

Cycling as a bridge from Health to Environment

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Abstract

This paper covers the health benefits of cycling and how it has a positive impact on the environment. It examines the Dutch model of the development of cycling, how it may be adapted to Indian conditions, and help to overcome the barriers to cycling, in the Indian context. In India, urban growth is a reality fuelled by the Services Sector development, and it impacts accessibility, liveability, sustainability, and the health of citizens. While cycling helps to obviate these issues, it has two major barriers to overcome in India - Road Safety and weather. Local, city, and climate-specific solutions are required and are suggested in this paper. Keywords: Cycling, urban infrastructure, health benefits, Dutch model, weather impact, road safety.

1. Introduction

- i. Urban growth continuously impacts accessibility, liveability, sustainability, and the health of citizens. Cycling assists in overcoming these issues as it also minimises carbon footprint, improves public spaces like car parks, and reduces traffic noise. All this goes to improve the environment we live in. However, the singular most important benefit is an improvement in local air quality. Studies have shown a 65% reduction in NOX pollution (Harms, L. and Kansen, M. 2018). In addition, there are social benefits like support for local shopping and an increase in social connect. The intangibles of cycling like a general improvement in mood, the feeling of independence, and mental state are evident though not objectively recordable.
- ii. There are numerous health benefits of cycling. Studies have shown that 30 minutes of cycling is equivalent to one week's recommended exercise, and it increases life expectancy by 3 to 14

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months and results in a reduction of cancer by 40%, heart disease by 52%, and premature death by 40% (Johan de Hartog, J., Boogaard, H., Nijland, H., & Hoek, G. 2010). As per a study carried out by Oja, P et al, 2011, “there is a clear positive relationship between cycling and cardiorespiratory fitness in youths. Prospective observational studies demonstrated a strong inverse relationship between commuter cycling and all-cause mortality, cancer mortality, and cancer morbidity among middle-aged to elderly subjects. Intervention studies among working-age adults indicated consistent improvements in cardiovascular fitness and some improvements in cardiovascular risk factors due to commuting cycling”. It also helps patients of Diabetes Type II and Obesity to overcome the detrimental effects of these diseases.

- iii. This paper seeks to establish that cycling, if adopted as a major mode of urban transport, can be a bridge to better health and an improved environment for Indian cities of the future. Having established that, it suggests certain action for implementation.

2. Current State of Urban Transport in India

India’s economic growth has been fuelled, largely by the tertiary sector, partly supported by the secondary sector. Economic activities in these sectors happen primarily in the urban areas. If these activities occur in the rural areas, especially of the secondary sector, these areas also lend themselves to rapid urbanisation.

- i. The rise of urbanisation in the country has been discussed earlier by various researchers. Increased migration from rural to urban areas, especially for the blue-collar jobs or lower-end white-collar jobs is a reality. Urban infrastructure is bursting at its seams due to this influx leading to stress on civic amenities and the urban backbones of electricity, water, sanitation, rail, and roads. The state of urban areas is very crucial to ensuring better living conditions for the urban population, especially those in the lower-income groups.

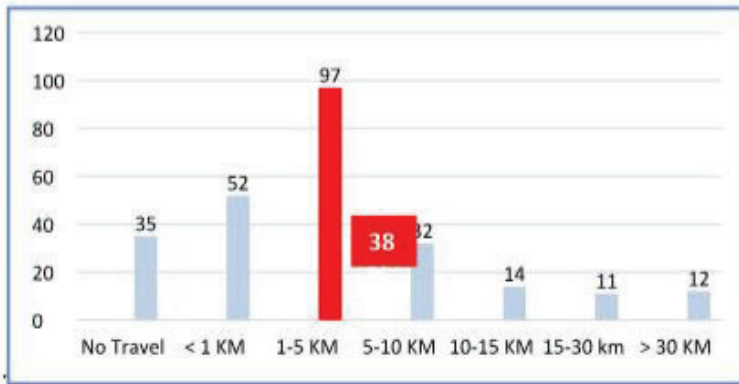


Figure 1: Comparative Indian Travel to Work (Households in Million)

Source: NSSO 2012

- ii. A large proportion of time, effort, energy, and resources of the urban population are spent on the daily commute to-and-fro work. Thus, the development of a good-quality public transport system is a necessary precondition to improve the quality of life of citizens in Indian cities. This was also noted by a World Bank feature. To save on living cost, significant numbers of low-income families depend on non-motorized transport, especially cycles. Integration of cycling as a major mode of transport will lead to alleviating congestion, reducing air pollution, and improving traffic safety.

