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Investigation into the use of motorcycle three-wheelers (Qingqis) as a mode of public transport in Punjab Province

Final Report

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Cover photo. Paul Starkey. Women boarding a motorcycle rickshaw in a village in Jhelum, Punjab, Pakistan

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Abstract

ReCAP contracted IMC Worldwide to undertake research on the use of motorcycle rickshaws (three-wheelers known as 'Qingqis') for rural transport services in Punjab Province. This report reviews the use of three-wheelers in Pakistan and other countries, stressing the differences between the rural route-based services offered by motorcycle rickshaws with the urban point-to-point services of auto-rickshaws. Survey data from three rural areas is presented, including traffic analyses, and opinions of users, operators, manufacturers and regulators. A big issue is the inexorable increase in motorcycles that is changing the market. Motorcycle rickshaws are providing the only affordable transport services on rural roads and are particularly crucial for rural women. Cost benefit analysis models have been prepared to investigate scenarios for improving motorcycle rickshaw technology or limiting loading levels. Most improvement options would raise fares. However, rural people, notably women expressed willingness to pay 40% extra for some improvements. Technological issues are discussed in relation to official standards, current production models (formal and informal) and other options.

The research suggests that motorcycle rickshaws are highly beneficial. They are optimising rural transport and should be allowed to continue and be legally recognised. Road safety is a great concern for all types of vehicles, particularly motorcycles, and needs addressing throughout the country. Following a stakeholder workshop, it was concluded that enforcing higher standards in manufacturing and operations should be introduced in a realistic manner, giving time for compliance. It is recommended that the regulatory framework be adjusted to include training and testing for three-wheeler operators and motorcyclists, with new driving licences dependent on tests. Unfortunately, such procedures might be susceptible to the pervasive non-compliance, non-enforcement and corruption. Self-regulation could be strengthened through the support of active operator associations that could also stimulate timetabled services. These should be promoted on a pilot basis. Manufacturers should be encouraged to develop electric vehicles. Improving the situation in a socially-just way, will require a gradual, phased approach, including widespread education and training.

Key words

Three-wheelers; Motorcycle rickshaws; Autorickshaws; Transport services; Rural mobility; Transport regulation; Motorcycles; Qingqis; Intermediate means of transport; Punjab

Research for Community Access Partnership (ReCAP)

Safe and sustainable transport for rural communities

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Acronyms, terminology, units and currencies

AsCAP	Asian Community Access Partnership
ADB	Asia Development Bank
BBC	British Broadcasting Cooperation
BCR	Benefit Cost Ratio
Bhatta	Bribe
CBA	Cost-benefit analysis
Chak	Village
CNG	compressed natural gas
DFID	Department for International Development, UK (UKAid)
E&T	Excise and Taxation
EDB	Engineering Development Board
eg	for example
EIRR	Economic internal rate of return
GBP	Great Britain Pound, UK pound sterling (in October 2019, GBP 1 ≈ PKR 200)
ha	hectare
HGV	Heavy goods vehicle
IMC	IMC Worldwide Ltd
IMF	International Monetary Fund
IMT	Intermediate means of transport
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
kg	kilogram
kgCO2e/TJ	kilograms carbon dioxide emissions per Terajoule
km	kilometre
LHE	Lahore
LVRR	Low-volume rural road
MHD	Muhammad
Min	Minute
MOST	Ministry of Science and Technology
MVR	Motor Vehicles Rules
NGO	Non-governmental organisation
NPV	Net Present Value
NTRC	National Transport Research Centre
NUST	National University of Sciences and Technology
O&M	Operation and maintenance
OPEX	Operating and maintenance expenditure
p	Pages
PAMA	Pakistan Automotive Manufacturers Association
PBS	Pakistan Bureau of Statics
PD Khan	Pind Dadan Khan
PDR	People's Democratic Republic
PKR	Pakistan Rupee (in October 2019, PKR 1 ≈ GBP 0.005 ≈ USD 0.0065)
PMU	Project/Programme Management Unit
PMVO	Provincial Motor Vehicles Ordinances
PSQCA	Pakistan Standards and Quality Control Authority
PTD	Punjab Transport Department
PSV	Public service vehicle
ReCAP	Research for Community Access Partnership
RTS	Rural transport services
RTSi	Rural transport services indicator
RWD	Raiwind
SIAM	Society of Indian Automobile Manufactures
SPSS	formerly 'Statistical Package for the Social Sciences' now SPSS is a brand name
ST	Sensitivity test
Tanga	Horse-drawn carriage
tehsil	Sub-District
TL	Team Leader
TOR	Terms of Reference
UC	Union council (village group)
UK	United Kingdom (of Great Britain and Northern Ireland)
UKAid	United Kingdom Aid (Department for International Development, UK)
USA	United States of America
USD	United States Dollar (in August 2019, USD 1 ≈ PKR 155)
VICS	Vehicle Inspection and Certification System
VOC	Vehicle operating costs
VOT	Value of time
VOTS	Value of time savings
WB	West bank (of main irrigation canal)

