

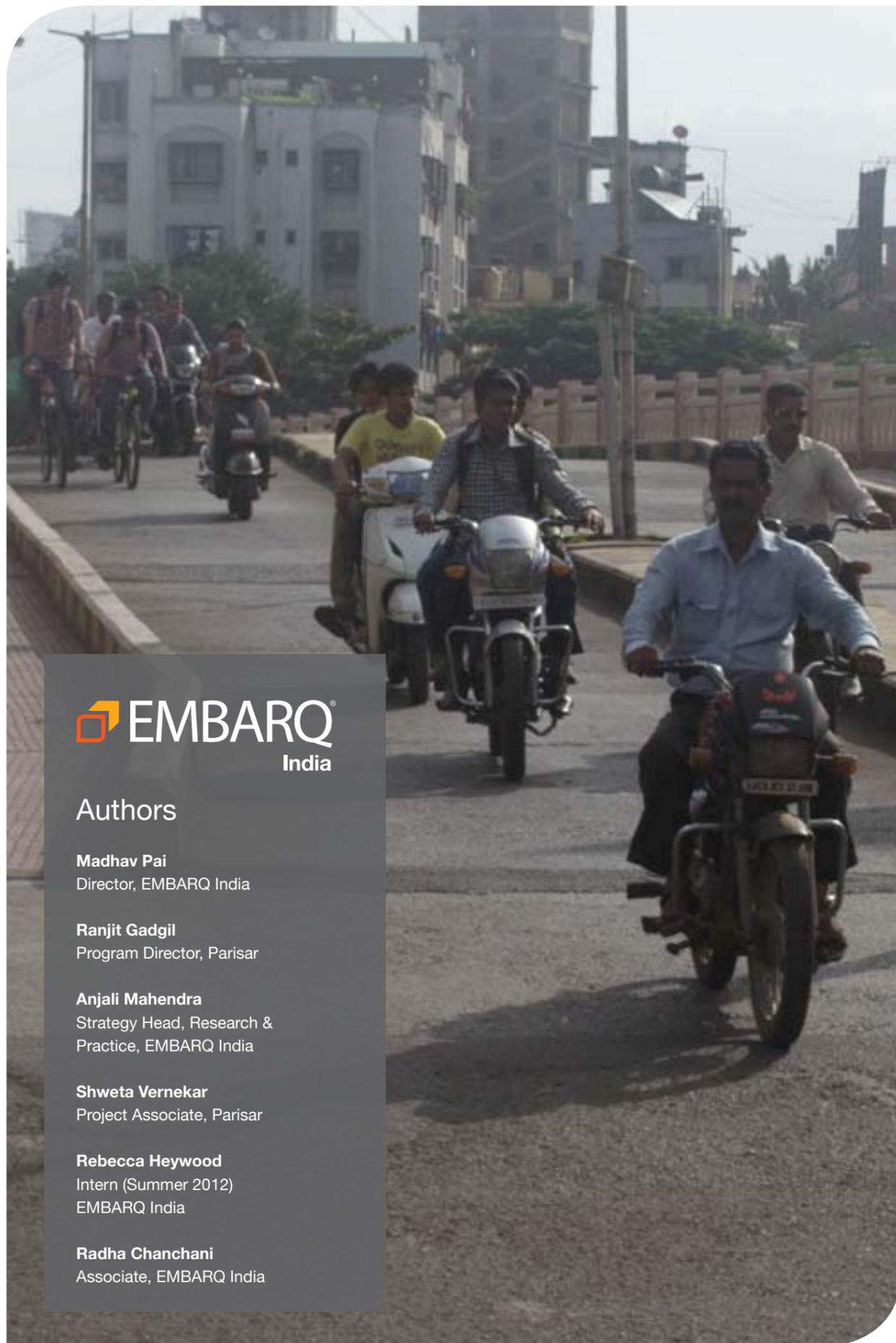


Working Paper

# MOTORIZED TWO-WHEELERS IN INDIAN CITIES

A Case Study of the City of Pune

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## EXECUTIVE SUMMARY

This working paper draws attention to the important and underexplored issue of motorized two-wheelers, a ubiquitous transport mode in growing Indian cities. On one hand, motorized two-wheelers present a challenge because of the serious safety concerns and dependence on personal motorized vehicles that they engender. On the other hand, they are an important transport mode for a large proportion of people in Indian cities who lack access to good quality, affordable public transport options.

Currently cars constitute just over 13 percent of the vehicle population in India, while two-wheelers constitute more than 70 percent. The key objective of this study is therefore, to better understand the role of motorized two-wheelers in urban transport, the mobility advantages they offer, the challenges they present, and possible policy options to manage them.

The authors conducted a thorough review of the literature on urban two-wheelers in Asia and India in particular, a case study of the city of Pune in India, and a review of experiences from cities like Taipei, Taiwan that have implemented successful policies to manage two-wheelers. Original survey data, as well as stakeholder interviews and first-person observations in Pune contribute to an in-depth understanding of the role of two-wheelers in a typical mid-sized Indian city. The paper discusses the effect of two-wheelers on motorization in Asia and India, key factors influencing two-wheeler ownership and use, economic and demographic characteristics of two-wheeler users, their usage patterns and propensity to shift to alternate modes of transport.

The findings show that affordability and convenience offered by two-wheelers have made them a hugely popular mode of transport in Indian cities, a trend significantly advanced by the lack of adequate and good quality public transport systems and non-motorized transport infrastructure in many cities. Data from the Pune survey suggests that the use of two-wheelers can engender a lifelong preference for private motorized mobility, with 80 percent of surveyed two-wheeler users stating that they would be interested in purchasing a car in the future. With the national government supporting the growth of the automotive industry, the market share of private motorized vehicles (cars and two-wheelers) appears set to grow. However, higher levels of motorization also mean increasing air pollution, congestion, road safety risks, loss in worker productivity, and compromised public spaces.

The rapid growth in two-wheeler users has implications for the ridership and use of public transport that loses mode share. Significantly, two-thirds of the two-wheeler riders surveyed in Pune said they used public transportation prior to using two-wheelers. The study notes this apparent co-relation between the motorized mode shares of public transport and two-wheelers. Large metros like Delhi, Kolkata and Mumbai with higher public transport shares have low two-wheeler shares, while the converse is true in the case of small to mid-sized cities like Ahmedabad and Pune, which have the highest two-wheelers shares in the country.



**Two-Wheeler Riders in Pune - A Typical Mid-Sized Indian City**

Source: Authors

Some key factors influencing two-wheeler ownership and use in Asian cities are their low costs and fuel economy, maneuverability and ease of parking in congested conditions, shorter distances or trip lengths and low levels of transit services, walking and cycling infrastructure. In Pune, comfort, convenience and enjoyment were the top reasons given by surveyed riders for starting to use motorized two-wheelers. While fuel price thresholds for shifting to alternate modes of transport were fairly inelastic, nearly 80 percent of the surveyed two-wheeler users said they would be willing to shift to public transport if services were improved. An interesting finding was that about 27 percent of the surveyed riders used the two-wheeler in conjunction with another mode of transportation on a single trip, primarily bus and autorickshaws, pointing to the potential for integrating two-wheelers with other public transport modes.

The Pune survey also provided interesting insights on the demographics and income distribution of two-wheeler users. It was seen that men primarily used two-wheelers to travel to work, while more women used them to access education or for recreation/shopping trips. This perhaps shows the opportunities provided by the mode to women, for whom the unreliability of public transportation may be a more significant problem than for men for reasons of safety and household responsibilities.

Safety with respect to two-wheelers is considered a significant concern. Two-wheeler riders were considered both more vulnerable in mixed traffic conditions while also adding to unsafe driving conditions owing to their tendency towards traffic indiscipline, speeding or rash driving. Recent data showed that the highest number of road fatalities in India were two-wheeler riders and the country records the maximum number of deaths from motorized two-wheeler accidents in the world. In Pune, 50 percent of the traffic accident-related fatalities in 2010-11 were two-wheeler riders, and of the surveyed two-wheeler riders, about 20 percent had been in an accident before. The survey also found that all respondents with children owned a two-wheeler, while a third of them also owned a car. The primary impetus for owning or wanting to own a car in the future was higher income and family convenience. Data also revealed that two-wheeler ownership and use was not limited to lower income populations as is normally perceived.

Across Asian countries, policies on two-wheelers have typically been lax due to the presumed vulnerable nature of the user (i.e., low income), and this may not be relevant because many two-wheeler users can afford to pay the full

costs of their ownership and use. However, a number of the stakeholders interviewed in Pune felt that charging the real costs of resources used by two-wheelers and the negative externalities they cause - which may include higher taxes and fuel prices, congestion and parking fees - would be politically difficult to implement for fear of public backlash. Moreover, given the increased need for mobility and the currently unmatched benefits that two-wheelers offer, these may not create enough of a disincentive for their use, even if implemented. As such it seems that such 'push' strategies would only really be effective when preceded by and combined with 'pull' strategies such as improving and integrating multi-modal public transport systems, and making them affordable and attractive. Stakeholders categorically felt that this was a prime condition before any thought of restricting or discouraging two-wheelers could be considered.

With rising urbanization and vehicle growth particularly in the mid-sized and smaller cities of India, it is imperative for local governments and other stakeholders to explore and implement relevant two-wheeler management strategies. Drawing on lessons from Taipei and other cities in Asia, these may be related to road design, traffic engineering and management, two-wheeler specific traffic regulation measures, parking management, mode integration, pricing, and incentives to influence user behavior, education and enforcement. The authors expect that this working paper will create greater dialog and debate among stakeholders regarding policies and innovative solutions to manage two-wheelers in the unique context of Indian cities.

## 1. INTRODUCTION

The motorized two-wheeler<sup>1</sup> market has been expanding rapidly, particularly in the urbanized areas of Asia. About 80 percent of the 300 million two-wheelers worldwide are in Asia, as are 90 percent of world two-wheeler sales (PCFV 2010).

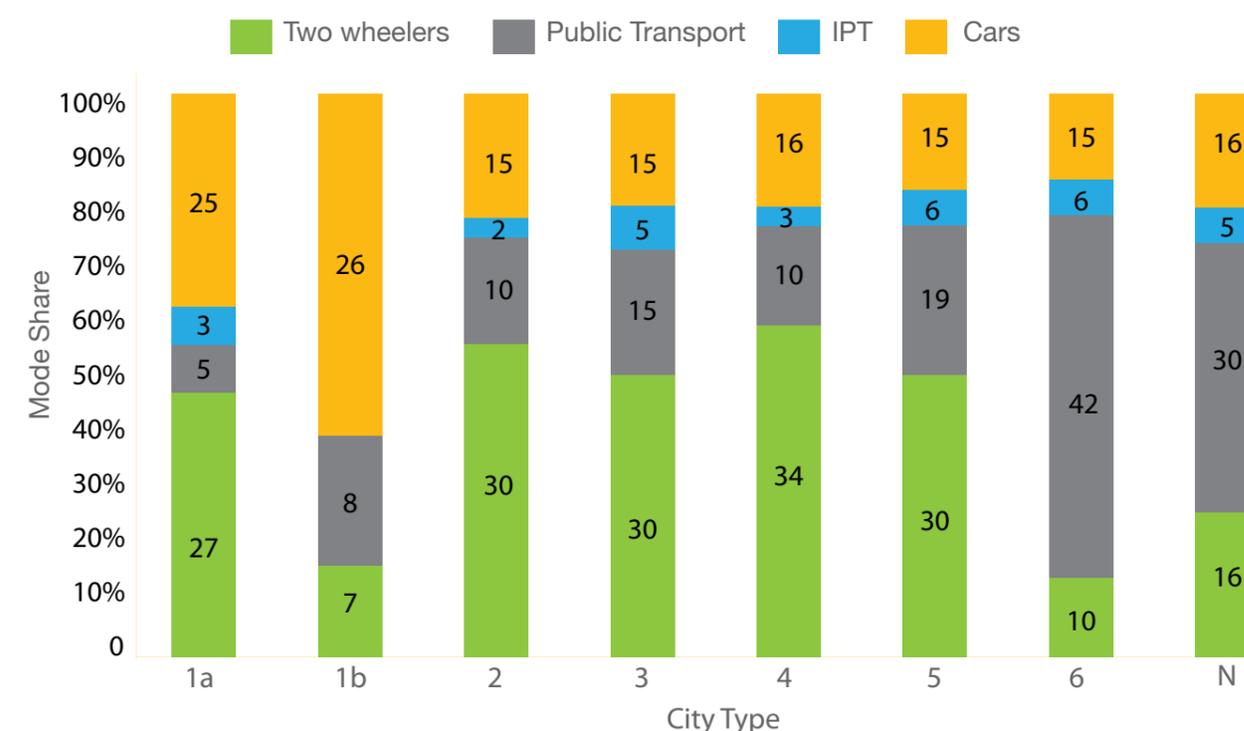
Two-wheelers cater to the needs of low and middle income users and help fill the gaps when public transport systems are inefficient, not integrated, or non-existent (PCFV 2010). The reality is that many Indian cities lack substantial and efficient public transport systems. As incomes rise, users of public transport and people limited by their lack of mobility are looking to private modes of transportation to meet their mobility needs. While car ownership may be on the rise, it is two-wheelers that are leading the process of mass motorization as millions of people in India's growing middle class are able to afford an entry-level two-wheeler. A nation-wide study by the Indian Ministry of Urban Development found that the share of personalized modes has grown by leaps and bounds in the past couple

of decades, especially two-wheelers at 12 percent per annum, while the share of public transport has generally dwindled (MoUD, Wilbur Smith Associates 2008). As Figure 1 demonstrates, two-wheelers (shown in green) play an important role in motorized transport in Indian cities of all sizes, with the highest modal shares of about 30 percent in small to mid-sized cities.

However according to the World Health Organization (WHO), two-wheeler users are more vulnerable to road accidents and deaths, and have very high levels of air pollution exposure (PCFV 2010). On the other hand, they are also criticized for contributing to air pollution, traffic congestion, unsafe driving conditions and accidents.

The issue of whether two-wheelers should be considered a "boon" or "bane" has been debated by practitioners, without being conclusive either way<sup>2</sup>, likely because the mode both, offers several benefits to travelers, as well as creates several challenges. Thus, policy recommendations for the sector in other cities have ranged from not taking any action to banning two-wheelers altogether.

Figure 1. Motorized Mode Shares in Indian Cities, 2007



Source: Adapted from MoUD (2008)

Note: City type (X-Axis) refers to cities categorized by population: 1a: < 0.5 million with plain terrain; 1b: < 0.5 million with hilly terrain; 2: 0.5 – 1 million; 3: 1-2 million; 4: 2-4 million; 5: 4-8 million; 6: > 8 million; N – refers to National

<sup>1</sup> Referred interchangeably in this document as motorcycles, motorbikes, motorized two-wheelers, or simply, two-wheelers, in India, this sector includes mopeds, scooters and motorbikes, the difference primarily being in engine size and power. Mopeds typically have an engine capacity of less than 50 cc and often come with pedals, similar to a bicycle. Scooters are fully motorized with higher engine capacities, typically between 50-150 cc and some are automatic. Motorbikes have manual gears and more powerful engines, typically over 250 cc.

<sup>2</sup> Session on "Motorbikes – a 'Boon' or a 'Bane'" held at the Transforming Transportation conference in Washington DC co-hosted by EMBARQ and the World Bank, January 28, 2013

Many road design and regulatory standards implemented in Asian cities are based on work from Europe and North America, where two-wheeler use is low and traffic is not as heterogeneous as it is in Asian cities. This has led to several design and regulation conflicts within developing cities. It is imperative to begin thinking about motorized two-wheelers in the developing world and Asian context to understand how to design roads and policies to support sustainable transportation in an increasingly motorized world.

As the mode share of two-wheelers grows in Indian cities, it is important to understand their role in urban transport, the mobility advantages they offer, the motivations of their users and the challenges they present, in order to create well-informed policy and planning decisions. While much research has been done on the role of motorized two-wheelers as a contributor to urban pollution and congestion, there has been little research on the unique demographics of two-wheeler users in Indian cities and why they choose to use two-wheelers instead of other modes of transport. Many Indian cities lack two-wheeler policies and infrastructure and can learn a great deal from some of the policies, regulations and experiences from across Asia. This study aims to inform the debate, using detailed survey data from the city of Pune in India and a review of experiences from cities like Taipei, Taiwan, that have implemented successful policies to manage two-wheelers.