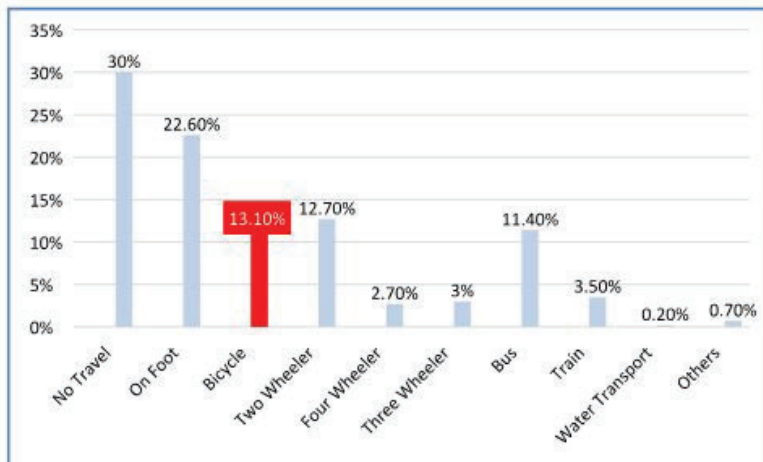


Figure 2: Comparative: Indian Modal Share (Source: Census 2011)

- iii. The National Urban Transport Policy (NUTP 2006) of the Government of India recognised this need and recommended the provision of multimodal public transport systems in cities while discouraging private vehicle ownership and usage.
- iv. NUTP 2014 also has reiterated the vision laid down in NUTP 2006 without any change. However, the NUTP has not been followed up by the necessary regulatory and financial mechanisms to realise the stated vision.
- v. Cycling was, at some time in our history, a major mode of transport in India. Surveys done in the country show that cycling accounts for more than 15% of trips in most towns. Even in large cities like Delhi, cycling accounts for over 10% of trips. This is attributable to it being a livelihood enabler and a low-cost mode of transport for the urban poor.
- vi. In the period 2001–2011, as per Census 2011, the number of car and two-wheeler owners in urban areas increased by 15% and 11 % respectively. The percentage of urban households using cycling as a mode of transport remained unchanged at 3% (TERI, 2018). This is due to an increase in disposable incomes, a reduction in the price of two-wheelers, and real or perceived road safety. Shorter distances in cities that could have been done using bicycles are now done using motorized transport.
- vii. The absence of safe cycling infrastructure remains a major cause of concern. 64% of those killed in Road Traffic Accidents (RTA) are those on NMT and Two Wheelers. These are also invariably from the low-income groups and the ones most likely to gain from a cycling-friendly environment, both economically and health wise.

3. Benefits of Cycling

i. Direct Benefits

Benefits that accrue directly to individuals using cycles are defined as direct benefits. In a study done by TERI, direct benefits such as personal fuel savings (TERI Transport Model), health benefits due to increased physical activity (WHO HEAT Model), reduced air pollution (TERI's Air Quality Modelling Framework), and travel-time savings by marginal unskilled workers (Wage Rate Model) are quantified using the models given in the parenthesis. As per the WHO Health Economic Assessment Tool (HEAT) Model, 79% of Direct Benefits of cycling are towards health.

- The Cost of Illness (CoI) approach quantifies the direct and indirect costs associated with cardiovascular diseases, diabetes, and obesity, which are caused by a sedentary lifestyle. A study done in The Netherlands found that with about 74 minutes per week spent by Dutch adults aged 20 to 90 years on cycling, the mortality rate reduction was about 6500 deaths per year. As per Fishman, E., Schepers, P., & Kamphuis, C. B. 2015 “at €2.8 million per prevented death, the total economic health benefits of cycling were estimated at €19 billion per year”.

