

# Assessing the Suitability of Cycle Infrastructure in Kathmandu

Nisha Tamang Ghising <sup>a</sup>, Sangeeta Singh <sup>b</sup>, Martina Maria Keitsch <sup>c</sup>

<sup>a, b</sup> Department of Architecture, Pulchowk Campus, IOE, Tribhuvan University, Nepal

<sup>c</sup> Department of Design, Norwegian Institute of Science and Technology, Trondheim, Norway

✉ <sup>a</sup> ghising30@gmail.com, <sup>b</sup> sangeeta@ioe.edu.np, <sup>c</sup> martina.keitsch@ntnu.no

## Abstract

Current urban mobility patterns are defined by continual urban growth, unrestrained road widening, and continued congestion. Sustainable transportation emerges in this setting to mitigate the negative impact of rising urban mobility and to promote more ecologically friendly modes of transportation. Western worlds are encouraging cycling as means of transportation as a part of the Sustainable Development Goals (SDGs). Kathmandu, the capital city of Nepal holds historical and cultural significance with amazing heritage sites. To pertain to its importance, the adoption of sustainable transportation plays an important role and Kathmandu has the capability of becoming a cycle-friendly city. The study employs an exploratory approach in which foreign undertakings related to the case area are investigated. The case area was further investigated to find the site attributes required to visualize the potential cycling infrastructure. The route examined starts from the existing cycle lane of Lalitpur city to Kathmandu durbar square including commercial and high traffic zone. The whole body of literature review, site study, and survey questionnaires helped to narrow down the potential approaches.

## Keywords

Sustainable transportation, Cycle infrastructure, Bicycle planning, Sustainability

## 1. Introduction

Rapid population growth has led to problems associated with social, political, and environmental disruptions. Population growth and density have a great impact on the transportation system. Municipal governments across the western world are increasingly promoting bicycling as a mode of transportation to help ease traffic congestion, reduce air pollution, and promote active lifestyles [1].

However, in our country, the increasing usage of vehicles introduces toxic materials into the atmosphere have caused several bad effects on human health and the ecosystem. The main pollutants emitted from vehicles are hydrocarbons, lead, benzene, carbon monoxide, sulfur dioxide, nitrogen dioxide, and particulate matter.

Owning a private vehicle has become a trend in the ever-growing population for the movement of people for their daily activities. Almost all people opt for vehicles that run on non-renewable energy. Very few adopt the bicycle as their mode of transportation.

Cycle lane has been constructed in Nepal in certain

places in Lalitpur city. There are considerably many benefits to adopting a bicycle. However, in our country, there is hesitation in people to own a bicycle.

Therefore, there is a need to understand why people are not shifting towards bicycles and whether the existing cycle lane is being implemented properly with proper rules. So, there is a need for a sustainable solution that gives light to environmental, economic, and social aspects.

The importance of this study is to develop strategies for energy-efficient practices. The study is important for local government, municipalities, local bodies, coordinated sectors, and policymakers to formulate policies related to sustainable development. Reducing the energy crisis requires inputs from various disciplines and across different stakeholders and above all, it requires a good understanding of the benefits of the effective implementation of cycle infrastructure.

The main motive of the cycle infrastructure is to demotivate the use of petrol-run vehicles in the city. Considering the eco-friendly practice and healthy

lifestyle, the bicycle is a real problem solver to ongoing air and noise pollution and traffic congestion due to motorized vehicles. Therefore, the findings of this research benefit every cyclist, non-cyclist along with government sector people who are going to plan further in this sector.

### 1.1 Problem Statement

Environmental degradation due to emissions from motor vehicles contributes to ambient levels of air toxics. The accelerating use of motorized vehicles leads to traffic congestion and accidents. Shifting towards sustainable practices by using bicycles can solve this problem to a great extent. Nonetheless, the existing cycle lane seems to not become a solutionist since there is a question mark on the safety factor of the cyclist. Most importantly, traffic rules regarding bicycle users and cycle lanes are not implemented effectively. Furthermore, looking from a gender perspective, female cyclists are often rarely seen. So, there is a problem in awareness on this subject regarding sustainable development.

### 1.2 Objectives

Overall Objective:

- To understand the condition of the existing scenario and potential regarding cycle infrastructure to promote cycling in Kathmandu.