## 1.1 Study Objectives

The key objective of this study is to better understand the role of motorized two-wheelers in providing urban mobility and the challenges associated with the sector in Indian cities, where two-wheelers are a ubiquitous transport mode. The discussion will focus on three main aspects:

- Current use and growth trends for motorized two-wheelers based on demographic, economic and other factors, showing why this is a popular transport mode in Indian cities, using evidence from Pune.
- Current and future challenges that result from the growing use of motorized two-wheelers such as safety risks, while understanding the mobility and increased accessibility provided by the mode for particular population groups, using evidence from Pune.
- Policy options to manage two-wheeler growth, reduce safety risks and other externalities, based on lessons from Taiwan.

The study is based on a detailed review of available literature on the urban two-wheeler sector in Asia and a traveler survey conducted in the city of Pune, India in 2012. To address the three areas identified above, some research questions explored in the study are:

1. Where does India currently fit on the motorization curve? How does this compare with other countries in Asia, and what implications does this have on future motorization levels?
2. Do two-wheelers accelerate the overall growth of motorization? Are two-wheelers a step towards car ownership?
3. What are the key factors that influence motorized two-wheeler ownership?
4. What is the demographic of two-wheeler users? What effect does income have on two-wheeler ownership?
5. Are there 'captive'<sup>3</sup> two-wheeler users?
6. What are some of the issues and challenges for Indian cities in dealing with the large volume of two-wheelers?
7. Do two-wheelers have a role in sustainable urban mobility in the Indian context? If so, what policy options are available to best manage them, based on international experience?

## 1.2 Study Methodology

The first step in this study was a literature review on the role of motorized two-wheelers in urban transport in Asia and how this related to urban India with the goal of identifying gaps in the available literature. Then, strategies used in Taipei, Taiwan, were reviewed to help understand the city's experience with two-wheeler management. Finally, a two-wheeler user survey was conducted in Pune, India to answer questions not addressed in the available literature. Survey data, as well as stakeholder interviews and first-person observations contributed to an in-depth understanding of the role of two-wheelers in Pune, a typical mid-sized Tier 2 Indian city<sup>4</sup>. A summary of the stakeholder interviews is shown in Appendix A and the complete survey questionnaire is included in Appendix B.

Some existing quantitative data on two-wheeler use in the Indian context already exists, based on surveys done in Bangalore (CiSTUP 2012) and Delhi (iTrans 2009). However, given the fastest growth in this mode in mid-sized and smaller cities like Pune, the survey conducted as part of this research provides important quantitative evidence

to understand the motivations and characteristics of two-wheeler users in such typical mid-sized cities.

### 1.2.1 Survey Design

The objectives of the survey were to understand which population groups used two-wheelers in Pune, what factors did their decision to use two-wheelers depend on, and what was their propensity to switch to alternative modes of transportation.

The survey was designed as an intercept<sup>5</sup> survey of one thousand two-wheeler users, over three months. The goal was to reach users from all parts of society, and as such, surveyors spoke to users in a variety of locations, times and days of the week. The survey was divided into seven parts: household information, user information, two-wheeler use information, safety, alternative transport modes, opinion about transportation in Pune and field notes.

About 72 percent of survey respondents were male and 28 percent were female. The respondents were asked questions about travel modes used by other members in their household as well, in order to draw correlations between household economic and demographic characteristics with the mode choice data. Considering all members of the respondents' households, the percentage of males and females represented in the dataset was almost even at about 51 percent and 49 percent respectively. This also allowed us to infer some important gender issues related to the use of two-wheelers from the survey data.

The next section provides a background on motorization rates across Asia and India, and how two-wheelers contribute to the growth in these rates. It places the discussion in the rest of the paper in context by explaining where India fits on a general motorization curve, how the country compares with other countries in Asia, and what implications this has for the future.

<sup>3</sup> 'Captive' users are those who use a mode because they have very limited other choices, often due to lack of access to alternative modes or lack of affordability.

<sup>4</sup> The Indian National government classifies Indian cities based on population. Tier I: > 4 million; Tier II: 1 – 4 million; and Tier III: <1 million

<sup>5</sup> An 'intercept' survey is an in-person, one-on-one, impromptu survey done on location. The questionnaire is administered to a sample of 'intercepted' respondents as they pass by the interviewer.

## 2. MOTORIZATION RATES AND THE EFFECT OF TWO-WHEELERS

Motorization rate or index is defined as the number of motor vehicles per thousand inhabitants. It is intricately tied with urbanization, economic and income growth, government policies and investments in a region (Chen and Zegras 2010).

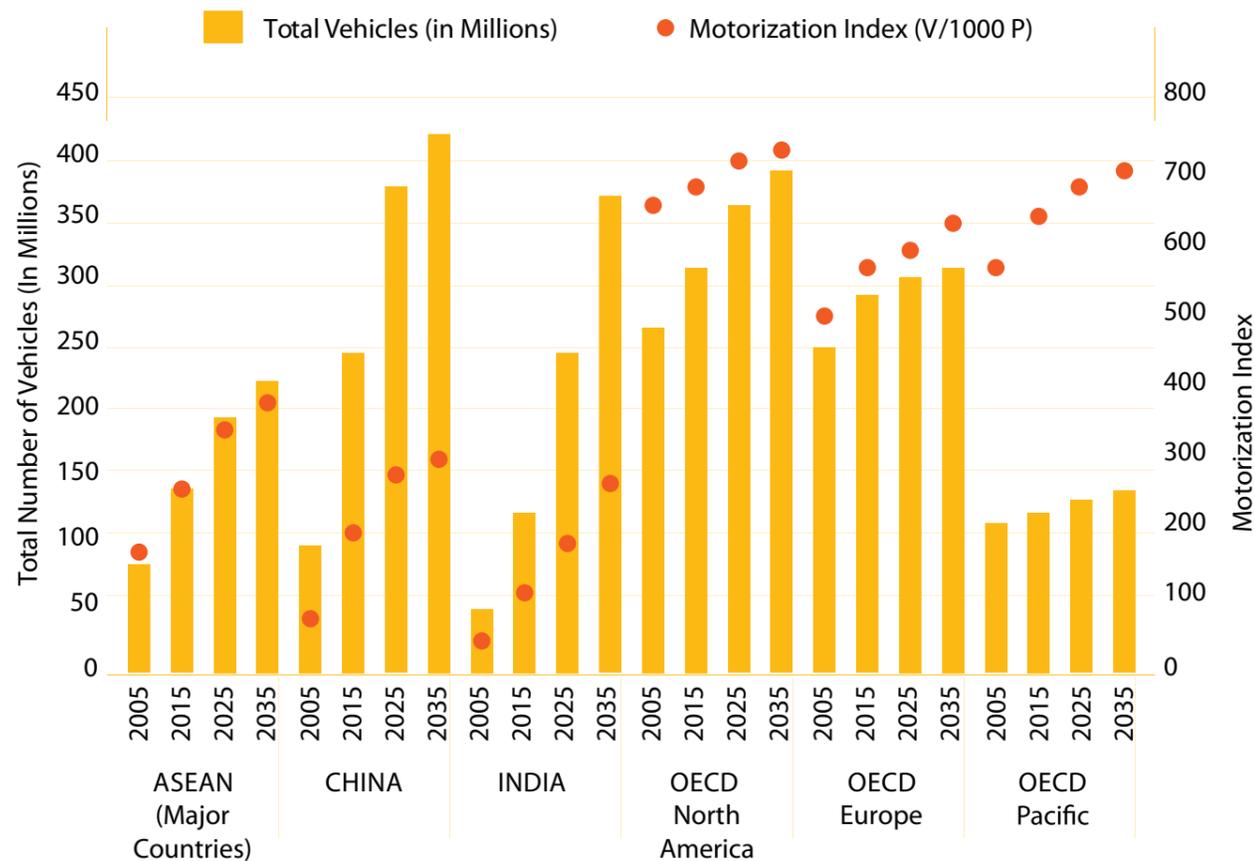
There is now a great deal of evidence showing how city size, demographic and income characteristics, urban fabric, i.e. density and diversity of land use, and importantly, the level of public transport services and non-motorized transport infrastructure, are important factors influencing mode choice in a city. A key challenge for sustainable mobility in developing countries is pressure from increasing motorization causing a decline in the modal share of public transport. In many developing cities, the high modal share of public transport comes from captive users (Archaya 2005), but does not indicate a high

quality transportation system. The reality is that public transport systems are not of adequate supply and quality in many developing Asian and Indian cities, and as income levels rise, people are turning to private vehicles ranging from more affordable two-wheelers to cars in order to meet their mobility needs.

Figure 2 makes it clear that while motorization and vehicle ownership in developed countries is slowing down, it is increasing at a very rapid rate in developing countries (Fabian 2012), largely due to increasing urbanization. Although India and China have low motorization indices, the total number of vehicles present in both countries, shown in orange, pose cause for concern. The potential number of private motor vehicle consumers, both two- and four-wheelers, in these two countries alone will be about 620 million by 2025. Higher levels of motorization mean more pollution, congestion, longer travel times, greater safety issues and loss in worker productivity.

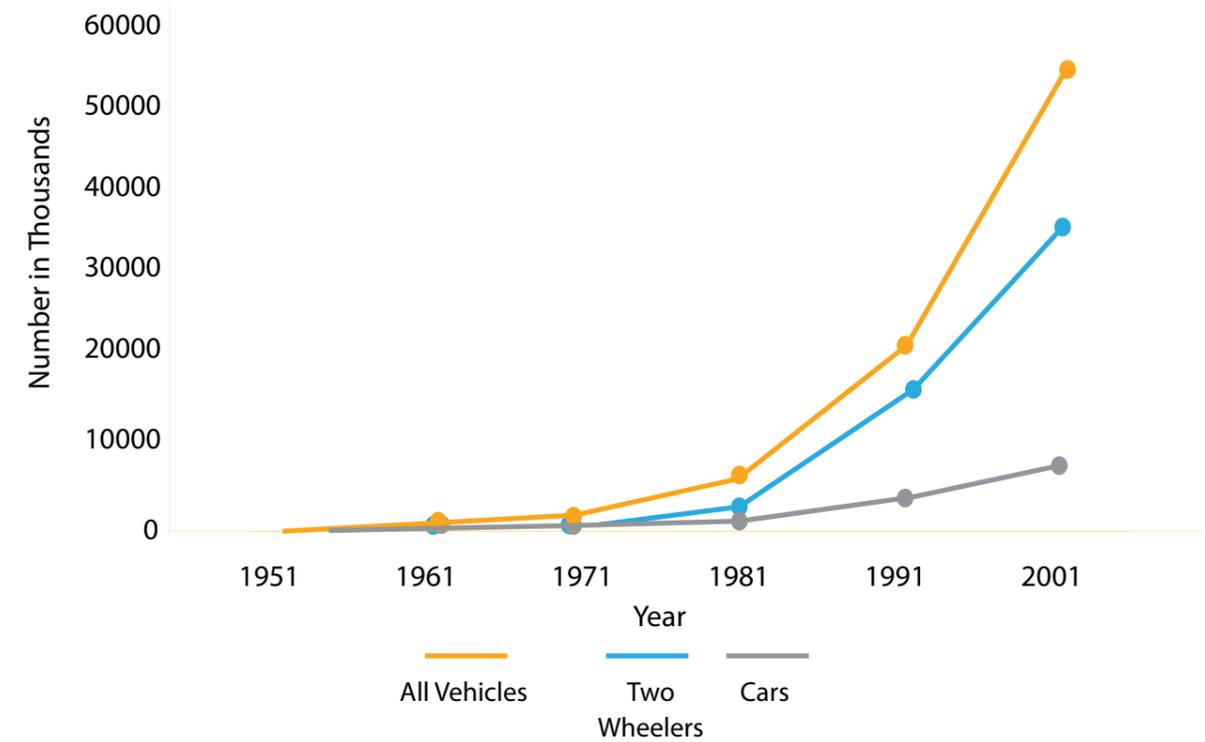
Much of this growth in motorization is from increases in two-wheeler ownership. In Asia, Vietnam has the highest percentage of its vehicle population being two-wheelers at

Figure 2. Number of Vehicles and Motorization Index by Region



Source: Fabian, 2012

Figure 3. Growth of Vehicles in India



Source: (MoUD, Wilbur Smith Associates 2008)

97 percent, while India's current two-wheeler population is more than 70 percent (Kamakate, Fatumata; Gordon, Deborah; 2009). See Figure 3.

### 2.1 Growth of Two-Wheelers and Cars in India

India has the second largest motorized two-wheeler market in the world, behind China (ICRA 2011), and this market share continues to grow as India continues to urbanize rapidly. A study by the Ministry of Urban Development (MoUD) across 30 Indian cities found that two-wheelers were growing faster than cars and constituted 60-70 percent of registered vehicles in most cities, as per 2001 figures (MoUD, Wilbur Smith Associates 2008)<sup>6</sup>. The percentage of urban households owning a two-wheeler increased from 11.6 percent in 1993-94 to 33 percent in 2009-10, while household car ownership increased from 1.2 percent to 6.5 percent in the same period (NSSO 2012).

As seen in Figure 3, the growth of motorized two-wheelers in the country has significantly outpaced the growth of cars since the 1970's. While private car ownership increased 7-fold from 1981 to 2002, two-wheeler ownership

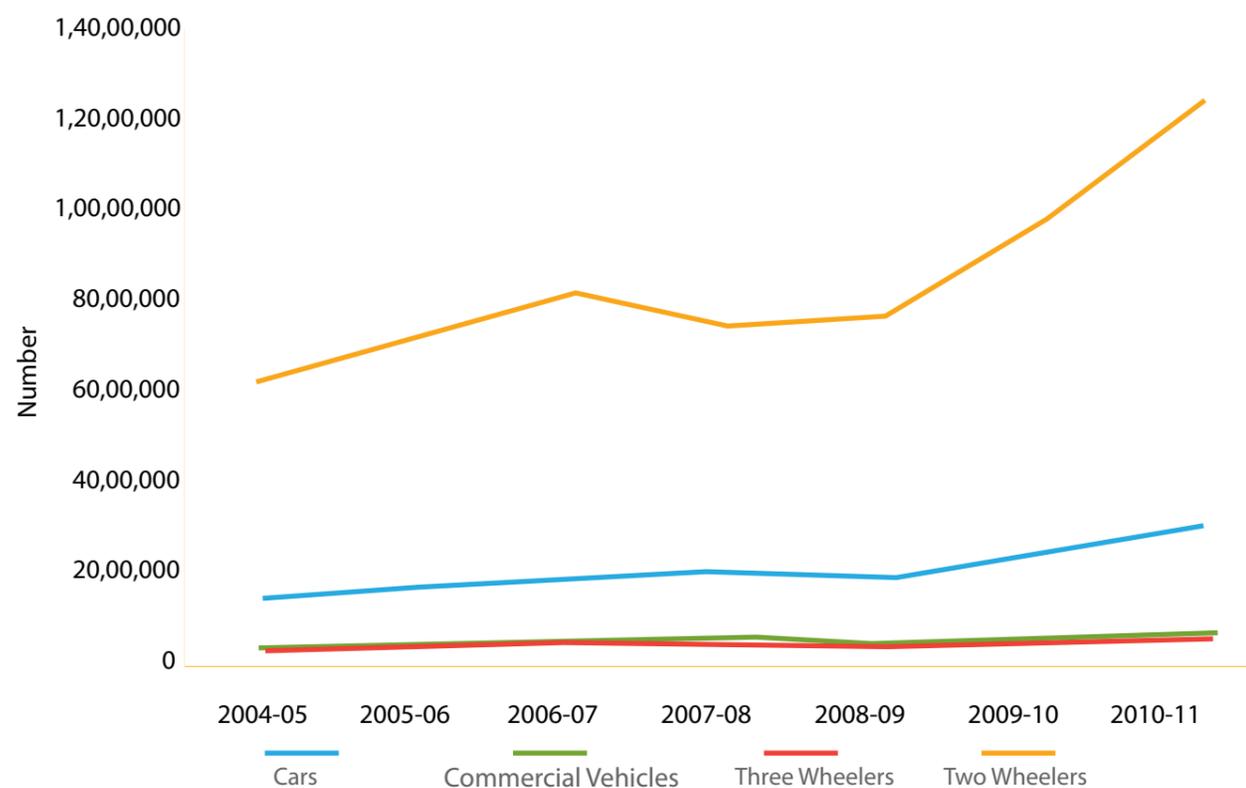
increased 16-fold in the same period (iTrans 2009). In 2012-13 close to 14 million two-wheelers were sold, more than five times the number of cars sold during the same year (SIAM 2013). Figure 4 shows the significant increase in domestic two-wheeler sales compared to other vehicle types.