- 77 million Indians are affected by Diabetes - the majority in urban areas (Pradeepa, R., Mohan, V 2017). India is the diabetes capital of the world. India also has one of the highest burdens of cardiovascular disease (CVD) worldwide. The annual number of deaths from CVD rose from 2.26 million in 1990 to 4.77 million in 2020. Coronary heart disease prevalence rates in India have been estimated over the past several decades and have ranged from 1.6% to 7.4% in rural populations and from 1% to 13.2% in urban populations (Huffman, M. D., Prabhakaran, D., Osmond, C., Fall, C. H., Tandon, N., Lakshmy, R., Ramji, S., Khalil, A., Gera, T., Prabhakaran, P., Biswas, S. K., Reddy, K. S., Bhargava, S. K., Sachdev, H. S., & New Delhi Birth Cohort 2011). “There are an estimated 32 million people in India living with ischemic heart disease. The seriousness of the consequences of these increasing risk factors should not be underestimated” (Paradis G, Chioloro A, et al 2011). • The health benefits of cycling in overcoming the debilitating impact of just diabetes and CVD alone would justify the additional cost of the development of cycling infrastructure.

ii. Indirect Benefits

- As per (TERI 2018), the tangible, indirect benefits of cycling that accrue to society are reduced CO₂ emissions, savings on fuel costs, and increased access to local socio-economic opportunities. According to TERI 2018, it was estimated that if bicycles replaced motor vehicles for short-distance trips, it could result in an annual benefit of Rs 1.8 trillion or 0.65% of Indian GDP for 2021-22. The intangible benefits of cycling – a general increase in happiness, freedom, social participation, quality of life, independence, enjoyment, time, convenience, and flexibility are not quantifiable but can be considerable.

iii. The Dutch Experience

a. History

- In 1972, 3000 people, including 450 children, died in cycling accidents in the Netherlands. The case for building better cycling infrastructure was started by one person, a journalist named Vic Langenhoff, who lost a school-going child in a cycling accident. A citizens' movement called "Stop de Kindermoord" (Stop the Child Murder) was formed. It demanded safer cycling conditions, especially for children. The movement took its name from the headline of an article written by the journalist himself.
- The sustainability of the motor vehicle as a major mode of transport was also affected by the 1973 oil crisis.
- Both of these issues helped persuade the Dutch government to invest in improved cycling infrastructure and to move away from urban infrastructure centred around cars.

b. Current State

The Netherlands can rightfully be called a country of bikes as it has 23 million bicycles for its 17 million people. Bicycles in the Netherlands are not only an alternative to public transport and cars for short distances, but they are also a mainstay of commuting for the population, especially in cities. A quarter of all journeys are made by bike. With 37,000 KM of cycle track in the country, it amounts to 17.6 billion KM per year or 3 KM per person per day.

c. Dutch Best Practices

In 2017, the Dutch government allocated a quarter of a billion euros to support cycling as a major mode of transport. The Dutch Tour de Force is a Joint Bicycle Agenda 2017-2020 that has brought together various stakeholders, including the government, private sector, NGOs, and knowledge partners, to increase the bicycle friendliness of their nation. The agenda was focused on improving bicycle highways, providing bicycle lockers and racks at train stations, and facilitating the first and the 'last mile'. It is primarily centred on providing the population with inherent flexibility in choosing the mode of transport and integrating the existing modes in a comprehensive manner. This approach can be applied in other countries, including our own. Some of the key initiatives are given below.

- To enable people to reach all destinations, the Dutch have built an extensive network of cycling infrastructure adapted to the environment to ensure safety and comfort for all cyclists. This effort not only focused on building cycle paths but also making intersections safer by changing layouts or by adding lights for cyclists, thereby reducing the chance of conflicts with vehicular traffic.
- Where the physical space is too small for physical separation, vehicular traffic is slowed down by a change in the street layout as well as signs. Dutch planners also create areas where cars are allowed to enter but where they are guests, and cyclists & pedestrians have priority.
- In the Netherlands, around 40% of train passengers arrive by bicycle. Planning for the bicycle further increases the catchment area of the station up to 15 times compared to just considering walking. This model extends the TOD (Transit Oriented Model) concept into a HOD: 'Hybrid Oriented Development' (Jonkeren, Olaf & Kager, Roland & Harms, Lucas & Brömmelstroet, Marco. 2021).
- In denser neighbourhoods, the modal shift for cycling is much higher than in more rural areas. The bicycle is a good mode of transport for short distances; therefore, its benefits are greatly increased when urban areas are designed for proximity between different uses (residential, commercial, health services and shops). No large supermarkets or 'hypermarché's' on the edge of town that can only be reached by car, but a spread of smaller shops within cycling distance.