Executive summary

Following a request of the National Transport Research Centre (NTRC), the Research for Community Access Partnership (ReCAP), funded by UKAid, contracted IMC Worldwide to carry out research on the use of motorcycle three-wheelers (known as 'motorcycle rickshaws' or 'Qingqis') for rural public transport in Punjab Province. Motorcycle rickshaws generally have 2/3 forward-facing and 2/3 rear-facing passenger seats and are used for route-based transport services, mainly in rural and peri-urban areas. Scooter-based auto-rickshaws, with 2/3 seats are mainly used in urban areas for point-to-point taxi services. There are seven factories authorised to produce motorcycle rickshaws. However, half of the estimated two million motorcycle rickshaws in use may have bodies built by informal sector workshops that are not authorised. There appears to be no evidence suggesting that the technical specifications or built quality of existing motorcycle rickshaws are intrinsically dangerous if used correctly in a safe driving environment. They are considered dangerous by some, but this is mainly due to over-loading, poor driver behaviour and other road users. Motorcycles are considered even more dangerous.

Surveys were conducted in three districts in north, east and south Punjab. Traffic counts were conducted on eight rural roads, counting 24,000 vehicles and 63,000 people travelling. Most vehicles (63%) were motorcycles that carried 47% of people travelling. Only 18% of people travelling on motorcycles were women. A few higher volume public transport services provided early-morning commuter services. After these left, the only public transport services that ran throughout the day on all roads were motorcycle rickshaws, although on one road pickups provided a 'timetabled' joint service with motorcycle rickshaws.

Transport operators, users, motorcycle owners and manufacturers were surveyed. Motorcycle rickshaw operators struggled to earn livelihoods, with increasing motorcycle use and market over-supply exacerbating their situation. Manufacturers are worried by the current cessation of the registration processes for rickshaws by the Punjab Transport Department. Informal workshops fear clampdowns.

Various options for improving or replacing motorcycle rickshaws are discussed. Rural people, notably women, were prepared to pay 40% extra for improved transport services. Motorcycle rickshaws are currently 'optimising' rural transport. A crucial gender issue is that low-income, rural women depend on motorcycle rickshaws. Without alternative options, a clamp down against them could be discriminatory.

Most of the problems of motorcycle rickshaws are not technological, but relate to the societal norms of poor driving, non-compliance and non-enforcement. These need to be addressed through good information and training and gradually enforced in a phased approach.

Cost-benefit models were prepared. Scenarios for enforcing low passenger numbers and improving rickshaw designs were not economically attractive, partly due to more use of motorcycles leading to worse safety outcomes and environmental impacts. One scenario involved training motorcycle rickshaw drivers, encouraging timetabled operations and improving self-regulation through operator associations. This had a economic internal rate of return (EIRR) of 29% and such training schemes are recommended.

A stakeholder workshop was held in Islamabad. Research findings were presented. Participants discussed issues relating to safety, vehicle manufacture and regulation, and gender and image issues. They proposed options and strategies for improving safety, enforcement and possible replacement vehicles for the future.