Figure 5 shows the modal split in 2006 of various Indian cities, ranging from Mumbai which had a population of 16.4 million (it is close to 20 million now) to Lucknow which had a population of 2.2 million. Given the surge in urban population and vehicle ownership in the past 5-6 years, current mode shares might be even more in favor of private motor vehicles (cars and two-wheelers) than what is being represented in Figure 5. However it is evident that two-wheelers are a dominant motorized mode in most cities. Mid-sized cities including Pune, Ahmedabad, Chennai and Hyderabad, with populations ranging from 3.8 million in the Pune Metropolitan Region to 6.6 million in Chennai, have the highest modal share of two-wheelers (iTrans 2009).

Kanpur and Lucknow appear to be unique cases with very limited public transport supply. In the other cities, there is an apparent co-relation between the mode shares of public

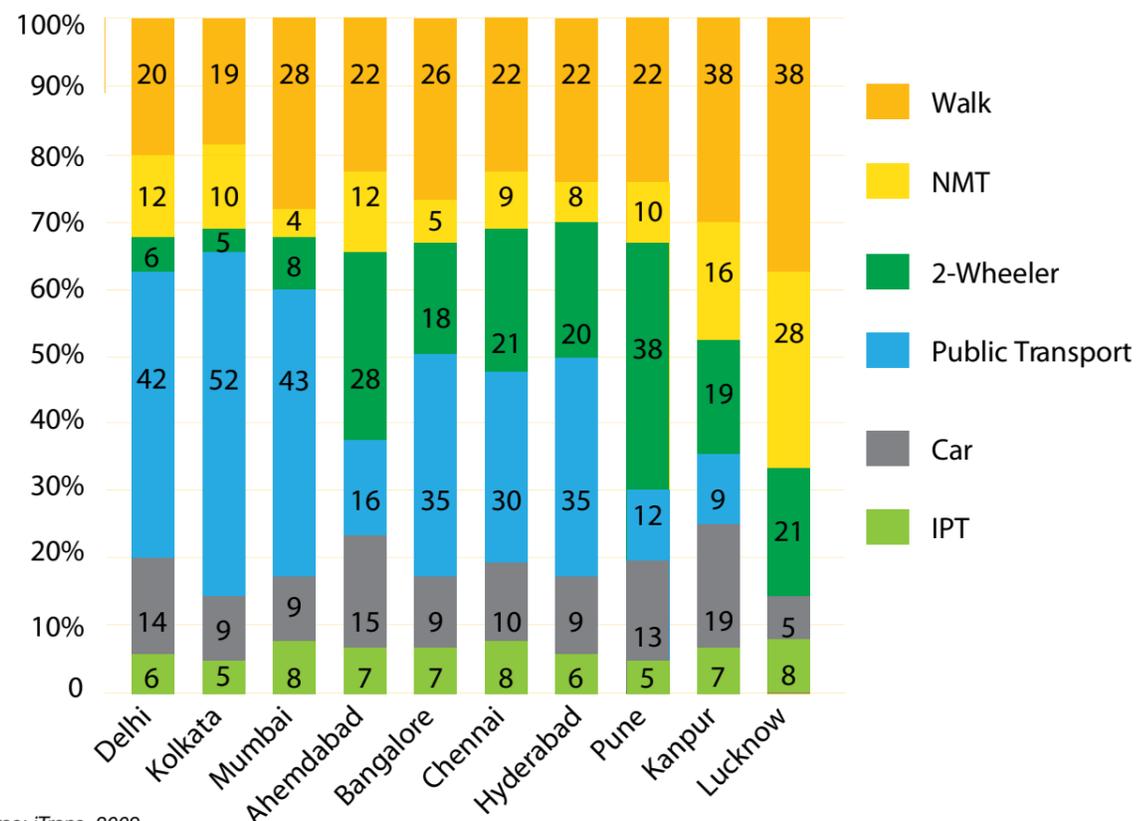
<sup>6</sup> According to the MoUD study, in 1991 there were 23 cities in the country with a population of over 1 million, which is expected to increase to 51 by 2021. The urban population in India is estimated to grow from 2001's 285 million (which is 29 percent of the total) to 540 million (37 percent of the total) by the year 2021. (MoUD, Wilbur Smith Associates 2008)

Figure 4. Automobile Domestic Sales Trends in India



Source: Society of Indian Automobile Manufacturers, 2011

Figure 5. Modal Split of Various Indian Cities, 2006



Source: iTrans, 2009

Note: IPT refers to Intermediate Public Transport or the auto rickshaw typically used in Indian cities

transport and two-wheelers (with other figures being in more or less similar ranges). One can see that large metros like Delhi, Kolkata and Mumbai with higher public transport shares have low two-wheeler shares, while the converse is true in the case of smaller cities like Ahmedabad and Pune.

One of the key questions that arises with the rapid growth and use of two-wheelers is whether they accelerate the overall growth of motorization and are a step towards car ownership. The growth in Gross Domestic Product (GDP) in Asia between 1989 and 2002 was much greater than the worldwide average, which has fueled motorization and two-wheeler ownership throughout the region (Kamakate, Fatumata; Gordon, Deborah; 2009). This growth in two-wheeler ownership could possibly lead to increased car ownership because of widespread aspirations of owning a private four-wheeled vehicle when income levels rise. However, there is an income threshold that must be exceeded before cars become affordable to the average person in many developing Asian countries.

Current data indicates that car ownership rises significantly only after incomes are greater than USD 8000 per year. These data also indicate that with higher two-wheeler ownership levels, car ownership levels tend to decrease. A recent study by EMBARQ showed that eleven of the twelve Indian cities studied have higher two-wheeler motorization, but lower car motorization than is average for middle-income Asian cities (EMBARQ India 2008). If one considers the fact that fuel prices are unlikely to decrease in the future, it appears that in 2015 (Indian per capita income USD 1700 at current prices) the average car ownership level in India should be about 2 cars per 100 persons for the country, and in the range of 10-15 cars per 100 persons in richer cities (Tiwari 2011).

Besides, while the experience of middle-income Asian cities can be used as a guide, Indian cities show very different growth experiences. It is found that in India, two-wheeler ownership and monthly household income levels are often not correlated (Pai 2009) as wealthier households also prefer to own and use two-wheelers for short trips.

Be that as it may so, the national government has continually liberalized policies within the automotive sector to make India a prime business destination for global automotive companies. The market has been opened to foreign manufacturers and collaborations, which has increased the number of competitors and models available for sale (Banerjee, et al. 2010). Additionally, the Automotive Mission Plan 2006-16, a partnership between government

and industry, has projected an increase in turnover by over USD 100 billion by 2016. This would mean that the industry's contribution to GDP would rise from 5 percent to nearly 10 percent, making it one of the key economic sectors in the country (SIAM 2013). These policies have the potential to lead to significant growth in the domestic two-wheeler and car market; a potential boon for the economy in one sense, but greatly problematic for cities in terms of increasing congestion, pollution, accidents and loss of public spaces. All of these have adverse economic implications. For instance, a recent study by Patankar et al (2011) found the total economic costs of air pollution exposure, caused in large part by transport vehicles, are an estimated 4523 million Indian Rupees (INR) or USD 113 million for a 50-µg/m3 increase in PM10 (Patankar & Trivedi 2011).

Many Asian countries are using price mechanisms and demand management as "push" strategies to reduce the demand for using motorized vehicles on the one hand, and on the other hand are improving the service quality of public transport as the "pull" strategy to attract more public transport users as well as to reduce the market share of motorized vehicles (Chen and Lai 2011). Cities with widespread and efficient public transport systems as well as growing traffic congestion may be able to entice motorized vehicle users, particularly two-wheeler users, to switch modes. A study conducted in Malaysia suggests that if a bus and two-wheeler were to travel the same distance at the same speed, 62 percent of people would use the bus while only 38 percent would choose to use a two-wheeler. This type of data is important to consider, as two-wheelers become a dominant mode in developing cities.

A study by the CAI-Asia Center<sup>7</sup> categorized the most influential factors, both positive and negative, that influence two-wheeler ownership in Asian cities, as seen in Table 1.

The next section delves deeper into the factors influencing two-wheeler ownership and use, and the reasons people switch modes to the two-wheeler, with a discussion of results from a survey conducted in Pune.

<sup>7</sup> Clean Air Institute, Asia chapter

Table 1. Factors Influencing Two-Wheeler Ownership in Asian Cities

Factors	Description	Impact
Cost and Financing	Low cost and availability through easy financing terms, sometimes at zero interest rates	+++
Fuel Economy	Consumes less fuel and has better mileage compared to other modes	+++
Congestion	Highly-congested areas suit 2-wheelers	+++
Trip Length	Motorcycles provide highly competitive service for trip lengths at the 2-10km range while for trip lengths greater than 10km, buses and cars are preferred	+++
Tax	Lower tax rates compared to 4-wheeled vehicles	++
Technology and Innovations	Maintenance and technological problems are relatively easier and cheaper to manage	++
Parking	Less parking space requirement	++
Maneuverability	High maneuverability in traffic congested areas and narrow streets	++
State of public transport and NMT	Low levels of services and adequate facilities for public transportation and non-motorized transportation	++
Regulations and enforcement	Poor and/or lack of regulations and insufficient enforcement	+
Occupancy	Lower occupancy	-
Weather	Exposure to sun and rain	---
Vulnerability	Prone to collisions with other transport modes and other accidents	---

Source: PCFV, 2010

Note: Number of + signs increases with factors having higher impact

## 3. CASE STUDY OF PUNE, INDIA

### 3.1 City Profile

#### 3.1.1 Area, Demographic And Socio-Economic Characteristics

Pune is the eighth largest city in India and second largest in the state of Maharashtra after Mumbai. Crowned with labels like 'Detroit of India' and 'Oxford of the East', the city is a major industrial hub particularly for automobile production, and an educational center with an estimated student population of over half a million. Pune is now emerging as one of India's top hi-tech cities, as well as a significant agro-business center (PMC 2006).

The population of Pune City (Municipal Corporation area) was about three million in 2011 with a working population of about 34 percent (PMC 2013). Data from 2001 shows that the Pune Municipal Corporation's jurisdiction covered an area of 244 square kilometers with an average population density of 10,412 persons per square kilometer, far lower than other peer group cities like Ahmedabad and Hyderabad<sup>8</sup>. The in-migration rate and floating population in Pune is high given the many educational and work opportunities it affords. This demographic characteristic is reflected in the median age of the population, which is close to 24 years, and 62 percent of the total population is under the age of 30. Pune is the sixth largest metropolitan economy in the country and one of the fastest growing too. It ranks seventh among Indian cities with the highest family incomes and has the second highest per capita income<sup>9</sup>.

#### 3.1.2 Transport and Traffic Characteristics

Historically known as the 'cycle city of India', Pune has now become a city of two-wheelers. The Bicycle Master Plan prepared in 1981 was only sparsely implemented and not successful. Pedestrian movements also suffer from the lack of adequate facilities in the city. More than 40 percent of the roads lack footpaths. Public transport has also not been able to keep pace with rising demands. City bus services have been inadequate and of poor quality, their performance further reduced as passengers have turned to intermediate and personal modes to meet their mobility

needs (PMC 2006).

Although bus services have improved in the past few years, latest figures (from 2013) reveal that the current fleet size of about 25 buses per lakh population is still far short of the target 55 set in the Comprehensive Mobility Plan (CMP). The percentage of average daily breakdowns and cancelled schedules are quite high. Crowding, cleanliness and affordability are the other concern areas, due to which there has been a loss in ridership. Far from the CMP's target of an annual three percent increase in ridership, there has been a 20 percent decrease since 2010-11, indicating an alarming trend of more dependence on personal vehicles (Parisar 2013).

Since the 1960's, while the city's population grew four times, vehicle population increased 87 times (PMC 2006). As can be seen in Figure 6, Pune possibly has the highest vehicle ownership pattern at more than 450 vehicles per 1000 population compared to its peer group cities - Ahmedabad, Hyderabad and Chennai. According to the Comprehensive Traffic and Transportation Plan for Pune prepared in 2005, about 30 percent of the population and more than 53 percent of households in Pune owned a two-wheeler.



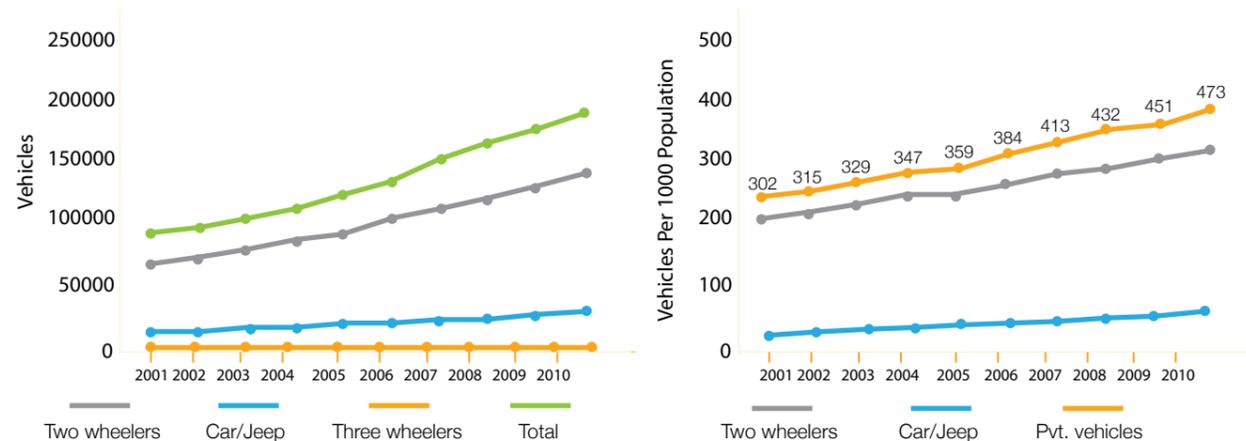
Pune - a City of Two-Wheelers

Source: Authors

<sup>8</sup> Cities in the same peer group as Pune like Ahmedabad and Hyderabad, have a significantly higher population density ranging from 18,424 - 21,207 persons/sq. km. respectively. In Pune, densities are high in the core city and in slum pockets (about six times the rest of the city), where nearly 40 percent of Pune's population lives.

<sup>9</sup> As per the City Development Plan 2006-2012, the per capita GDP of Pune is almost 50 percent higher than India's per capita income. Based on a Monitor Group Report prepared in 2003 the per capita income of Pune was estimated at Rs. 30,000 against Mumbai's Rs. 47,000; higher than Hyderabad but comparable to Bangalore and Kolkata.