Specific Objective:

- To investigate the social, economic, and infrastructure aspects of Kathmandu for becoming a cycle-friendly city.
- To propose possible guidelines to be adopted by the local authority for the promotion of safe cycling culture in the city.

### 1.3 Literature Review

**Sustainable Transportation** Sustainable transportation refers to modes of transportation that are both socially and environmentally responsible. The study includes transportation operations and logistics, as well as transit-oriented development. The effectiveness and efficiency of transportation systems, as well as the effects those systems have on the

environment and the climate, are the main factors that determine transportation sustainability [2].

Systems of transportation that are environmentally, socially, and economically sustainable benefit the communities where they are used. People swiftly take advantage of the opportunities provided by improved mobility, with low-income households benefiting considerably from low-carbon transportation options

**Cycling Infrastructure** All infrastructure that cyclists are allowed to use is referred to as cycling infrastructure, including the system of roads and streets that motorists use, with the exception of those where cyclists are prohibited such as many freeways and motorways, as well as bikeways that are not accessible to motor vehicles, such as bike paths, bike lanes, cycle tracks, rail trails, and, where allowed, sidewalks. The bicycle infrastructure includes things like bike racks for parking, shelters, fueling stations, and specialized traffic signs and signals. The extent of local bike infrastructure has a strong correlation with cycling modal share [3].

The case study identified the following characteristics as being relevant to selecting a bicycle for transportation socio-economic factors, distance and time, incentives and car ownership, network layout and facilities, landscape, weather, climate, and self-selection and connectivity. The World Health Organization estimates that 41,000 cyclists worldwide pass away every year in traffic-related accidents, making up about 3% of all fatalities on the road. Injuries to cyclists and pedestrians could be avoided or diminished by lowering speed limits on city streets through straightforward design modifications and speed-calming tactics. Additionally, more separation between traffic and bicycles is required in some high-speed roadway environments in order to emphasize the safety of cyclists. Some safety characteristics are:

- Car-free zones
- Bicycle Boulevards
- Pop-up Bike Lanes
- Physical Segregation

## 2. Case Area



Figure 1: Study area of Kathmandu

With 2.9 million people living in its urban agglomeration and 845,767 residents in 105,649 homes in 2021 (Government, 2078), Kathmandu is both the capital and the most populated city in Nepal. It is situated at a height of 1,400 meters in the Kathmandu Valley, a sizable valley on the high plateaus of central Nepal. It is popular with tourists for its unique architecture and rich culture. The highlighted route in red color is the case area connecting with Lalitpur on the southern side. Whereas the green color denotes the already existing cycle lane. The selected route is chosen considering the link to the existing Lalitpur cycle lane. And the connection is made from Thapathali bridge (which connects Lalitpur to Kathmandu via Bagmati bridge) to Kathmandu Durbar Square connecting Maitighar, Bhadrakali, and New Road gate in between. The selected route focuses on the Lalitpur cycle lane connectivity and traffic congestion between Durbar Square, the main heritage site.

## 3. Methodology

Understanding the condition of the existing scenario and the potential regarding cycle infrastructure to promote cycling in Kathmandu is the key objective of this study.

## 3.1 Research Paradigm

The study is supported by more qualitative information and follows the pragmatic paradigm with participatory research.

## 3.2 Ontology

The ontological position of the study is that the current cycle lane is not being used properly and effective utilization of the existing cycle lane can uplift the comfortability of people. Introducing bicycle infrastructures to Kathmandu can significantly help in traffic reduction and environmental pollution.

## 3.3 Epistemology

To assist this research, literature study, case study, site visits, observation survey, open-ended questions, and in-depth interviews with the stakeholders are the sources of information that hold the epistemological position for the research.

## 3.4 Methodology

A paradigm has guided us to pose certain queries and make use of methodologically sound techniques for systematic investigation. This is the basis for choices regarding ontology, epistemology, methodology, methods, literature, or research design. The social survey method is the basis for data collection where open-ended questions and in-depth interviews were carried out.

