.11) for both "Yes" or "No"

13. Have you had a cycle accident in the last five years?

    Yes (Serious)

    Yes (Minor)

    No

    If yes, please give a brief description

14. Which of the following do you find important when providing a new cycle route. Please rank in order of importance:

	1 (Low)	2	3	4	5 (High)
Clear signage					
Continuous route with little or no stopping					
Wide cycle paths/cycle lanes					
Hard surfaces					
Reducing vehicle speed/volume					
Maintenance of routes					

15. How safe do you feel cycling on the following provision at any time of the day?

	1 (Not Safe at all)	2	3	4	5 (Very Safe)
Roads					
Cycle lanes in roads					
Shared footpath/Cycle way					
Segregated cycle path					

16. How safe do you feel cycling on the following provision during off-peak times?

	1 (Not Safe at all)	2	3	4	5 (Very Safe)
Roads					
Cycle lanes in roads					
Shared footpath/Cycle way					
Segregated cycle path					

17. What puts you off cycling? Sharing space with:

	1 Stops me cycling	2	3	4	5 Is not a problem
Pedestrians					
Motorcycles					
Buses/taxis					
Cars/vans					
HGVs					

18. Which of the following puts you off cycling?

	1 Stops me cycling	2	3	4	5 Is not a problem
Going uphill					
The weather					
No secure parking					
Journey is over five kms					
Uneven road surface					
Other (please specify)					

19. How would you rate the following as reasons that you do not BICYCLE more frequently?

	1 Not a reason	2	3	4	5 Major reason
Not adequate facilities					
No bicycle parking					
No bike lanes					
Bike lanes in poor condition					
Unsafe intersections					
Bad driver behaviors					
Automobile traffic					
Personal safety concerns					
Visually unappealing surroundings					
Destinations are too far away					
Bad weather					
Too many stops to make					
It's a Prestige concern					

20. What would encourage you to cycle more?

21. Do you have any other suggestions for existing/new cycle routes?

22. What type of safety proposals you would suggest?

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