Figure 6: Vehicular Growth and Vehicle Ownership in Pune (2001-2010)



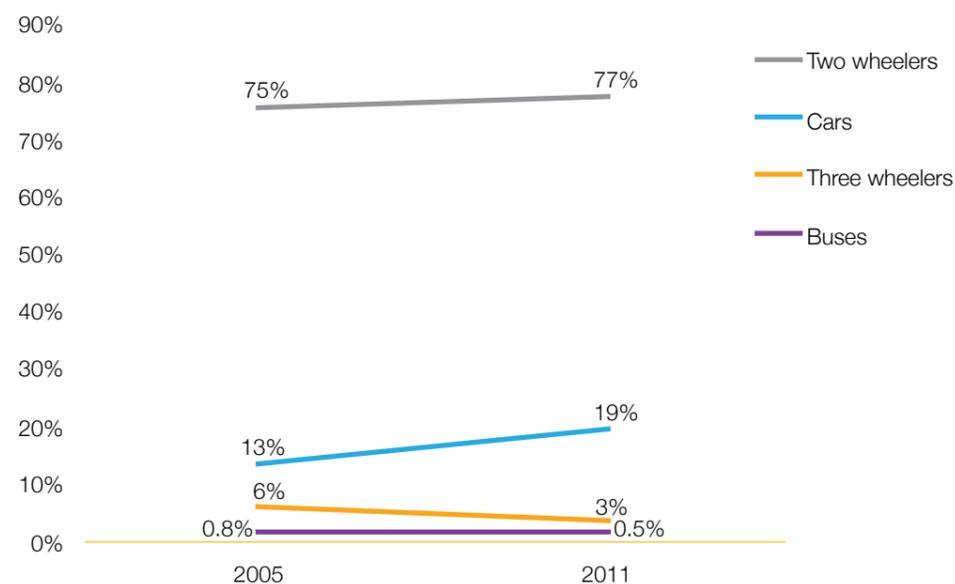
Source: RTO, Pune

Data from the Regional Transport Office in Pune showed that in 2011, the total number of registered vehicles were 2.3 million (nearly double from the 1.2 million in 2005); with 12,000-15,000 new vehicles being registered monthly. Figure 7 shows the comparative vehicular composition in 2005 and 2011. One can see that the share of two-wheelers and cars has increased while the share of three-wheelers and buses has reduced, indicating a shift towards private motorized transport in the city (PMC 2013).

Parking surveys carried out in the city also reflect the high number and use of two-wheelers. They comprised 63

percent of the average composition of vehicles parked at all locations, followed by cars at 26 percent. Ambient air quality (SO<sub>2</sub>/NO<sub>x</sub>/SPM)<sup>10</sup> measures from 2002, showed that the contribution of two-wheelers to pollution was the highest at 78 percent, followed by cars at 12 percent (PMC, Wilbur Smith Associates 2008). According to the CTPP report for Pune, two-wheelers accounted for 20 percent of fatal and serious accidents (after trucks at 24 percent) and cars and light medium vehicles accounted for 14 percent.

Figure 7: Composition of Registered Vehicles in Pune, 2005 and 2011



Source: CDP 2006-2012 and RTO, Pune

<sup>10</sup> Sulphur dioxide, oxides of nitrogen and suspended particulate matter

### 3.2 Reasons for Two-Wheeler Ownership and Use in Pune

Drawing on the literature review and the Pune survey findings, this section describes some factors likely to influence motorized two-wheeler ownership and use in Indian cities (See Table 1 for factors considered important in Asia).

Table 2 provides some background on the survey that was conducted in Pune, by describing the basic household characteristics and vehicle ownership statistics for survey respondents, who were all two-wheeler users.

While the average ownership was 1.5 two-wheelers per household, the distribution was in line with the stated household incomes as seen in Figure 8.

The modes used by the surveyed riders in Pune prior to two-wheeler use are shown in Figure 9. Significantly the majority, 67 percent, said they used public transportation prior to using two-wheelers, while 14 percent cycled.

While motorized two-wheelers are often perceived as an unsafe mode of transportation, the low capital and maintenance cost, good fuel economy, easy maneuverability in congested conditions, and ease of parking make them an attractive mode of transport for millions of people.

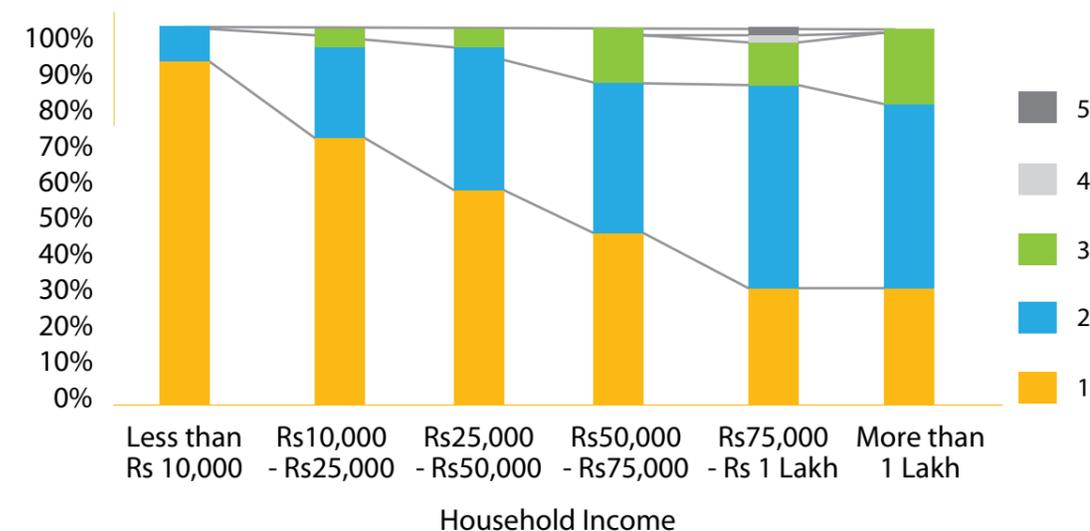
Table 2. Household Statistics of Pune Survey Respondents

	Average	Maximum	Minimum
Household Size	3.7 persons	8	1
Number of adults	3.0 adults	8	1
Number of children	0.6 children	3	0
Monthly household income (% of respondents)	Rs. 25,000 to 50,000 [USD 404-809] (33% of sample)	More than Rs. 100,000 [USD 1,617] (12% of sample)	Less than Rs 10,000 [USD 162] (5% of sample)
Number of motorized vehicles	1.9	10	1
Number of motorized two-wheelers	1.5	5	1
Number of cars	0.4	8	0
Number of bicycles	0.4	3	0

Source: Pune survey done for this study, 2012

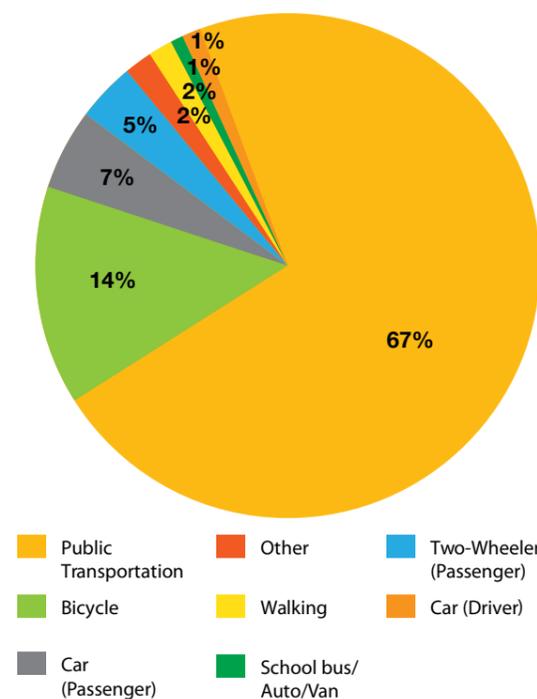
Currency conversion done on 2/3/2014 using currency converter available on: <http://www.xe.com/currencyconverter/>

Figure 8. Two-wheeler Ownership by Monthly Household Income for Pune Survey Respondents



Source: Pune survey, 2012

Figure 9. Transport Modes Used Prior to Two-wheelers by Pune Survey Respondents



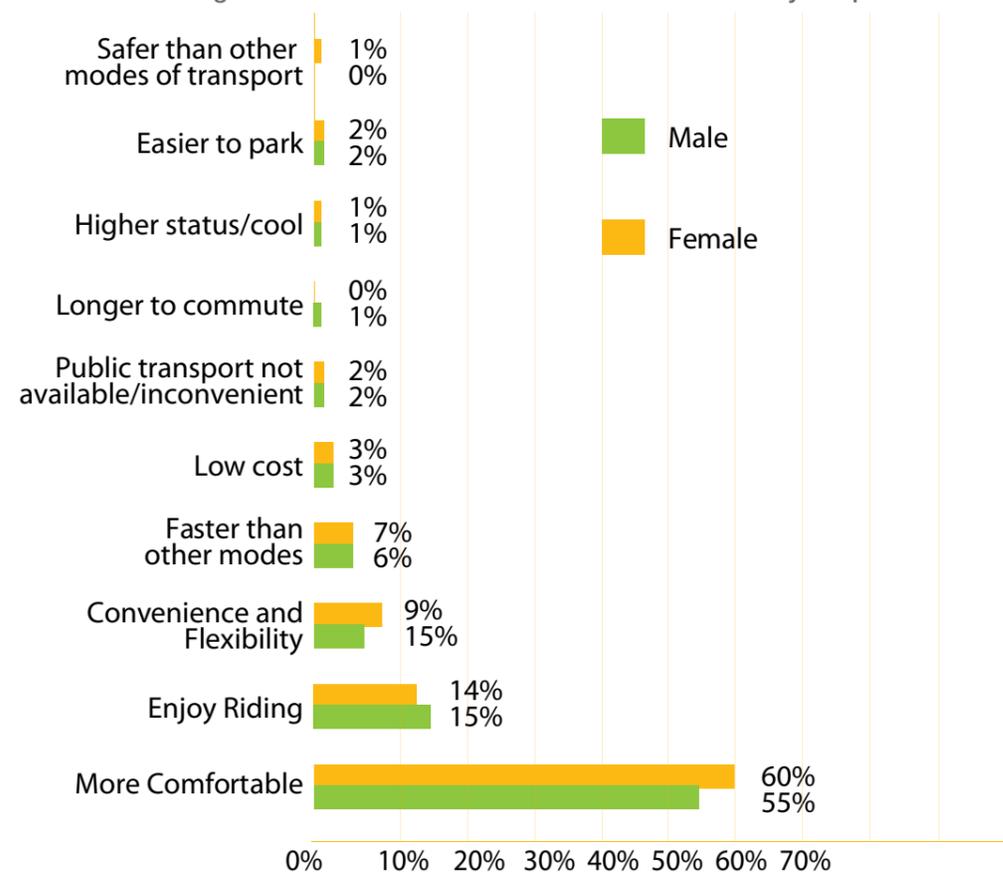
Source: Pune survey, 2012

In Pune when surveyed travelers were asked why they began to use two-wheelers over other modes, the majority of both males (55 percent) and females (60 percent), responded that two-wheelers are more comfortable than the mode they were previously using. As seen in Figure 10, comfort, convenience and enjoyment were the top three reasons for two-wheeler use for both men and women. These reasons could vary in different cities based on a variety of factors. In Pune they seem to correlate to its unique demographic of having a large, young student and working population, and the perceived advantages of two-wheelers over public transport. For example, the average commute time for surveyed two-wheeler riders in Pune was just about 30 minutes, while commuting by public transport typically takes longer.

Aside from the survey, all stakeholders interviewed in Pune, that included politicians, activists, government officers and corporates, were also of the opinion that the convenience and affordability of two-wheelers combined with the lack of good public transport were the prime reasons behind their popularity and exponential growth.

The Pune survey also asked what it would take for respondents to switch or consider switching to public

Figure 10. Reasons for Starting to Ride Motorized Two-Wheelers for Pune Survey Respondents



Source: Pune Survey, 2012

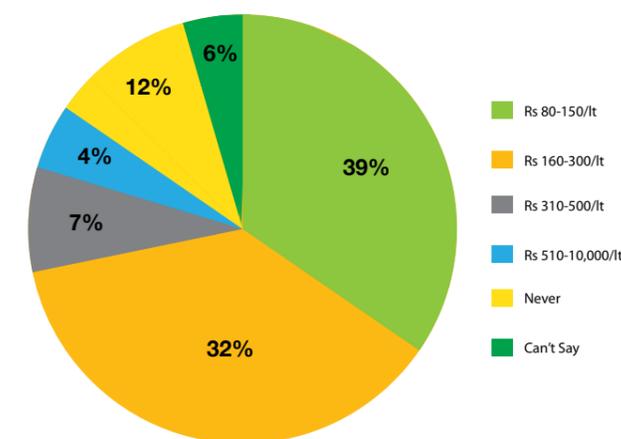
transportation, cycling and walking. As can be seen in Table 3, 13 percent of respondents said they would not walk and 44 percent said they would not cycle. The top conditions to consider shifting to these alternatives were if the distances were small or for recreation/exercise. While 20 percent of respondents said they would not use public transportation, the remaining 80 percent gave a variety of scenarios in which they would use it as shown in the table. The top responses were that if public transport services were improved in terms of reliability, comfort, frequency, and cleanliness, many would be willing to shift; a view also expressed by all interviewed stakeholders.

This is corroborated by the findings from another study on the travel characteristics of two-wheeler users in Bangalore and their willingness to shift to public transport (CiSTUP 2012). According to the study, frequency, easy access and seat availability were the main considerations for travelers to use public transport. Most of the respondents said they would shift from two-wheelers to buses if: the frequency was less than 10 minutes, the bus stop less than 750 meters away, a seat was assured most times, ordinary bus fares were less than Rs. 3 per kilometer and AC bus fares less than Rs. 7 per kilometer.

In Pune, two-wheeler users were also asked at what fuel price point they would consider shifting to another mode, and Figure 11 shows their response. At the time the survey was done (2012), the fuel price was approximately Rs. 75 per liter of petrol (USD 1.2)<sup>11</sup>.

These responses indicate that the fuel price thresholds are fairly inelastic and given the need, small increases in fuel prices may not prove to be much of a disincentive for two-wheeler use. It is also clear from the responses that some would not consider switching to other forms of transportation, including public or non-motorized transport no matter the fuel price. Such responses included “never”, “no limit”, or “at any condition, I’d never stop riding a motorbike”.

Figure 11. Fuel Price Thresholds for Shifting Modes for Pune Survey Respondents



Source: Pune survey, 2012

Table 3. Top Reasons to Switch Modes from Two-Wheelers to Other Alternatives for Pune Survey Respondents

Switch to Public Transportation	Switch to Cycling	Switch to Walking
Won't use PT (20%)	Won't cycle (44%)	Small distance (50%)
Reliable/Regular (16%)	Small distance (16%)	Exercise (25%)
Less crowded (13%)	Recreation/exercise (15%)	Won't walk (13%)
More frequent (10%)	Cycle track (9%)	Better footpaths (8%)
Clean/neat (10%)	Compulsory/law (5%)	Last option (4%)
Better buses (9%)	Greater cycle use (4%)	
Safer for women (6%)	Very high petrol price (4%)	
Conductor/driver behaviour (4%)	Can't ride cycle (1%)	
Reserved seats (5%)	Old age (1%)	
Air-conditioned (3%)		
Door-to-door-service (1%)		
Information system (1%)		
Metro/tram (1%)		

Source: Pune Survey, 2012

<sup>11</sup> Source: <http://www.mypetrolprice.com/7/Petrol-price-in-Pune?FuelType=0&LocationId=7;> Currency conversion done on 2/3/2014 using currency converter available on: <http://www.xe.com/currencyconverter/>

### 3.3 Demographics of Two-Wheeler Users and Usage Patterns

There is limited literature available about the demographics of two-wheeler users in Asian cities. One major question is also the income distribution of two-wheeler users. While it is often assumed that many two-wheeler users belong to a lower income group, the relative speed and flexibility of two-wheelers actually results in a wider income distribution among users, such that higher income travelers also prefer to use two-wheelers to cover short distances.

A 1997 survey done in Pune found that two-wheelers were less frequently used by women and more frequently by men, and that women were more likely to travel by foot (Astrop 1997). Though the situation has changed significantly in Pune since then, it is generally accepted that men are more likely than women to ride a two-wheeler

in urban Asia. While women are not historically the drivers of personal transportation purchases, their increasing role in two-wheeler ownership across India is being noticed by manufacturers. Several of the largest two-wheeler manufacturers in India have marketed specific bikes, most often scooters, oriented towards women. These include the TVS Scooty, Hero Honda Pleasure, and the Honda Dio. Additionally, the Indian government provides loans for two-wheelers to women at a special interest rate - one percent less than that charged to men (iTrans 2009). Finally, scooters, which are primarily targeted at women, accounted for 18 percent of total two-wheeler sales in India in 2010-11 (ICRA 2011).

Some trends from the survey in Pune are captured below. Interesting results were obtained on the influence of demographic factors like age and gender. Surveyed two-wheeler riders were asked what the primary mode of transport for each member in their household was. Figure 12 shows the primary mode split by gender based on

this household data. Figure 13 disaggregates this primary mode split, showing how it varies by gender and age.