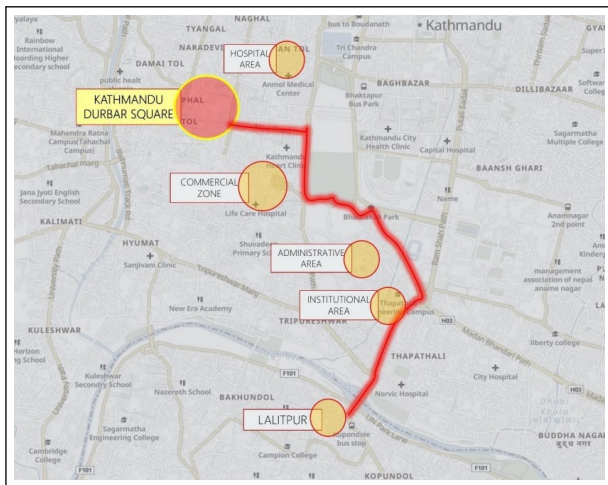
## 4. Findings and Analysis

The following methods were used to obtain information on cycling:

- Observation survey
- Literature studies
- Interview

## 4.1 Observation Survey

### 4.1.1 Kathmandu Study Map



**Figure 2:** Kathmandu study map according to zoning

The above-shown map is the study area constituting different zones. The route chosen from Kupondole to Kathmandu durbar square highlighted with red color touches various areas. Areas such as institutional, administrative, commercial, and hospital areas are connected via the selected route. All types of public and private vehicles run through the route where heavy traffic flow is found during peak hours.

### 4.1.2 Social Aspects

Gender issues in the context of transportation are crucially important. The literature on women and transportation has also amply demonstrated that their needs for travel are typically different resulting from the numerous tasks they must complete in their homes and communities. In addition, low-income women are typically far less mobile than men. They typically have less access and are more reliant on walking to any bicycles or motorcycles in a household. Many social constraints prevent women from moving about freely cultures.

**Gender Survey** As Nepali culture started to change, women turned to the cycle as a means of expressing their independence. For Nepali women, bicycles represent independence from conventional restrictions. However, from the observation study, it was found that most of the cyclists are male whereas females are hardly found on the road.

**Sharing the road** Currently, there is insufficient space on the roadways for cyclists. As the number of

larger, faster cars increases, they must compete for space and risk collisions with aggressive drivers. Since cyclists have no appropriate space, some women find it more difficult to ride a bicycle since men may need to adjust to unsafe driving to survive to experience this battle every day.

**Gender-biased infrastructure design** No gender-friendly infrastructure is designed. It is all designed for the anthropometrics of young male cyclists. Gender-friendly infrastructures include cycle lanes and fully separated from traffic, well-lit street lamps, and bicycle resting stands.

**Uncomfortable bicycles** The more widely available male cycles are inappropriate for women. Women are unable to ride them if they are wearing skirts or saris. So, it also seems like clothing is a problem.

**Harassment and abuse of women** The overall transportation system in our city restricts their ability to move. The reasons behind this are dimly lit. Subways, useless overhead bridges, ridiculously high sidewalks, unattractive bus shelters, poor lighting unmaintained roads and walkways make for a particularly unpleasant street environment for the women. Cycling on these dimly lighted, pothole-filled roads is a challenge that evolves as an invitation to insults and harassment for female cyclists.



**Figure 3:** Good conditioned road

### 4.1.3 Economic Aspects

**Income Group** Higher-income is associated with a lower likelihood of riding; having a high personal or household income is associated with less cycling. Socioeconomic factors were seen to influence the modal divide. As per an observation survey conducted in the case area, higher income leads to a higher percentage of commuter trips by vehicle and less by

bike or foot. There are statistically significant correlations between the socioeconomic factors of gender, income, occupation, vehicle ownership, housing type, and the mode of transportation chosen, including bicycling.

**Type of bicycle and income** It was discovered that cyclists who use bicycles to earn money utilize non-g geared bikes, while the rest of the cyclists use geared bikes. Similarly, just a few cyclists wear helmets for protection, while the majority do not because it is costly, and low-income people cannot afford it.

**Class Survey** From the observation study, it was found that the lowest number of cyclists were high-class people who used cycles for recreational purposes. Others use a bicycle for daily commutes and the rest of the people to work. They usually work as postmen, power line repairmen, gardeners, domestic workers, masons, security guards, service providers. The cyclist works as a delivery driver, carrying milk, restaurant meals, mineral water, and cooking gas cylinders, and also works as a rickshaw driver and as a street vendor, selling vegetables, groceries, and sweets.