It is concluded that motorcycle rickshaws should be allowed to operate and be legally registered. They could gradually be replaced by autorickshaws with two rows of seats, and eventually be electric vehicles. Road safety needs to be tackled throughout the road transport sector. Recommendations are made for a realistic and gradual approach to enforcing standards for informal workshops and rural motorcycle rickshaw operations. Changes to the regulatory framework are proposed in conjunction with training of motorcycle rickshaw operators and motorcyclists. New tests would be introduced for three-wheelers and new driving licences would require drivers to pass tests. Such testing regimes might be susceptible to corruption. A pilot project should be started to encourage safety compliance and timetabled services by working with local operator associations. If successful, this should be widely replicated. Private manufacturers should be encouraged to start developing electric vehicles now, as these are likely to be the long-term future of rural transport. An electric 'golf-buggy' type of transport services should be piloted.

1 Background and research context

1.1 Introduction to the research project on motorcycle rickshaws ('Qingqis')

Following-up a research suggestion provided by the National Transport Research Centre (NTRC), the Research for Community Access Partnership (ReCAP), funded by UKAid, commissioned IMC Worldwide to undertake a research study on the use of motorcycle rickshaws (often known as 'Qingqis') as a mode of public transport in the Punjab Province of Pakistan.

Motorcycle rickshaws in Pakistan are motorcycle-based three-wheelers that are used for urban and rural public transport services. They have been designed to have six seats (see Figure 1), three forward-facing and three rear-facing (although their current official capacity is four seats). Using motorcycle-size front wheels, they differ from motor-scooter-based auto-rickshaws (sometimes known by the 'Bajaj' brand name). Auto-rickshaws (see Figure 2) have smaller, scooter-sized front wheels and may have just three forward-facing seats (now officially two seats). However, in common parlance and in much of the literature (including some legal documents), the different types of three-wheeler are often not distinguished. They may be referred to as rickshaws, auto-rickshaws, three-wheelers or 'Qingqis'.

Figure 1 Examples of 6-seater passenger Qingqis in Punjab Province

Figure 2 Examples of auto-rickshaws in Punjab Province: 3-seater, sideway seats and freight (2)

Motorcycle rickshaws appear to have been first used in the Punjab, where they initially replaced 6-seater, horse-drawn *tangas* (Hasan and Raza, 2015). The Qingqi name comes from the large Chinese Jinan Qingqi Motorcycle Company. Initially, the Qingqi three-wheelers were imported from China, but they are now manufactured in Pakistan (with imported and local components), notably by Plum Qingqi and United in Lahore. Although the word Qingqi originated as a brand name (which is still in commercial use in Pakistan), Qingqi is now a commonly-used generic term ('proprietary eponym') for a motorcycle-based three-wheeler, and the name Qingqi is used as a generic term in some legal documents, including a Supreme Court judgement (Supreme Court, 2015). In this document, Qingqi is used as a general term for a motorcycle-based three-wheeler (a motorcycle rickshaw) and in contrast to scooter-based auto-rickshaws. Plum Qingqi (that still has the rights to the Qingqi brand name in Pakistan) is no longer the major formal-sector manufacturer of motorcycle rickshaws, and most rural 'Qingqi' bodies appear to be made in numerous informal sector workshops and fitted to a range of different motorcycles.

Some passenger motorcycle rickshaws made by the informal sector have sideways facing seats (see Figure 3). These are often used as small 'school buses' to transport ten (or more) children to and from schools.

Figure 3 Examples of passenger motorcycle rickshaws with sideways-facing seats in Punjab Province

There are also freight-carrying motorcycle rickshaws, as illustrated in Figure 4. These 'loader Qingqis' also come in many configurations including enclosed/box body, cage, flat-bed and pickup bodies as illustrated in Figure 4.

Figure 4 Examples of 'loader' motorcycle rickshaws for freight transport in Punjab Province

Other public transport vehicles seen in some villages include passenger pickups, minivans (known as carry vans), minibuses (often known as Hiaces after a Toyota model), midibuses (generally known as Coasters after a Toyota model) and large buses. These are all illustrated in Figure 5.

Figure 5 Other passenger transport types (L-R): pickup, carryvan, minibus, midibus and large bus

1.2 Research objective and envisaged outcomes

The overall purpose of the project was to conduct a detailed investigation into motorcycle rickshaws as a mode of public transport in Punjab. The study has considered the technological (including power options), economic, social (including gender), legal, safety and environmental aspects of motorcycle rickshaws and their implications. The project has also considered the alternative options to motorcycle rickshaws for public transport, and their relative advantages and disadvantages.