From Figures 12 and 13, the following inferences can be made:

- Two-wheelers were the primary mode of transport for 55 percent of the total members (either as drivers or passengers), for 19 percent it was cars (drivers/passengers) and for 15 percent it was public transport.
- The majority of car and two-wheeler drivers were male; however there were a notable number of female two-wheeler drivers between the age of 18-50.
- The majority of two-wheeler and car passengers were female, as were the majority of public transportation users.
- Males and females under 18 were mostly passengers of school bus/van/auto or two-wheelers.
- A large number of both men and women in the 18-50

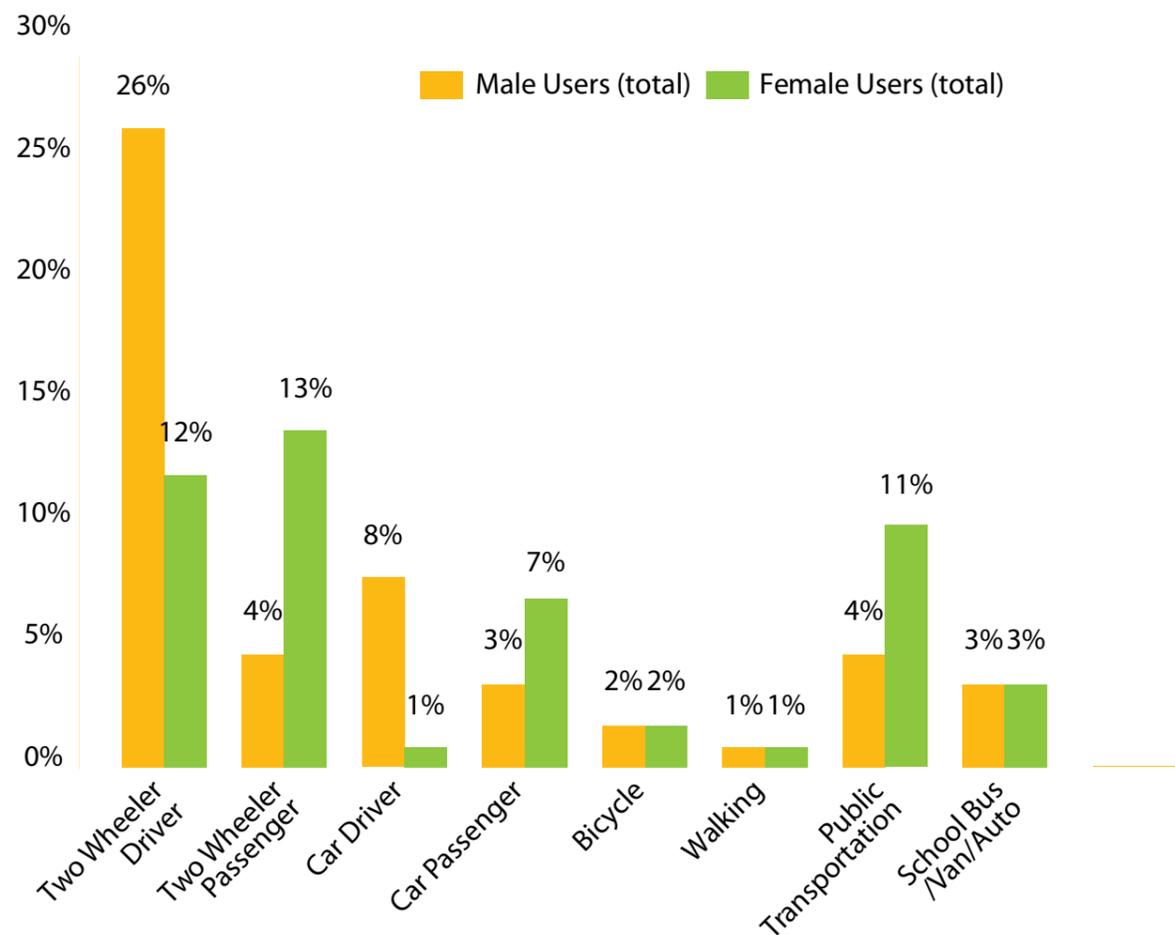
age group were dependent on two-wheelers, either as drivers or passengers.

- After age 50, the percentage of men and women driving two-wheelers decreased drastically; men shifted to being car drivers/passengers or public transport users, while women shifted to being car/two-wheeler passengers or public transport users.

It was found that all respondents with children owned a two-wheeler, while 33 percent owned a car as well. Half of those whose household owned at least one car indicated that their primary mode of transport was a two-wheeler, while the other half relied on the car.

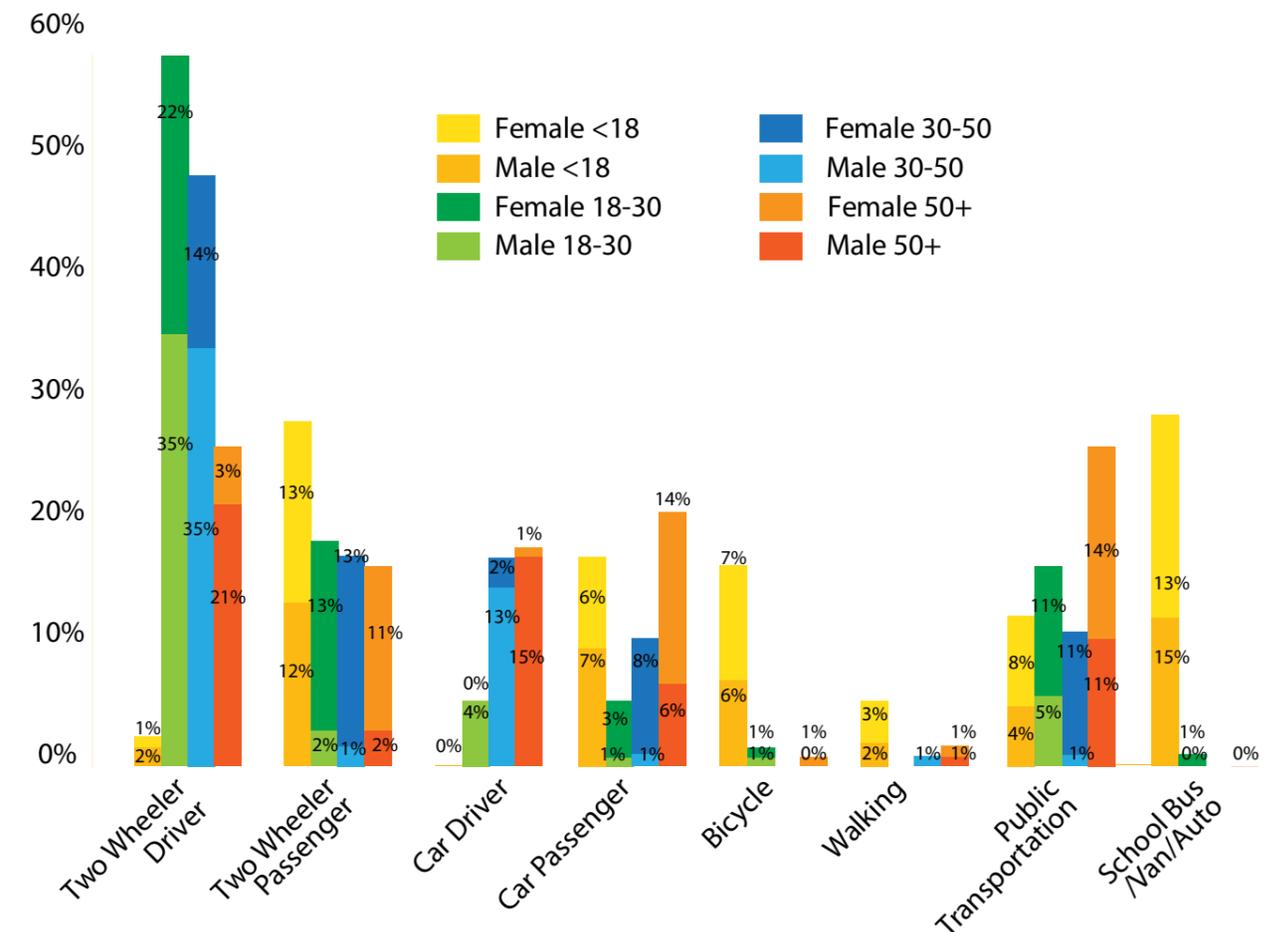
The average age when men began riding a two-wheeler was about 20, while for women it was 21.5 years. Like in many Indian cities, the households in Pune often had multiple generations living in the home. The fact that two-wheeler users move to other modes like cars or public transport after the age of 50 may allude to the safety

Figure 12. Overall Transport Mode Split by Gender from Pune Survey



Source: Pune Survey, 2012

Figure 13. Transport Mode Split by Gender and Age from Pune Survey<sup>12</sup>



Source: Pune Survey, 2012

<sup>12</sup> In Figure 13, the aggregate numbers shown in Figure 12 have been disaggregated by age and gender. The reader must note that the combined mode shares for males and females across each age group total to 100 percent. For example, in the <18 age group, percentages shown for males and females across all modes add up to 100 percent representing the total number of travelers in that age group.

concerns with the mode such that older adults feel unsafe riding it. The improved purchasing power of an older adult and lower comfort associated with a two-wheeler are other reasons this may be the case.

Surveyed riders in Pune were asked about the nature of trips made using two-wheelers. Figure 14 shows the



Women Two-wheeler riders in Pune

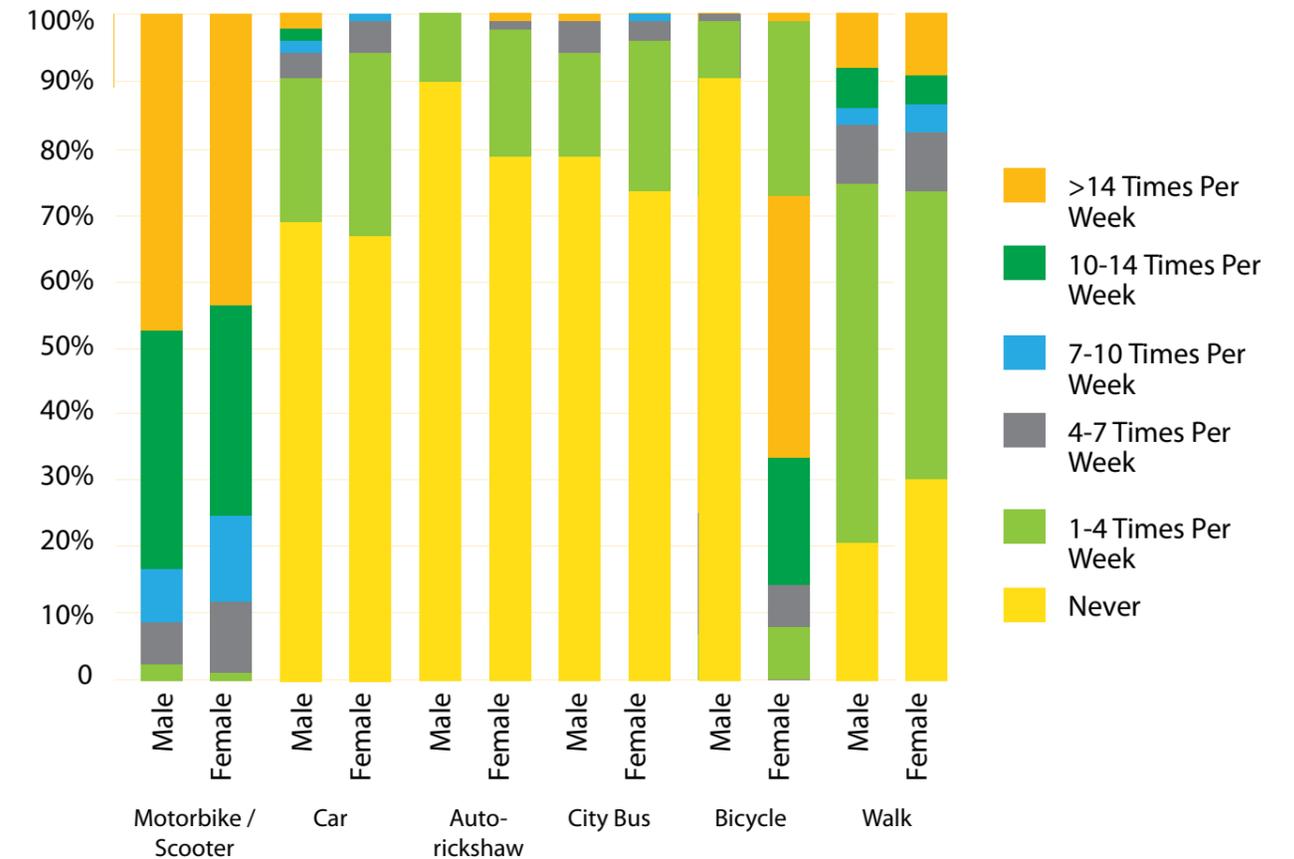
Source: Authors

primary purpose of using two-wheelers by gender. It is seen that men primarily use them to travel to work, while more women use two-wheelers to access education or for recreation or shopping trips. This is interesting and shows the opportunities provided by the mode to women, for whom the unreliability of public transportation may be a more significant problem than for men for reasons of safety and household responsibilities.

Figure 15 shows the vehicle usage patterns by gender and mode for all two-wheeler users surveyed. Roughly 45 percent of both male and female respondents said they used a two-wheeler more than 14 times per week and 33 percent used it 10-14 times. Apart from two-wheelers, about 31 percent of respondents said they also used the car on occasion, 25 percent used city buses and about 16 percent (more females) used auto-rickshaws occasionally, while 72 percent also walked occasionally or often in the week.

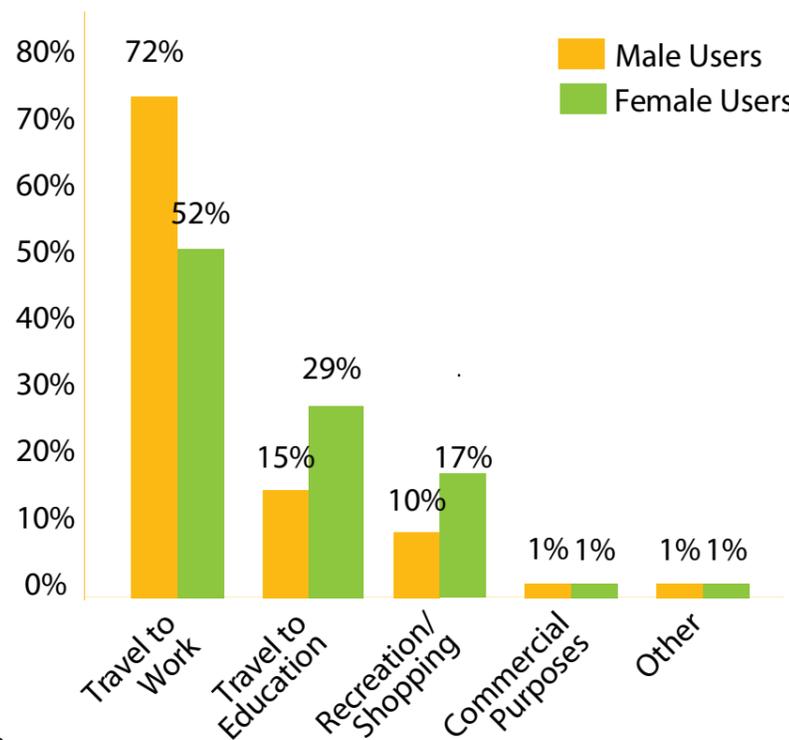
When surveyed riders were asked if they typically used a two-wheeler in conjunction with another mode of transportation on a single trip, 26 percent of males and 30 percent of females responded in the affirmative. Of these, about 43 percent combined it with the bus, 31 percent with auto rickshaws, 20 percent with walk and 6 percent responded with 'other'.

Figure 15. Vehicle Usage Patterns by Gender and Mode for Pune Survey Respondents



Source: Pune Survey, 2012

Figure 14. Primary Purpose for Two-Wheeler Use by Gender for Pune Survey Respondents



Source: Pune Survey, 2012

In the CiSTUP 2012 study, the profile of two-wheeler users in Bangalore based on a random sample of 858 users, seem to broadly match the profile of users and trends in Pune.