**Figure 4:** Rickshaw driver as a source of income

### 4.1.4 Infrastructure Aspects

The selected route is paved roads which reflects readiness to be planned for bicycle infrastructure. Pavements on some roadsides and inner route roads are broken, creating difficulty for vehicles and people movement.

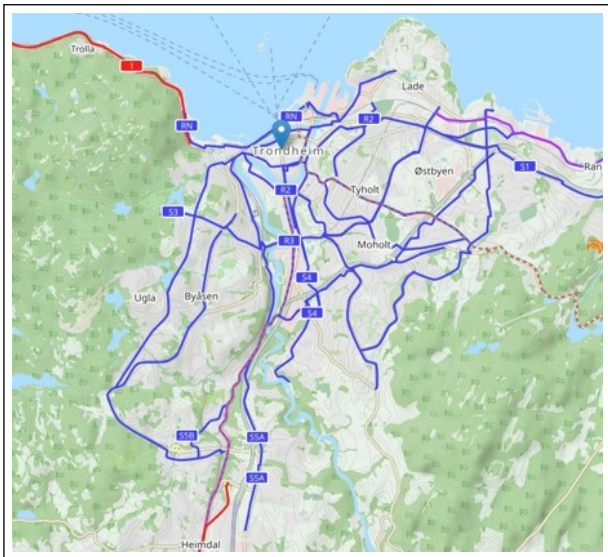


**Figure 5:** Hurdles due to broken pavement

**Bicycle infrastructure features** The most important aspect that has resulted in safe riding in all areas is cycling facilities that are noted as being segregated from heavily used routes. Segregating bike infrastructure from motorized traffic is a key element in encouraging riding. Efforts to improve quality, such as bike parking, bicycle signage, bicycle traffic signs, buffering or segregation from traffic, integration with public transportation, and traffic education and training, all play a role in making networks safer and more appealing. However, these features do not exist in Kathmandu. Whereas, Kathmandu has the potential in building cycle networks. But when designing cycle networks, destinations such as transportation stations, schools, parks, markets, community centers, factories, and office districts should be linked directly. Pathways can be made continuous, with no extra impediments, delays, or diversions, and must be planned systemically.

## 4.2 Findings in Trondheim, Norway

Trondheim is Norway's most bike-friendly city. There are cycling pathways, a network of purpose-built cycleways that cover the city and are well-marked. The chosen sites in Kathmandu are similar to Trondheim. Both have historical significance and heritage zone. The study is based on Infrastructure facility based. Bicycle facilities such as bicycle stands, bicycle signage, one-way for cars, a bypass tunnel for cyclists and pedestrians, a bicycle count system, wheeling ramps, ramps bicycle lifts, and bicycle sharing docks. As per observation and interview survey, some roads in Trondheim seemed confusing for the cyclist making the pedestrians and cyclists collide and may cause accidents.



**Figure 6:** Bicycle route in Trondheim, Norway

### 4.3 Interview

For this study, a semi-structured interview was employed since the research involves the examination of an activity that is contextual in nature and involves specific stakeholders. The semi-structured interview allows the informant to speak freely but also uses a prearranged interview guide to direct the dialogue. Perceptions of various Stakeholders in Kathmandu are summarized on different sustainable aspects.

#### 4.3.1 Social Aspect

**Municipality** Nepalese people are slowly shifting towards clean technology in terms of transportation and people are aware of the benefits of cycling. Several gender-based campaigns for cycling also take place where municipality women are invited to actively take part.

**Traffic police** Punishment such as charging fines over the people parking their vehicles has been taking place Monitoring of the road rules beneficial for the cyclist is also done.

**Nepal Cycle Society (NCS)** NCS members mentioned the slow behavioral change in the people in adapting bicycles as their mode of transportation. NCS has been conducting awareness campaigns on gender issues and social and environmental issues.

**Cyclist commuters** The cycle users are happy with the construction of the cycle lane however; they have shown dissatisfaction with the behavior which they

receive while on road. Many cyclists said that the big vehicles come near to them while driving on the road which scares them as they feel unsafe.

#### 4.3.2 Economic Aspect

**Municipality** As per municipality stakeholders, People using a bicycle are viewed as low-class people and high-class people use other motorized vehicles. A bicycle is known as a means of transportation just for leisure activity, for health concerns but not for the day-to-day commute.