In the long term, this research should lead to improved mobility for rural people in Pakistan through better public transport services. In the short-to-medium term, the research should promote greater understanding of motorcycle rickshaws as a form of public transport, with options and recommendations for their improvement (and/or replacement) and appropriate regulatory initiatives.

The evidence collected from a wide range of relevant stakeholders has been shared in a series of reports (including this document) and a stakeholder workshop. Information has also been shared through an international conference paper and poster and will also be shared internationally through a journal paper.

1.3 Project activities

An Inception Report was prepared in February 2019 and, following reviews, it was revised and finalised in April 2019 (Starkey, Batool and Waqas, 2019a). This included a literature review, an initial analysis of some of the relevant issues, suggestions for three research sites in Punjab Province and initial plans for the surveys and other data collection.

In March 2019, the research team visited the three research areas in Punjab Province and consulted key informants in Lahore and Islamabad. The team made a presentation at NTRC on their initial findings and research plans. Details of the timetable for the data collection phase, as well as the survey instruments prepared, were presented in a Progress Report that was reviewed and finalised in May 2019 (Starkey, Batool, Younis and Reeves, 2019c).

Survey work in the villages started in April 2019 with the traffic counts. The surveys of users, operators, and motorcycle owners were finished in June 2019.

In June 2019, the Team Leader and Transport Economist held discussions with NTRC. They then joined the survey team to visit the research sites in Jhelum and Kasur, where meetings were held with transport operators and other stakeholders. In Lahore, they held discussions with the provincial transport and tax authorities. They visited several motorcycle rickshaw and auto-rickshaw manufacturers, including some informal sector manufacturers and suppliers. In Islamabad, they held discussions with the Pakistan Standards and Quality Control Authority (PSQCA). The team presented their findings from the visits, and discussed ideas on future policies and strategies with NTRC.

In June and July 2019, the research team members entered the survey data into SPSS statistical databases and started to analyse the results. At the end of July, they presented their findings in a Draft Final Report (Starkey, Batool, Younis, Humpish, Rehman and Ali, 2019d). This current report supersedes that document.

The key findings of the Draft Final Report were summarised and circulated ahead of a stakeholder workshop held on 5 September 2019 at NTRC Headquarters in Islamabad. About 100 participants attended, including a wide range of high-level stakeholders from federal and provincial government, statutory authorities, the manufacturing sector, road safety organisations, academia and the international development sector. Some of the key findings of the workshop are discussed in Section 6 of this report, and a separate, more detailed Workshop Report is available (Starkey, Batool, Younis, Umer, Rehman and Ali, 2019e).

In February 2019, the team prepared a paper for the World Road Congress. The paper (Starkey, Batool and Younis, 2019b) was peer-reviewed and accepted for publication in the proceedings. The UK committee of the World Road Association judged this paper to be the best of the many papers from the UK submitted in the class of 'Roads and intermodality'. The Team Leader was presented with an award for the paper by the UK's Minister of Transport at a World Road Association event in the British Houses of Parliament. In October 2019, two members of the team, Paul Starkey and Waqas Younis, were sponsored by ReCAP to attend the World Road Congress in Abu Dhabi, where they presented a poster, summarising some of the project's findings.

2 Three-wheelers and their context in Pakistan

2.1 Global overview of three-wheelers

2.1.1 Origin of motorcycles and three-wheelers in industrialised countries

The first motorised three-wheeler, the Butler Petrol Cycle, was designed in England in 1884, although this never went into mass production (3wheelers, 2019). The first mass-production of motorcycles was started in Germany in 1894. Within a decade of this, many of the famous old motorcycle brands, including Triumph, Royal Enfield, Norton, Indian and Harley-Davidson were being mass-produced in England and USA. During the first half of the twentieth century, numbers of motorcycles increased steadily, with production dominated by manufacturers in Europe and the United States. A wide range of three-wheeler

vehicles were produced, but in much smaller numbers. Designs included motorcycles with sidecars, vehicles with two front wheels and one rear wheel, and others with one front wheel and two rear wheels. Motorcycles with sidecars were considered robust and have been used by the military, including as military ambulances, since the First World War. Many three-wheelers were used for urban freight movements or for personal (and family) mobility. They were not generally used as public transport vehicles.