iv. Barriers to Cycling

There are a large number of barriers to cycling, but primarily, in the Indian context, there are two major ones.

a. Road Safety

- Perceptions matter more than reality. While statistics may speak otherwise, if the physical environment looks dangerous, people will not consider cycling a viable transport option. Therefore, first and foremost, the infrastructure design must look safe for cycling. This comes in the shape of physical separation of cycling and car lanes, institution of road dividers, guard rails, and plant-based separators/screens.
- Dutch policies also have a preference for promoting the prevention of accidents or active safety rather than passive safety (softening the outcome of accidents). This

is done through the creation of bicycle infrastructure rather than shifting the onus to the bicycle user in the form of wearing a helmet, lights, or reflective clothes.

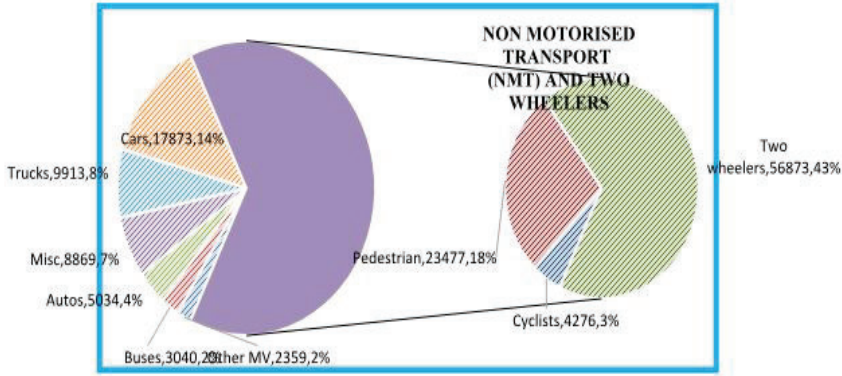


Figure 3: Indians Killed in Road Accidents (Source: Report on Road Accidents in India 2020 by MORTH)

b. Weather

- A major barrier, especially in the Indian context, is the weather, especially the heat, sunlight, and consequently dusty or arid conditions. Eighteen Indian cities have a population greater than that of the Netherlands. Twelve of these cities are classified as having Tropical Wet and Dry weather, and three are arid/semi-arid. The weather thus poses a major challenge in India.
- Intuitively, air temperature is a common indicator that deters cyclists from venturing out. Two thermal variables - Mean Radiant Temperature (MRT) and Physiological Equivalent Temperature (PET) - better explain cycling behaviour than just air temperature (Böcker and Thorsson, 2013).
- Mean Radiant Temperature (MRT) is the radiant heat exchange between humans and the environment. • Physiological Equivalent Temperature (PET) is an index combining the effects of air temperature, MRT, air humidity, and wind speed.
- Studies have indicated a daily fluctuation of bicycle volume by 80% due to changes in weather conditions (Thomas, Jaarsma, and Tutert, 2013).

- It has also been found that there is a drastic drop in cycling when the ambient temperatures rise above 35 degrees or drop below 8 degrees Celsius (Pazdan, S., 2020). However, in areas with high humidity levels above 78%, even ambient temperatures as low as 28 degrees Celsius make it difficult for cyclists to continue (Chabert, C., Collado, A., & Hue, O. 2021).

5. Way Forward/Recommendations

i. Legislation

The key issue here is to take cycling seriously. Currently, it is seen as an adjunct to the proper modes of transportation, i.e., car, bus, rail, auto, cab. Resources for infrastructure are allocated accordingly. To overcome this debilitating factor, there is a need for an affirmative action programme through legislation. The Active Mobility Bill tabled in Karnataka seems to be one such step in the right direction.

ii. Policy

In the Indian context, policy needs to cater to the low-income group cyclist, the commuter, the recreational, and lastly, the sports cyclists, in that order of priority. For that, we need an integrated cycling policy covering the aspects as given here. The current national urban transport policy obliquely alludes to it without specifically addressing the issue. The policy needs to be centered on bicycle infrastructure, and again, we may take inspiration from the Dutch CROW Design Manual for Bicycle Traffic. This manual considers five basic design principles for infrastructure design, i.e., cohesion, directness, safety, comfort, and attractiveness. The USP of Dutch design principles is their transferability.

iii. National Urban Transport Policy (NUTP) Implementation

- The NUTP 2006 and 2014 recognised the need to address safety concerns of cyclists. It sought to address this by encouraging the construction of segregated rights of way for bicycles and pedestrians.
 - **Segregated Paths for Different Vehicles**
 - a. Different classes of vehicles move at different average speeds. Forcing them to move one behind another would result in sub-optimal speeds and increased emissions.