**Nepal Cycle Society** Cycle stands are there but to earn money, the local people are refusing to keep the stands so that they would get to use the parking area for bike and car parking. He mentioned that the laws for cycle lanes are not being able to implement properly due to political issues.

**Cyclist commuters** People who earn their living from the bicycle, as rickshaw drivers, or who sell vegetables and fruits on their bicycles have shown misery as they are looked at by low-class people and are often used the harsh word just because of their work.

#### 4.3.3 Infrastructure Aspect

**Municipality** Providing the right infrastructure plays an important role when it comes to development. Rules for cycle lanes and cyclists are planned but yet to be implemented. The municipality has been recently re-working on the Maitighar to Tinkune route. Before there was a cycle lane constructed but because of its bad design and wrong use of construction materials, it was a major failure. However, planning hand re-designing has been done for the same route.

**Cyclist commuters** Gender and class concerns were directly linked with the unavailability of proper cycle infrastructures.

### 4.4 Cycle-related National Policies

Nepal Road Standard 2070 Evaluation (NRS-2070) All Strategic Roads being built in Nepal's rural districts must adhere to NRS-2070. Getting consistent road design and construction is the major goal of NRS-2070. All roads being built in Nepal must adhere to these requirements. Bicycle tracks should be built on all roads having an average daily traffic volume of more than 4000 passenger car units (PCU) and more

than 1000 bicycles per day. The track shall be built on a distinct formation or at least 1 m away from the edge of the roadway, with a minimum width of 1.2 meters for each lane in each direction of travel. When peak cycling usage on roads with motor vehicle traffic is less than 200 PCU/hr, separate cycle lanes should be made available. Even if the bicycle traffic is barely 100 per hour, separate cycle lanes are justified when the motor vehicle traffic surpasses the threshold. The minimum width of the cycle lane shall be 1.2 m, with 1.0 m between it and the edge of the pavement on either side of the road. Where necessary, each additional lane should be 1.0 m. Review of Cycle Related-Policies in Trondheim, Norway

### **NORWEGIAN PUBLIC ROADS ADMINISTRATION**

(In collaboration with the Norwegian Association of Local and Regional Authorities, the Norwegian National Cycling Association, and the Directorate of Health and Social Affairs.) The proposed National Transport Plan 2006-2015 includes recommendations from the Norwegian Public Roads Administration for implementing the country's cycling plan. Making cycling safer and more appealing is the aim of a national cycling policy, as stated in the National Transport Plan 2006-2015, published in May 2003. These brief objectives have been established: A cyclist's risk of dying in a car accident or suffering severe injuries shouldn't be higher than a driver's. In "bicycle towns" (cities that have chosen to promote cycling), the percentage of bicycle traffic is expected to rise by 50%. At least 8% of all travel in Norway must be by bicycle (out of the total number of trips). According to the Ministry of Transport and Communications, there should be more signs that direct bicycles and indicate how far away the next city is.

## **5. Discussion**

### **5.1 Social Aspect**

According to the hypothesis, the location of the study may affect how gender influences the propensity to cycle.[4] who likewise primarily base their literature study on US studies come to the conclusion that women travel shorter distances by bicycle than men. In Indian cities, there is hardly any infrastructure for cyclists overall, and what there is was created with the anthropometrics of young male bikers in mind. The whole transportation infrastructure of our cities, from poorly lighted overhead bridges, sidewalks,

unpleasant bus shelters, poorly illuminated pathways, and crumbling roadways, all contribute to an unfriendly street environment for women, actively impeding female movement. Cycling on these poorly lighted, potholed roads invites jeering insults, and abuse directed at the ladies on the road. Similarly, from observation surveys and interviews, similar perceptions were grasped regarding women and cycling. The key reasons that constricted women from cycling in Kathmandu were the conservative society. The harassment problem to infrastructure problem. So, if the infrastructure facilities are well planned and designed then Kathmandu can never be late to becoming a cycle-friendly city for all genders and classes.