- Of the two-wheeler users surveyed, 72 percent were male and 28 percent female, almost the same split as two-wheeler users surveyed in Pune from a random sample of 1000.
- 81 percent of two-wheeler users were in the age group of 18-45 years.
- Users under the age of 18 and over the age of 60 were only 1 percent each, again corroborating the Pune data that older adults prefer not to use two-wheelers.
- The majority of respondents were working or earning members (82 percent), followed by students (12 percent) and housewives (2 percent).

- As such, 83 percent of the respondents said their primary purpose of trips was travel to work, followed by 10 percent whose primary purpose was travel to education.
- It was interesting to note that 71 percent of the respondents said their average number of two-wheeler trips was over 18 per week.

### 3.4 Economic Factors<sup>13</sup>

According to the iTrans 2009 report, Pune has very high levels of two-wheeler ownership and use due to a large middle class. Figure 16 shows the personal monthly income of the two-wheeler users surveyed in Pune. As can be seen, the majority of about 50 percent indicated an income in the range of Rs. 10,000-25,000 (USD 162-404), followed by 27 percent in the range of Rs. 25,000-50,000 (USD 404-809) and about 10 percent earned upward of Rs. 50,000 (USD 809) per month. This shows that two-wheeler ownership is not limited to lower income populations as is typically perceived.

As per the survey, the purchase price for new two-wheelers ranged between Rs. 40,000-60,000 (USD 647-970), and about Rs. 20,000-40,000 (USD 323-647) or less for second-hand vehicles. Two-wheeler users were asked about their monthly expenditure on fuel and maintenance, to which 42 percent said they spent upto Rs. 1000 (USD 16) per month, while 44 percent spent Rs. 1000-2000 (USD 16-32), as can be seen in Figure 17. These numbers reveal the comparatively low capital, operational and maintenance costs of two-wheelers, though evidence from the larger city of Bangalore shows these costs can vary between cities based on differences in fuel price and trip lengths (CiSTUP 2012).

All stakeholders interviewed in Pune felt that two-wheelers were owned and used across socio-economic classes. They expressed that two-wheelers are not a luxury or status symbol, but more of a necessity today as current public transport services are unable to satisfactorily meet the mobility needs of the masses.

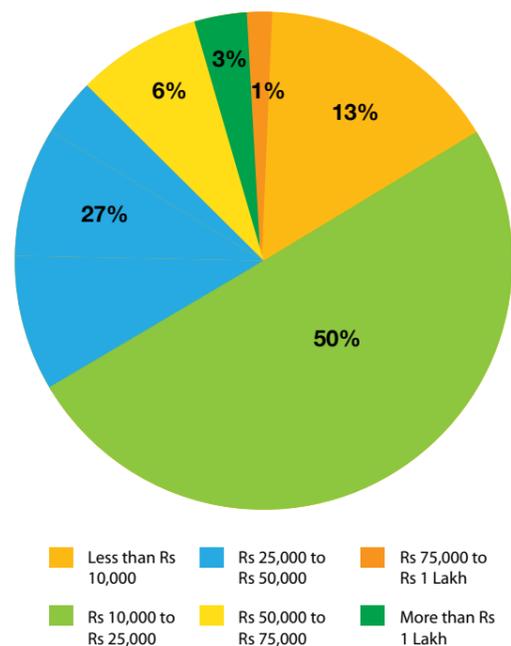
An important concern that arises is that given the state of public transport in many Indian cities and the unavailability of proper cycling and pedestrian facilities in many cases, there may be two-wheeler users who could be considered 'captive.' Captive users are those who use a mode because they have very limited alternative choices. Normally this concept is applied to public transport, and captive users are often low-income people who do not have access to any form of private transport and must therefore use public transport regardless of its quality. Some research (Jain and Tiwari 2011), (Advani and Tiwari 2006), (Tiwari 1999) has been done into the concept of captive cyclists, those who use bicycles because there are no other viable options available to them. To apply this concept to motorized two-wheelers, however, is a relatively new idea. Captive users of two-wheelers may not just be lower-income people, but also women or in a few cases the elderly, who would prefer to use another mode, but do not have an option in order to meet their daily travel needs.

From the survey, we found that while it is difficult to ascertain whether there are 'captive' two-wheeler users in Pune, it is evident that many feel that the alternatives are not suitable to meet their needs. Public transportation is seen as unreliable, crowded, dirty and unsafe for women. These issues would need to be addressed for potential 'captive' users to feel comfortable switching modes.

To explore the effect on overall motorization rate discussed in the previous section, some questions that were explored through the Pune survey data were whether two-wheeler ownership directly leads to an increase in car ownership in India, and if so, at what level of income per capita would this occur.

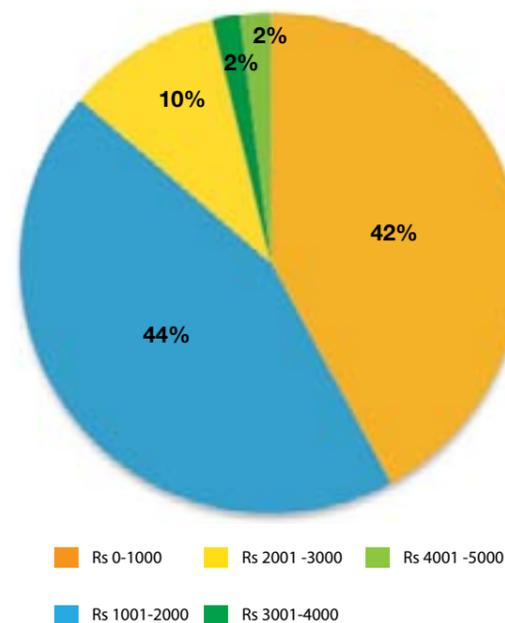
Just under a third of the surveyed riders in Pune also owned a car in their household and their average household income was Rs. 65,650 (about USD 1060) per month, while the average monthly income of all two-wheeler users was between Rs. 25,000-50,000 (USD 404-809). Close to 80 percent of those who currently did not own a car indicated that they would be interested in purchasing one in the future. The primary impetus for a future car purchase would be higher income, cited by 76 percent of respondents, followed by marriage and children. Similar reasons were also cited by current car owners as the reasons for their purchase: family convenience followed by higher income, work convenience and comfort. Roughly 33 percent of those who had children owned a car.

Figure 16. Personal Monthly Income of Pune Survey Respondents



Source: Pune survey, 2012

Figure 17. Monthly Fuel and Maintenance Costs of Pune Survey Respondents



Source: Pune survey, 2012

<sup>13</sup> All currency conversion done on 2/3/2014 using currency converter available on: <http://www.xe.com/currencyconverter/>

## 4. CHALLENGES ARISING FROM THE RAPID GROWTH OF TWO-WHEELERS

As urbanization increases and incomes in developing Asian cities continue to rise, there is concern about increasing levels of car ownership among the growing middle class. However, according to a report on two-wheelers by ITDP (2009), rising income levels and car ownership do not necessarily lead to a decline in the role or mode share of two-wheelers. In Taipei, Taiwan, which has the highest two-wheeler density in the world, the majority of households own cars, but nearly one in two persons owns a two-wheeler, with two-wheeler ridership and mode shares remaining high (ITDP 2009).

Similar trends were also foreseen by a number of stakeholders interviewed in Pune when asked if in their opinion, two-wheeler users in the city were likely to shift to cars in the future. While some felt that with higher incomes car ownership would rise, others felt that hardly 5-10 percent of two-wheeler users would shift to cars as they were a luxury not so easily affordable by everyone. Yet others felt that given cars are a status symbol, people may aspire to or own cars in the future, but continue to use two-wheelers in view of growing congestion and parking problems, or given their cost-effectiveness. In fact, they felt there is a possibility that some regular car users may even shift to two-wheelers for this reason.

As discussed earlier, two-wheelers have incredibly high modal shares in India, and their ownership is not just limited to the poor and lower-middle classes. With two-wheeler users being the fastest growing group of travelers, this has implications for the ridership and use of public transport that loses mode share and consequently suffers a negative effect. Low public transport ridership leads to low investment in the sector, which in turn causes the conditions that drive increased use of two-wheelers, in a vicious cycle. The data from the Pune survey suggests that the use of two-wheelers can engender a lifelong preference for private motorized mobility, given that 80 percent of two-wheeler users mentioned being interested in purchasing a car in the future.

Next we discuss some key issues and challenges that are arising in Asian cities from the rapid growth of motorized two-wheelers.



On-Street Two-Wheeler parking in Pune

Source: Authors

### 4.1 Parking Problems

Parking is an important consideration as the total numbers of two-wheelers and cars increase. In Taipei, Taiwan, even after two-wheeler parking charges were implemented, compliance was low with only about 30 percent of users paying parking fees (Chang 2012). In Pune, India, parking charges were repealed due to an incorrect concern that parking fees were an undue hardship on the low-income users that were thought to make up the majority of the two-wheeler population. However, many two-wheeler users in Pune own a car, but choose not to use it for daily travel needs (Gadgil 2012). Policies on two-wheelers that have previously been lax due to the presumed vulnerable nature of the user (i.e. belonging to low income groups) may not be relevant because many two-wheeler users can afford to pay the full cost of their ownership.

When surveyed, two-wheeler riders in Pune were asked what they felt were reasonable fees for parking. 52 percent were of the opinion that two-wheeler parking should be free, 28 percent responded with Rs. 2 per hour, 18 percent with Rs. 5 and only 2 percent said Rs 10 or a quarter of the fees paid by a car.

54 percent of the respondents felt that currently two-wheeler parking was not a problem, presumably because restrictions are few and it is usually free of cost. However, more and more space being consumed by parking is

becoming a major issue for the city. The overcrowding of roads by private vehicles as well as parking problems have prompted the Pune Municipal Corporation to study the trends more closely in order to frame policy and find solutions to the city's traffic and parking issues (Khape 2013).

### 4.2 Congestion and Restrictions on Two-Wheelers

Growing traffic congestion has led to some cities imposing bans on two-wheelers as they are considered key contributors to this problem. For instance in 2009, the Pune Municipal Corporation's Traffic Department was considering turning the core peth<sup>14</sup> areas of the city into a pedestrian-friendly zone. According to the Deputy Commissioner of Police (Traffic), heavy traffic congestion and parking were two major problems in these areas. Plans included levying higher parking and congestion charges in the zone and even a ban on two-wheelers entering some parts of the city's core areas (Kanchan 2009).

However, there is ambiguity in data regarding the congestion impacts of two-wheelers because Passenger Car Unit equivalent tables (PCUs) used by traffic engineers do not typically include two-wheelers. Urban road morphology and capacity are key to consider when looking at the congestion impacts of two-wheelers and cars. It is important to consider whether traffic operations follow lane demarcation and the assumptions that have been made

#### Two-wheeler Ban in Guangzhou, China

One of the cities that has banned the operation of motorized two-wheelers within city limits is Guangzhou, China. Two-wheelers gained popularity in Guangzhou in the early 1980's, a time when owning a two-wheeler was a status symbol equivalent to having an expensive car today. Two-wheeler taxis became a common mode of transport, often driven by local young people and laid-off workers from urban villages. Despite the high levels of two-wheeler ownership in Guangzhou, government officials decided in 1991 to begin phasing them out in the city because of rising concerns regarding crime and safety. Over the next decade and a half, the city gradually tightened restrictions on two-wheeler ownership before officially banning them in urban areas from January 1, 2007 (Fjellstrom 2008). The gradual nature of Guangzhou's ban gave the public

about load factors per vehicle. While many countries follow US standards, these may not be applicable in many Indian cities. Rather than restricting two-wheelers, management strategies may be considered and vehicle restriction measures most likely to successfully mitigate congestion may be targeted at private, single-occupancy cars and taxis to enable a more efficient use of road space. Bicycles and two-wheelers are the most efficient users of road space after buses and pedestrians (ITDP 2009).

### 4.3 Road Safety

Safety is a particularly significant concern with the use of two-wheelers. According to a recent study, India records the maximum number of deaths from motorized two-wheeler accidents in the world (Gupta et al. 2014). Data from 2012 shows that the highest number of road fatalities in the country were two-wheeler riders (23.2 percent), followed by trucks/lorries (19.2 percent) as seen in Figure 18 (Ruikar 2013).

According to data from Pune Traffic Police, of the 460 people killed in traffic accidents in the city during FY 2010-11, 50 percent were two-wheeler riders. Of these, 71 percent were involved in collisions with cars or other heavy vehicles, while 21 percent slipped or collided with a stationary object. Only one percent of riders were wearing a helmet (Save Pune Traffic Movement 2012).

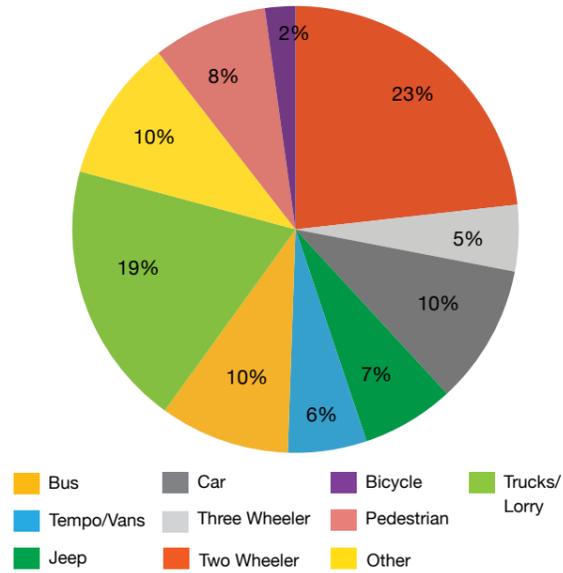
Among the two-wheeler users surveyed for this study, about 19 percent of the male respondents and 22 percent

sufficient time to adapt and find alternate modes of transport. However, many former two-wheeler users switched to using private automobiles, in part because the city did not have adequate capacity within its already at-capacity public transport network to accommodate the two-wheeler users. The rise of private cars has led to a significant increase in congestion in the city, and the lack of adequate public transport services has led to a variety of unregulated para-transit services and cycle rickshaws to replace routes formerly served by two-wheeler taxis. However, of the 20 percent of two-wheeler trips, 51 percent shifted to bus, 18 percent to bicycle, 18 percent to cars or taxis, 9 percent to walking, 2 percent to metro and 2 percent to other modes. Traffic crashes dropped by 17.5 percent, deaths by 2.2 percent, injuries by 20.4 percent and most interestingly, property losses by 42.3 percent, from January to August 2007.

<sup>14</sup> Peth is the local term referring to the traditional, compact mixed-use neighborhoods which were developed nearly three centuries ago, having narrow organic streets and a human scale.

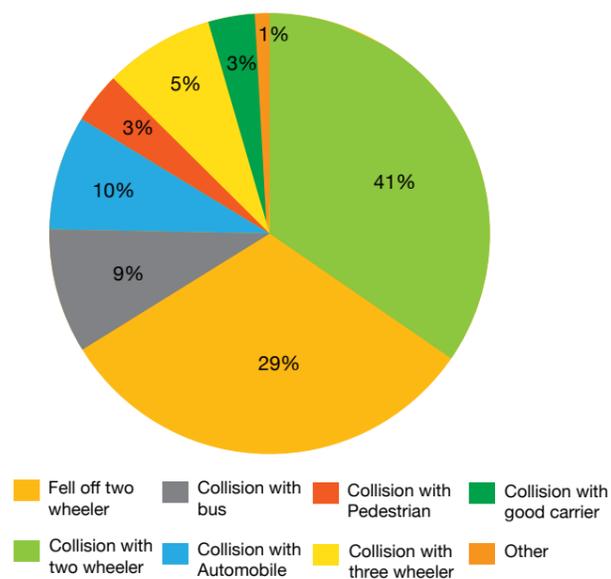
of the female respondents said that they had been in an accident. The average number of accidents was 1.2, while the maximum number reported was 6 in the last three years. The most common accident types are shown in Figure 19. Collision with another two-wheeler and falling off the vehicle were responsible for 70 percent of all two-wheeler accidents, while 27 percent of accidents occurred due to collision with a larger vehicle. 25 percent of accidents resulted in a visit to the doctor and 7 percent in a trip to the hospital. 43 percent required the rider to take time off from work or school.