- b. Segregation would also increase both actual and perceived safety. This would result in an increase in bicycle traffic and consequently reduce motorised transport.
 - c. This would also help improve traffic flow and increase the average speed of traffic.
 - d. These would be useful both for arterial roads and as a means of improving access to major public transport stations, especially metro stations.
 - e. When combined with safe bicycle parking places, this would contribute to increasing the use of public transport.
- Other facilities envisaged include planting of shade-giving trees, clean drinking water, and resting stations along bicycle corridors. These would mitigate adverse weather conditions.

iv. Urban Transportation Model

- We also need to tweak our transportation model from a Car/Transit orientation to a Hybrid Oriented Model to ensure that it is scalable, sustainable, and creates attractive streets and public spaces. It thus seeks to combine two opposite yet synergistic transport modes – rapid, efficient mass transit like metro and walking/cycling for short distances.
- Both metro and cycling have a large intersection of clientele. Integration of both modes would synergise the strengths of each while overcoming weaknesses like first/last mile connectivity (of metro) and reach (of cycling).
- In the Netherlands, 40% of train travellers arrive by cycle, i.e., 4.8 Lakh per day. In June 2022, Delhi Metro recorded 41 Lakh people trips per day. Almost all would arrive at the metro station by means other than cycling, i.e., cars, autos, buses, or walking.
- In order to encourage some percentage to arrive by cycle, we need to build first/last mile connectivity, including bike racks/parking. We should even consider permitting cycles on board the metro during off-peak hours or segments of low utilisation, like in many developed countries. While this method lacks scalability, especially in crowded segments, it is implementable on a limited scale (Kager, R. and L. Harms 2017).

v. Overcome Impact of Weather

- While solutions exist for screening against direct sunlight, as shown by South Korea, our development of cycling infrastructure needs to be tempered with the limitations in the months when it would not be exploited and areas which are not amenable to cycling. So, it is important to implement based on local factors and not force-fit solutions based on targets laid down.

vi. Overcoming Non-usage of Cycling Infrastructure

- A casual look around major cities would indicate that many cycle tracks do not get used as initially envisaged. Primarily, it is because of design and utility limitations.

- Utility Cycling infrastructure is currently being developed to meet laid-down targets. Instead, it needs to be constructed to meet citizen requirements. For example, a cycling route from a residential colony to the nearest metro station terminating at bicycle racks/secured parking facilities would serve better than a similar length of track parallel to a random road segment. Therefore, there is a requirement to ascertain public demand before freezing the design and to create end-to-end cycling infrastructure to solve specific transportation problems.

- Design This is a critical element. Poor design dissuades people from cycling. Key aspects of design include physical separation and safety from other modes of transport, crossings at intersections, marking, lighting, and colour coding of asphalt/surface. Another aspect of design is its impact on perceived safety. A bike path that looks safe will be used more (William Riggs, 2019).

- Encroachment of cycle paths, including illegal parking and hawking on cycling paths, affects safety and needs enforcement with strict penalties.

6. Conclusion

The health and environmental benefits of cycling need no elaboration. The Netherlands has shown the way forward, and what happened there with respect to cycling is special. It delivers, but at the same time, it's not so special that it cannot be replicated. There are 18 Indian cities with a population larger than that of The Netherlands. The challenge for India with respect to scale is obviously phenomenal. Compounding the challenge is the pressure of population, population density in cities, and the

consequential impact on urban infrastructure. Local weather conditions impede the adoption of cycling as a primary means of transportation. Thus, the creation of infrastructure for cycling needs careful planning considering local conditions and requirements rather than imposing solutions at the national or state level. We need to adapt the Dutch model to suit Indian conditions. The Hybrid Oriented Model is the way forward for the cities of India.

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