### **5.2 Economic Aspect**

Shorter commute distances and economic variables like income, occupation, vehicle ownership, and dwelling style all have statistically significant connections with choosing to travel by bicycle. It also shows how a lot of mixed land use increases the number of bicycle trips [5]. Higher-income, according to [6], is associated with a lower likelihood of riding; having a high personal or household income is associated with less cycling. Higher-income, on the other hand, is linked to longer cycling distances. When discussing the bike culture in Copenhagen, Nepali engineers, planners, bureaucrats, and the general public frequently comment that we cannot do it in our city and that Kathmandu is not Copenhagen. However, Copenhagen was not what they are now. Like the streets of today's Kathmandu, the city was congested even then. It is even more critical to give low-cost and fair transportation options, like cycling, priority in low-income communities like Kathmandu. Correspondingly, from observation surveys and interviews, similar perceptions were grasped regarding class differences in society in using bicycles as a mode of transportation. Also, the theory shows if employers are offered financial support for cycling the individual will be positively influenced to cycle. And high parking costs are positively associated with bicycle commuting.

**Infrastructure Aspect** The population and its geographic dispersion determine the need for infrastructure services. As a result, population density is a significant factor for infrastructure requirements as well as the urgency with which services must be supplied. As a result, increasing population density

needs higher daily travel movements that can be supported or substituted by riding a bicycle as a method of transportation. (Heinen & Maat, the effect of work-related factors on the bicycle commute mode choice in the Netherlands, 2013) cite comparative studies that show nations with better bicycle infrastructure had a larger modal split share of cycling. The theory claims that while the provision of infrastructure may lead to increased cycling, a higher cycling frequency may also encourage the creation of bicycle infrastructure. History reminds us that Copenhagen's extensive bike infrastructure investment assisted in preserving and advancing a cycling culture. Importantly, the political will of the local administration had a significant influence on the city's transportation infrastructure. The government's support, however, did not come about by accident. A bottom-up civil society movement consistently pressured decision-makers to include cycling in transportation planning and restrained the government from mindlessly embracing car-centric modernism. According to a survey, places such as transit stations, schools, parks, marketplaces, community centers, factories, and office districts should be closely linked when constructing bicycle networks. Pathways must be reasonable and continuous, with no additional obstructions, delays, or diversions, and they must be planned holistically. Efforts to increase quality, such as bike parking, integration with public transit, and traffic education and training, all contribute to safer and more appealing networks. Therefore, when planning for bicycles as a mode of transportation in Kathmandu, there are several points that need to be addressed. Such as the public impact, stakeholder engagement, management, and policy-making and implementation.

## 6. Conclusion

Cycling is a significant means of transportation since it has many benefits, including those to the environment, the human body, the economy, and to social equity. Making the city bike-friendly has a significant impact on sustainable transportation. With the objective to understand the condition of the existing scenario and the potential regarding cycle infrastructure to promote cycling in Kathmandu, different aspects such as social, economic, and infrastructure aspects were investigated along with cycling regulations and guidelines. The characteristics and elements of the case area, such as land use,

population density, road surface condition, and transportation routes, were noted, which helped to identify the potential pathways for cycling connectivity. The research was carried out through the study of literature and case study together with an interview with respective stakeholders. All in all, focus groups and interview revealed that the social aspect related to gender and class was an important concern for cyclists. Furthermore, discussions were made on infrastructure facilities with proper rules and regulations that would contribute to safer and more appealing bicycle networks. Bicycles as a mode of transportation would ultimately lead to neglect of the use of non-renewable sources for transportation, hence, moving towards sustainability. Considering the eco-friendly practice and healthy lifestyle, the bicycle is a real problem solver to ongoing air and noise pollution and also traffic congestion due to motorized vehicles and helps to achieve the associated sustainable development goals.

## 7. Recommendation

The following strategies in social, and economic aspects, if executed correctly, could contribute to accomplishing the goals. It was determined by an in-depth analysis of the literature, surveys, and site study.

### 7.1 Short-term recommendations

- Women's cycle program/rally
- Awareness Campaign
- Car-free day

### 7.2 Medium-term recommendations

- Installation of cycle stands-considering the flow of the cycle in the area
- Signage in Intersection areas
- Installation of the bicycle-sharing dock

### 7.3 Long-term recommendations

- Placement of street vendors
- Providing incentives to the employees to cycle
- Proposal of connected outer ring road dedicated cycle lane
- Proposal of the only bicycle-friendly zone in the Durbar Square area.
- High parking costs of vehicles



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