Figure 18. Road Accident Deaths by Various Modes in India, 2012



Source: (Ruikar 2013)

Figure 19. Types of Accidents among Pune Survey Respondents



Source: Pune Survey, 2012

Of the respondents who had been in an accident, 44 percent said they wear a helmet regularly, while about 26 percent said occasionally and 30 percent responded that they do not wear a helmet. For those who have not been in an accident, the numbers were not very different at 42 percent, 23 percent, and 35 percent respectively. Yet, the majority of respondents (64 percent) were in favor of compulsory helmet laws. Some of the main reasons given by those against the law were personal choice; could not see/hear and therefore unsafe; inconvenient to carry; and uncomfortable (neck or back pain, suffocation).



None of the two wheeler riders in these photographs were wearing helmets, Pune

Source: Authors

Research data strongly supports the fact that helmet use reduces the severity of head injury and the rate of fatalities in two-wheeler accidents. The effectiveness of a helmet use regulation is linked to helmet quality, public education and enforcement. Though the Indian Motor Vehicles Act has mandatory helmet legislation, the notification and implementation of the law is the responsibility of individual states. For a variety of reasons, Indian states have not notified the law, and when introduced, are partial in nature (Gururaj n.d.). The gender bias in mandating helmet laws for men but not women, also increases risks for predominantly non-helmeted females, as a recent study reveals (Gupta A et al. 2014).

## 5. POLICY OPTIONS TO MANAGE TWO-WHEELERS: EXPERIENCE FROM TAIPEI, TAIWAN

A key question when looking at motorized two-wheelers in developing cities is whether policies to manage them can have a positive effect or not. Taipei, Taiwan is a city that has undergone two-wheeler management reform and has managed to stem the shift from motorized two-wheelers to private automobiles. Two-wheeler ownership has remained fairly constant despite rising incomes. Here, we look at the lessons that can be learned from the experience in Taipei and at two-wheeler management and reform policies in other cities in Asia.<sup>15</sup>

### 5.1 Motor Vehicle Ownership Trends in Taipei, Taiwan

In 2006, the two-wheeler ownership rate in Taiwan was one per 1.8 people, while in Malaysia it was one per 3.5 people; in Thailand, one per 4.2 people; in Vietnam one per 5.9 people, and in Japan, one per 9.7 people (JAMA 2006).



Source: Chang 2012

<sup>15</sup> The material in this section is based on interview with Professor Jason Chang (Chang 2012), Advisor to the Taipei City Government, and his presentation at the 'Transforming Transportation 2013' event (Chang 2013), available at: <http://www.slideshare.net/EMBARQNetwork/p3-c-motorcycle-jasonchang130118r>

Taipei, Taiwan, with a population of about 6.8 million, is home to the highest two-wheeler density in the world, with 3.2 million registered two-wheelers and 2.5 million registered cars in 2010 (Chang 2012); a density of 870 motorized vehicles per 1000 population and 560 motorized vehicles per square kilometer (Heywood 2012). Despite having one of the most comprehensive public transport systems in Asia, people in Taipei continue to use cars and two-wheelers as the costs are comparatively low. Even though many families own both, two-wheelers are used for daily and commuting trips, while cars tend to be used for occasional trips. Often there are no parking fees for two-wheelers. While this has been changing slowly, some believe that until users are charged the full cost of these modes, it will continue to be an uphill battle to get people to switch to public transportation.

### 5.2 Two-wheeler Management Policies used in Taiwan

About three decades ago, decision makers in Taiwan assumed that two-wheelers, despite being a popular travel mode at the time, would disappear with higher income levels but that has not been the case. About 80 percent of Taiwanese families own both a car and a two-wheeler, and with an increase in oil prices in 2008, 20 percent of regular car users shifted modes - about 5 percent to public transport and 15 percent to two-wheelers. Car parking continues to be more difficult to find and more expensive than two-wheeler parking, and this contributes to the high mode share of two-wheelers in Taipei. Their convenience and cost-effectiveness make them a highly popular mode.

The need for two-wheeler management was first voiced by academics, and through articles in local papers, reports, consumer foundations and public hearings, they eventually gained the support of the Mayor of Taipei.

Taipei thus began implementing two-wheeler-specific traffic management policies as far back as 1984. To improve junction safety and efficiency, it began with setting up a two-stage left turn at major intersections. Left-turning two-wheelers have to travel straight across an intersection to a painted two-wheeler box and wait for the next traffic signal to turn green. Two-wheelers have a specific waiting zone in front of cars because they have faster accelerations and the separation of modes allows for smoother travel. Finally, there are some separate two-wheeler lanes on major roads. For safety reasons, two-



Source: Lung, Chang and Hong 2012

wheelers, which are considered a form of urban transport, are not allowed to drive on expressways in Taiwan.

As per the Institute of Transportation, MOTC 2011 figures, two-wheelers constitute 80 percent of the fatality and 90 percent of injury cases in traffic accidents in Taiwan, but urban areas have comparatively lower two-wheeler fatality rates (54.5 percent in Taipei). This is attributed to speed limit and lane regulation, traffic management, education and enforcement.

Improved road design and traffic engineering along the Bus Rapid Transit (BRT) corridor in Taipei has also reduced two-wheeler-related accidents by 85 percent in those corridors. Taipei City saw the introduction of a Trial Helmet Law in 1994. A pilot study showed an increase in helmet use from 21 to 79 percent and a 56 percent reduction in motorized vehicle-related fatality. With the National Helmet Law passed in 1997, motorized vehicle-related fatalities



Source: Chang 2012

fell by about 50 percent between 1998 and 2008. From an environmental perspective, two-stroke two-wheelers have been stopped since 2004.

Another area that was considered was parking management. Until 15 years ago, two-wheelers were allowed to park almost anywhere, including sidewalks. The strategy used in Taipei was to implement two-wheeler parking fees on a zone-by-zone basis in order to acclimatize users to paying parking fees. Currently the city is at about 60 percent implementation, and the reaction has been positive. Although there was initial reluctance from two-wheeler users about losing curb space and free parking, there is greater acceptance now. Two-wheelers no longer park on the sidewalk because some curbside parking has been shifted from cars to two-wheelers. More users are now paying parking fees and pedestrian comfort and flow has improved within the city.



Source: Chang 2013

However, the overall use of private motorized modes is heavily subsidized by social resources (e.g., fuel price subsidies) and motorcyclists in Taiwan, like car owners, pay only a fraction of the costs they impose on society. In the case of two-wheelers, this figure is estimated at about 40 percent of the costs that ought to be paid by two-wheeler users. Private motorized vehicles generate numerous external costs, including pollution, noise, fatalities and congestion that affect everyone in their environment, not just the users. They are allocated significant public space for parking, which takes space away from pedestrians. While this is on a smaller scale for two-wheelers, it is an issue of concern just as it is for car users. However, because the mode share of two-wheelers is much higher in Taiwan, they have been the focus of management policies.

### 5.3 Future Vision for Two-Wheelers in Taipei and Taiwan

Public transportation currently has a 35 percent mode share and the goal is to increase this to 60 percent in Taipei, though most other Taiwanese cities have public transport mode shares below 10 percent. Currently two-

wheelers are considered the most convenient mode of transport, due in large part to their low costs. But as the users begin to pay the full cost of use, and the subway and BRT networks continue to be improved, more people are expected to begin riding public transport in the Taipei Metropolitan Area. In terms of the environment and the overall social good, public transportation needs to be at the forefront of transportation in Taiwan. While two-wheelers are more convenient than cars, a high mode share for any type of private motorized transport is not what is envisioned for Taiwan. In some cities, it is expected that two-wheelers will be integrated with public transport (metro, railway, ferry) and in others, work is underway to introduce electric two-wheelers as a low-carbon alternative to the conventional ones in areas without good public transportation. For example, in the Penghu Island Low Carbon Village demonstration project in Taiwan, 5000 two-wheelers have been given a subsidy of USD 250-1200 per vehicle and 300 charging stations powered by solar and wind have been set up. There is also a national project where 15,000 electric two-wheelers are subsidized with USD 800 per vehicle annually.

It is important to think of two-wheelers as a separate mode of transport, not lumped together with cars or non-

motorized modes. They have unique characteristics and fill a void in the transportation spectrum. They have a smaller footprint than cars, both physically and environmentally, particularly when they are electric-powered but this does not mean that they need not be regulated. Economics plays a big role in why people use two-wheelers, and contrary to common perceptions, they are not necessarily vulnerable users (i.e. low income). When the full cost of using a two-wheeler is not levied on the user it becomes a cost-effective form of transportation for individuals. While this may not be the case in all developing cities, it has impacted two-wheeler management policies significantly in Taiwan.

## 6. NEXT STEPS TOWARDS MANAGING TWO-WHEELERS IN INDIAN CITIES: INSIGHTS FROM THE CASE STUDY OF PUNE, INDIA

This section offers some conclusions based on insights gained from the Pune case study and interviews conducted with stakeholders in the city. The discussion provides a basis for further research and dialogue on the need for, and possible policy options to manage two-wheelers in Indian cities.

As discussed in earlier sections of the paper, the affordability and convenience of personal mobility offered by two-wheelers have made them a hugely popular mode of transport in Indian cities, a trend significantly advanced by the lack of adequate and good quality public transport systems and non-motorized transport infrastructure in many cities. With the national government supporting the growth of the automotive industry and the already huge motorized two-wheeler market in the country, this trend appears set to continue. However the uncontrolled growth of private motorized vehicles, of which two-wheelers form the major proportion, has many negative consequences and high social, environmental and economic costs.

This was recognized and lamented upon by all the stakeholders interviewed in Pune, from different socio-economic groups<sup>16</sup>. Everyone felt that the traffic situation in the city was bad and worsening with the exponential growth of private vehicles, of which two-wheelers constituted about 72 percent. This they said, had led to a number of related issues such as increased congestion, travel times, fuel consumption, pollution, accidents, road rage, parking problems and loss of worker productivity. The lack of traffic sense and indiscipline added to the chaos on the roads and safety concerns. Most felt that lacking infrastructure (that typically lags development), and poor traffic management and enforcement furthered the problems.

All stakeholders highlighted the glaring problem that two wheelers posed in the city today. Given the acknowledgement of a problem, the reasons behind it and

the ways to tackle it differed with each representative and their role in society.

While some saw the phenomenon in the larger context of urbanization and development planning, others saw it in correlation to the substandard public transport system in the city. All felt that the two-wheeler was not a status symbol but had almost become a necessity today given the lack of better alternatives. Current public transport services are unable to satisfactorily meet the mobility needs of the public, walking and cycling infrastructure is poor, and the car is still unaffordable by the masses, making two-wheelers the mode of choice.

While there was agreement that the rising number of two-wheelers were a cause for concern, it was categorically felt that a good, fully equipped public transport system as an alternative was a prime condition before any thought of restricting or discouraging two-wheelers could be considered. This condition also meant that most people interviewed strongly felt that if public transport is improved, at least a section of people would shift from their private vehicles. Some interviewed stakeholders felt that instead of radical measures like banning two-wheelers from certain parts or roads, it was better to start with smaller initiatives like vehicle-free days in campuses, in certain areas or roads on particular days or restricting them along BRT corridors, thus giving people a chance to get used to an idea and notice its efficacy.

Safety with respect to two-wheelers was seen as an issue of concern by all. On the one hand, two-wheelers are more vulnerable in mixed traffic conditions and on the other hand, they add to unsafe driving conditions owing to their tendency towards traffic indiscipline, speeding or rash driving. Concerns were also expressed over the license age for two-wheelers being reduced from 18 to 16 years, and many youngsters around the age of 14-16 driving illegally, which raised safety issues. The perception was that although accidents may have reduced, fatalities have increased, therefore many were strongly for the helmet law as it is in public interest. However, others felt that helmets can be made compulsory on highways but voluntary within the city. An official from the traffic police mentioned that in the past three years, 50 percent of fatalities were among those who did not wear helmets. He expressed that the successful implementation of such a law depends on education and enforcement, and they have admittedly struggled with the enforcement of this law.

<sup>16</sup> Ten in-depth interviews were conducted in Pune with stakeholders that included politicians, activists, government officers and corporates, to solicit their views on current and expected future traffic scenarios in the city and the role of two-wheelers within it, issues concerning two-wheelers and possible policy options to manage them. See Appendix A.

On the issue of parking, views were conflicting. Most stakeholders were against paid parking and the reasons given were that it was not a luxury but a necessity, or that it was unfair to charge high parking fees when individuals have paid all the taxes. Some felt that there was no point in restricting facilities given to a vehicle owner. If anything, vehicle ownership should be restricted in the first place. However, an approach that can be learned from Taipei and tried here could be the better regulation of on-street parking with proper demarcated areas and enforcing parking fees on a zone-by-zone basis, giving users time to acclimatize.

Overall, with respect to charging the real costs of resources used by two-wheelers and the negative externalities they cause, which may include higher taxes and fuel prices, congestion and parking fees, many felt that this would be politically difficult to implement for fear of public backlash. Moreover, many were of the opinion that given the increased need for mobility and the currently unmatched benefits that two-wheelers offer, these may not prove to be enough of a disincentive for their use, even if implemented. This is also reflected to an extent in the survey where a number of respondents said they would not shift to public transport no matter what the fuel cost, or that cycling and walking were considered the very last option. As such it seems that disincentives or 'push' strategies would only really be effective when preceded by and combined with 'pull' strategies such as improving and integrating multi-modal public transport systems, and making them affordable and attractive.

Some of the other broad measures that should be looked at include improved road design and traffic engineering, speed and lane regulation, special traffic regulations for two-wheelers, and education and enforcement. Improving vehicle design and technology from a safety and environmental perspective is another important action area.

Stakeholders from the private sector offered views on what possible roles and responsibilities they could take on in addressing the issue of growing private vehicles and traffic and transportation issues in the city. Some ideas discussed were that companies can reserve parking space for car-poolers and bicyclists and charge parking fees for other private motor vehicles, at least where special facilities are provided. They can stop providing incentives to acquire personal vehicles and instead incentivize travel by public transport or company buses. Companies can actively support initiatives like Bus or Cycle Days, provide training, innovation and technological support and work with local authorities to resolve traffic and transport issues in the city.

Some suggested that more could be done under corporate social responsibility, like buying buses for the city or building road infrastructure. Given that they can influence a large number of employees and citizens, the role of the private sector in bringing about a change in attitudes and trends can be significant.

Many of the stakeholders interviewed ended on the note that real change can happen only when a fragmented and short-sighted approach, political compulsions and vested interests are set aside for the betterment of the city. Political will would need to be backed by economic and decision-making capability. Awareness of issues needs to grow among decision-makers and citizens alike, and people need to come together and ask for solutions that benefit the urban environment and society as a whole.

Some pointed to the lack of a comprehensive urbanization policy and called for a scientific and integrated approach to land use and transport planning and infrastructure provision. A need was also felt for clear, non-conflicting policies that encouraged public transport and discouraged the use of private vehicles.

Perhaps the most surprising opinion gathered from the interviews was the uniform response that the city has no policy to address the traffic and transportation problem. This is in spite of the fact that the city actually approved a Comprehensive Mobility Plan in 2012. This plan is based on a vision of 'moving people and not vehicles', and prioritizes public and non-motorized transport in accordance with the National Urban Transport Policy announced by the Government of India in 2006.

The goals of the plan include increasing the share of non-motorized trips to 50 percent and public transport to 40 percent by 2031. To achieve these goals, the plan proposes various initiatives such as radical improvements in public transport, roads with usable footpaths, a city-wide cycle track network, and pedestrianized areas.

It was surprising to note that though the range of stakeholders included those involved in administration, policy making and implementation, none of them recognized or even mentioned the Comprehensive Mobility Plan as the nodal plan for the city. Everyone interviewed saw the response of the city as reactionary, short term and ad hoc, a reflection of the fact that the Comprehensive Mobility Plan is not being implemented in earnest.

In conclusion, it is clear that the issue of managing two-wheelers to maximize the advantages of the mode and

minimize its social and environmental externalities is a crucial and urgent one for Indian cities. In particular, with rising urbanization and vehicle growth in the mid-sized and smaller cities of India, it is imperative for local governments and other stakeholders to explore and implement relevant two-wheeler management strategies. These may be related to infrastructure management and design, safety improvement, pricing and incentives to influence user behavior, enforcement of traffic regulations, public transport improvements, and other aspects. The authors expect that this working paper will create greater dialog and debate among stakeholders regarding these policies, so that innovative solutions can emerge to manage two-wheelers in the unique context of Indian cities.

## APPENDIX A: STAKEHOLDER INTERVIEWS SUMMARY

Stakeholder Type	Political	Political	Political	Political / Activist
Traffic situation	Not very serious, but worsening	Very bad	Bad, due to lack of PT	Terrible, getting worse
Discourage two wheelers		First improve PT	Yes, some disincentives needed	Not without providing for an alternative
Conversion to car usage	No, not affordable, only a small section will become car owners		Depends on affordability	
Switch to PT	Possible, PT needs to be subsidized and made attractive	Possible	Challenging but possible	Possible, but PT has to work on its credibility
Helmet law	For	Against	For	Not required in the city, inconsistent enforcement as of now.
Current Policy	No policy	No policy	No policy	No policy
Role of Police	Should be educative and enforcing both		Scope for improvement	Insufficient, no knowledge of laws
Parking	Necessity. Cannot charge people exorbitantly/ at all	Scarcity of parking space, should be charged but the revenue should be used for improving roads.	Against paid parking, if they want to charge safety should be guaranteed. Providing parking doesn't encourage usage.	Rates are already steep, insufficient parking, if it is paid it should guarantee safety at least.
Future	Two wheelers will increase, cars will reduce, urbanization will be a problem	Political will will be decisive in shaping the situation, realistically situation will worsen, population and two wheelers will keep increasing	Pune will exhaust itself in 15 years, need for politics administration consensus	Public solutions are needed instead of personal solutions, there will be efforts to solve the problem because of its magnitude in future.

Government	Government	Activist	Activist	Corporate
Bad, exponential growth always problematic	Problematic	Serious problem, two wheelers are an addiction	Problematic	Uncontrolled, worsening
Yes	Only if there is an alternative			
No, depends on income, cars are not yet a necessity	There will be rise in car ownership, not necessarily use of cars	Ownership may increase but not on roads, in fact in coming years, even car owners may prefer two wheelers	Eventually it will, as income increases, but car is still a status symbol	Depends on affordability, tendency among their employees is high
Needs to match the convenience of two wheelers, but also needs to be combined with discouraging two wheelers	Possible	20-25% may shift, especially those having limited and decided travel pattern	To some extent, if PT is made affordable and good – for those who drive a two wheeler as a necessity	Possible, innovation and use of technology required
	For, there has been improvement in enforcement and awareness	For	For	For
No policy, ad hoc		No policy	No policy	No policy
	Lack manpower and other resources		They lack understanding of traffic issues, inconsistent enforcement	
		Free parking is a populist stance, but it isn't a deciding factor in two wheeler growth		Debatable issue – whether providing free parking is subsidizing two wheeler users as against other employees
Two wheelers growth will not decline in the coming years, but as the city grows even two wheelers might become inconvenient	City at crossroads, can improve or worsen	Situation will worsen, numbers will plateau, when people opt out of driving for safety.	Two wheelers will keep on increasing, cars will also increase.	Growth rate of cars will increase and that of two wheelers will decrease.

# APPENDIX B: PUNE SURVEY QUESTIONNAIRE, 2012

## Embarq/Parisar - Motorized Two-Wheeler Survey – August 2012

Surveyor:	Date:	Time:
Location:		

### I. Household

Household includes all the people, (adults & children), who live permanently/semi-permanently in the same house.

1. What is the size of your household?

Adults
Children (below 18 yrs)

2. How many vehicles do your household own?

Vehicle	Number
Bicycle	
Motorbike/scooter	
Car	

Others (specify)	Number

Number of members must match

3. What is the **primary** mode of transport for each member of your household? (Multiple choice possible)

	Age	Gender	Primary Transport Mode		
1.		<input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Car (Driver) <input type="checkbox"/> Two-wheeler(passenger) <input type="checkbox"/> Public Transportation <input type="checkbox"/> Other:	<input type="checkbox"/> Car (Passenger) <input type="checkbox"/> Bicycle <input type="checkbox"/> School Bus/Van/Auto (children):	<input type="checkbox"/> Two-wheeler (driver) <input type="checkbox"/> Walking
2.		<input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Car (Driver) <input type="checkbox"/> Two-wheeler(passenger) <input type="checkbox"/> Public Transportation <input type="checkbox"/> Other:	<input type="checkbox"/> Car (Passenger) <input type="checkbox"/> Bicycle <input type="checkbox"/> School Bus/Van/Auto (children):	<input type="checkbox"/> Two-wheeler (driver) <input type="checkbox"/> Walking
3.		<input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Car (Driver) <input type="checkbox"/> Two-wheeler(passenger) <input type="checkbox"/> Public Transportation <input type="checkbox"/> Other:	<input type="checkbox"/> Car (Passenger) <input type="checkbox"/> Bicycle <input type="checkbox"/> School Bus/Van/Auto (children):	<input type="checkbox"/> Two-wheeler (driver) <input type="checkbox"/> Walking
4.		<input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Car (Driver) <input type="checkbox"/> Two-wheeler(passenger) <input type="checkbox"/> Public Transportation <input type="checkbox"/> Other:	<input type="checkbox"/> Car (Passenger) <input type="checkbox"/> Bicycle <input type="checkbox"/> School Bus/Van/Auto (children):	<input type="checkbox"/> Two-wheeler (driver) <input type="checkbox"/> Walking
5.		<input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Car (Driver) <input type="checkbox"/> Two-wheeler(passenger) <input type="checkbox"/> Public Transportation <input type="checkbox"/> Other:	<input type="checkbox"/> Car (Passenger) <input type="checkbox"/> Bicycle <input type="checkbox"/> School Bus/Van/Auto (children):	<input type="checkbox"/> Two-wheeler (driver) <input type="checkbox"/> Walking
6.		<input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Car (Driver) <input type="checkbox"/> Two-wheeler(passenger) <input type="checkbox"/> Public Transportation <input type="checkbox"/> Other:	<input type="checkbox"/> Car (Passenger) <input type="checkbox"/> Bicycle <input type="checkbox"/> School Bus/Van/Auto (children):	<input type="checkbox"/> Two-wheeler (driver) <input type="checkbox"/> Walking
7.		<input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Car (Driver) <input type="checkbox"/> Two-wheeler(passenger) <input type="checkbox"/> Public Transportation <input type="checkbox"/> Other:	<input type="checkbox"/> Car (Passenger) <input type="checkbox"/> Bicycle <input type="checkbox"/> School Bus/Van/Auto (children):	<input type="checkbox"/> Two-wheeler (driver) <input type="checkbox"/> Walking
8.		<input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Car (Driver) <input type="checkbox"/> Two-wheeler(passenger) <input type="checkbox"/> Public Transportation <input type="checkbox"/> Other:	<input type="checkbox"/> Car (Passenger) <input type="checkbox"/> Bicycle <input type="checkbox"/> School Bus/Van/Auto (children):	<input type="checkbox"/> Two-wheeler (driver) <input type="checkbox"/> Walking

4. Two-Wheeler Information (number of two-wheelers should match answer in Q2)

I.	
Manufacturer and Model	
Age of vehicle	yrs
Purchase condition	<input type="radio"/> New <input type="radio"/> Second-Hand
Purchase price (only if second hand)	<input type="radio"/> <Rs. 10,000 <input type="radio"/> Rs. 10,000-20,000 <input type="radio"/> Rs. 20,000-40,000 <input type="radio"/> Rs. 40,000-50,000 <input type="radio"/> Rs. 50,000-60,000 <input type="radio"/> >Rs. 60,000

II.	
Manufacturer and Model	
Age of vehicle	yrs
Purchase condition	<input type="radio"/> New <input type="radio"/> Second-Hand
Purchase price (only if second hand)	<input type="radio"/> <Rs. 10,000 <input type="radio"/> Rs. 10,000-20,000 <input type="radio"/> Rs. 20,000-40,000 <input type="radio"/> Rs. 40,000-50,000 <input type="radio"/> Rs. 50,000-60,000 <input type="radio"/> >Rs. 60,000

III.	
Manufacturer and Model	
Age of vehicle	yrs
Purchase condition	<input type="radio"/> New <input type="radio"/> Second-Hand
Purchase price (only if second hand)	<input type="radio"/> <Rs. 10,000 <input type="radio"/> Rs. 10,000-20,000 <input type="radio"/> Rs. 20,000-40,000 <input type="radio"/> Rs. 40,000-50,000 <input type="radio"/> Rs. 50,000-60,000 <input type="radio"/> >Rs. 60,000

IV.	
Manufacturer and Model	
Age of vehicle	yrs
Purchase condition	<input type="radio"/> New <input type="radio"/> Second-Hand
Purchase price (only if second hand)	<input type="radio"/> <Rs. 10,000 <input type="radio"/> Rs. 10,000-20,000 <input type="radio"/> Rs. 20,000-40,000 <input type="radio"/> Rs. 40,000-50,000 <input type="radio"/> Rs. 50,000-60,000 <input type="radio"/> >Rs. 60,000

V.	
Manufacturer and Model	
Age of vehicle	yrs
Purchase condition	<input type="radio"/> New <input type="radio"/> Second-Hand
Purchase price (only if second hand)	<input type="radio"/> <Rs. 10,000 <input type="radio"/> Rs. 10,000-20,000 <input type="radio"/> Rs. 20,000-40,000 <input type="radio"/> Rs. 40,000-50,000 <input type="radio"/> Rs. 50,000-60,000 <input type="radio"/> >Rs. 60,000

VI.	
Manufacturer and Model	
Age of vehicle	yrs
Purchase condition	<input type="radio"/> New <input type="radio"/> Second-Hand
Purchase price (only if second hand)	<input type="radio"/> <Rs. 10,000 <input type="radio"/> Rs. 10,000-20,000 <input type="radio"/> Rs. 20,000-40,000 <input type="radio"/> Rs. 40,000-50,000 <input type="radio"/> Rs. 50,000-60,000 <input type="radio"/> >Rs. 60,000

5. Is a two-wheeler used in the household as a family vehicle?

Yes     No

**II. User Information**

For this section, please provide some general details about yourself.

6. Gender:  Male  Female

7. What is your age?  years old

Should match entry in Q3.

8. What is your marital status?

Single  Married  Divorced  Widowed

9. What is the latest level of education that you have fully completed?

Nil  Till 4th std  Till 10th std  Till 12th std  Bachelors degree  Masters degree or higher

10. Generally in a week, how many times do you use each one of these modes?

Motorbike / scooter	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
Car	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
Auto-rickshaw	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
City Bus	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
Bicycle	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
Walk	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never

**III. Two-wheeler Use Information**

For this section, think of all the times you use a two-wheeler for any purpose; work or personal.

11. What is your primary purpose in riding a two-wheeler?

Travel to work  Commercial purposes (i.e. delivery driver)  Recreation/Shop ping/Visiting Friends/relatives  Travel to Education  Other:

12. At what age did you begin riding a motorbike/scooter?

years old

**II. User Information**

For this section, please provide some general details about yourself.

6. Gender:  Male  Female

7. What is your age?  years old

Should match entry in Q3.

8. What is your marital status?

Single  Married  Divorced  Widowed

9. What is the latest level of education that you have fully completed?

Nil  Till 4th std  Till 10th std  Till 12th std  Bachelors degree  Masters degree or higher

10. Generally in a week, how many times do you use each one of these modes?

Motorbike / scooter	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
Car	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
Auto-rickshaw	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
City Bus	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
Bicycle	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never
Walk	<input type="radio"/> >14 times per week	<input type="radio"/> 10-14 times per week	<input type="radio"/> 7-10 times per week	<input type="radio"/> 4-7 times per week	<input type="radio"/> 1-4 times per week	<input type="radio"/> Never

**III. Two-wheeler Use Information**

For this section, think of all the times you use a two-wheeler for any purpose; work or personal.

11. What is your primary purpose in riding a two-wheeler?

Travel to work  Commercial purposes (i.e. delivery driver)  Recreation/Shop ping/Visiting Friends/relatives  Travel to Education  Other:

12. At what age did you begin riding a motorbike/scooter?

years old

13. What was your **primary** mode of transportation **before** owning a two-wheeler?

- Two-wheeler(passenger)    Public Transportation    Bicycle    Walking  
 Car (Driver)    Car (Passenger)    Other:

14. Why did you **begin** riding a two-wheeler? (Multiple choices possible.)

- More comfortable    Low Cost    Convenience and Flexibility    Easier to park    Higher Status/Cool  
 Enjoy riding    Faster than other modes    Public transport not available/inconvenient    Safer than other modes of transport    Longer commute distance  
 Other :

15. Today why do you **continue** to ride a two-wheeler? (Multiple choices possible.)

- More comfortable    Low Cost    Convenience and Flexibility    Easier to park    Higher Status/Cool  
 Enjoy riding    Faster than other modes    Public transport not available/inconvenient    Safer than other modes of transport    Longer commute distance  
 Other :

16. Please estimate how much you spend **per month** on fuel and maintenance costs for your two-wheeler.

Rs.

17. At what time do you do your **main trips** during the day and how long does it take to reach your destination?

Time	Duration per Day (in minutes)
Morning	
Afternoon	
Evening	

18. On average, how far do you travel per day on a two-wheeler?

Work related  km   Non-Work related:  km

19. On a typical **Day**, do you ever use a two-wheeler in combination with another form of transportation (i.e. ride to the bus stop or parking lot)? If yes, what other mode?

Yes    No   Mode:

#### IV. Safety

For this section, please answer questions regarding safety and motorized two-wheelers.

20. Have you ever been involved in an accident while on a two-wheeler?

Yes    No

21. If yes, how many accidents have you been involved in during the past **3 years**?

22. If yes, what types of accidents have you been involved in the past **3 years**? Multiple choices possible.

- Collision with two-wheeler    Collision with automobile    Collision with goods carrier    Collision with bus    Collision with three-wheeler  
 Collision with pedestrian    Fell off bike    Other:

23. Have you required medical care by a doctor or hospital because of injuries sustained in these collisions?

Yes, doctor	<input type="text"/>
Yes, hospital	<input type="text"/>
No	<input type="text"/>

24. If yes, have you needed to take time off work or from riding a two-wheeler due to injuries sustained in these collisions?

Yes    No

25. Do you use a helmet?

Yes    No    Occasionally

#### V. Alternative Transport

26. If you **do not own a car**, would you consider buying a car in the future?

Yes    No

IF 'Yes'

27. What would lead to a car purchase? (Multiple choices possible.)

- Higher income    Marriage    Children    Longer commute    Lower parking fees  
 Lower petrol cost    Other:

If you own a car (can be owned by user OR the household)

28. How long have you owned your car?

29. What led you to purchase a car?

VI. Opinions

For this section, please answer the following questions with your opinions.

30. What would it take for you to switch (or consider switching) to an alternate mode of transport?

Public Transportation	
Bicycle	
Walking	

31. What is your opinion of the helmet law?

If against Helmet Law – reasons

- Helmet is not safe/can't hear properly  Inconvenient  Should be personal choice  
 Other:

32. Are you concerned about future petrol price hikes?

- Yes  No

At what price point would you consider using an alternative mode?

Rs.

33. Is finding parking a problem?

- Yes  No

34. How much do you typically pay for two-wheeler parking usually (for 1 hour)?

Rs.  (per hour)

35. What do you think is a reasonable charge for two-wheeler parking?

- Half of car parking charge  1/4<sup>th</sup> of car parking charge  Rs 10  Rs 5  Rs 2  Free

36. What do you think about the traffic in Pune?

37. What should Government do to improve traffic situation in Pune?

38. What is the average income per month of your household, including all earning members?

- Less than Rs 10,000  Rs 10,000 to Rs 25,000  Rs 25,000 to Rs 50,000  Rs 50,000 to Rs 75,000  Rs 75,000 to Rs 1 lakh  More than Rs 1 lakh  Decline to answer

39. What is your average income per month?

- Less than Rs 10,000  Rs 10,000 to Rs 25,000  Rs 25,000 to Rs 50,000  Rs 50,000 to Rs 75,000  Rs 75,000 to Rs 1 lakh  More than Rs 1 lakh  Decline to answer  No Income

If Decline to answer

Occupation

VII. Field Notes

Surveyor should add any comments or observations that are relevant to the study here.

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