2.1.2 Growth of motorcycles and three-wheelers in low-income countries

During the second half of the twentieth century, there was a gradual shift of geographic focus (southwards and eastwards) in the manufacture and use of motorcycles and three-wheelers. Large-scale production declined in Europe and USA, and expansion began in Japan, India and China. This trend is continuing, although Japanese designs are increasingly made outside of Japan through collaborative ventures in China, India, Pakistan, Vietnam, Indonesia and other countries. Japan has had a small, domestic three-wheeler market since the 1930s. These were mainly used for urban deliveries; some were exported to Thailand and became the basis of the 'tuk-tuk' three-wheeler market for urban public transport.

Since the 1950s, the cost of motorcycles and three-wheelers has declined relative to people's incomes, and the numbers in use have increased rapidly – particularly in the past thirty years. For example, in many African countries, such as Tanzania, the motorcycles available to buy in the 1980s were Japanese, at a cost of more than USD 2,000. Now, Chinese and Indian motorcycles are available for about USD 600, making them much more affordable (Starkey, 2016a). Motorcycles have increased rapidly in numbers and as a proportion of the national fleet in very many countries in Asia, Africa and Latin America. For example, in Tanzania motorcycles comprised about 2% of the national fleet in 2000 but by 2015, they had jumped to 57% of all registered motor vehicles. In India, there are now about 150 million motorcycles, representing about 80% of the motorised vehicles on the roads. In certain countries, including India and Nepal, motorcycles are mainly used for personal transport. However, in many countries, motorcycles are also very important as transport services. Indeed, their rapid growth in sub-Saharan Africa since the beginning of the twenty-first century has largely been fuelled by the expansion of motorcycle taxi services, that allow purchase costs to be paid for from the income gained by motorcycle taxi fares (Starkey, 2016a). Motorcycle taxis have not been a driver of motorcycle adoption in Pakistan. However, there are some motorcycle riders who have been providing transport services, including taking children to school. In 2016, companies using mobile phone apps, including Uber and Careem, were launched to provide motorcycle taxis, autorickshaw taxis and car-based taxis in Lahore and other cities. With these apps, people can opt for 2-, 3- or 4-wheeler taxis when requesting a taxi service.

The use of three-wheelers for transport services started to take off around 1950, when the Indian Bajaj company started to sell three-wheelers using Italian Piaggio scooter components ('scooter-based' three-wheelers had been used in Italy as low-cost freight vehicles). The Bajaj scooter-based three-wheeler had one rear seat to take 2/3 people and started to be used widely as a low-cost, point-to-point urban taxi. They began to replace the bicycle rickshaws and became known as 'auto-rickshaws'. Bajaj also adapted the German Tempo freight three-wheeler to produce a higher power, greater capacity vehicle with two rear seats that could carry six passengers. These were more appropriate for route-based three-wheeler transport services operations. Bajaj soon became the largest manufacture of three-wheelers in the world. By 2018, India was making over one-million three-wheelers a year, of which about one third were exported, including to many African countries (SIAM, 2019a and 2019b). In many Asian countries, three wheelers started to be used as urban transport services, using Bajaj designs, local adaptations and/or local innovations. Examples of Bajaj-type three-wheelers are shown in Figure 6.

Figure 6 Examples of 'Bajaj' type urban three-wheelers in Nepal, Tanzania and Liberia

2.1.3 Diversity of designs and powers sources for three-wheelers

In the Philippines, some side-car-based passenger three-wheelers were developed, following the widespread use of bicycle-based three-wheel taxis. Similarly, some side-car-based three-wheeler transport services were initiated in Timor Leste (see Figure 7).

Figure 7 Examples of side-car public transport three-wheelers in the Philippines and Timor Leste

Several innovative attempts were made to make three-wheelers using motorcycle components. By the 1980s, motorcycle-based flat-bed or pickup-body freight trucks started to be manufactured on a large scale in China, with exports to other Asian countries. This led to a wide variety of derivative designs, using mainly Chinese motorcycle components and rear axles. Examples of local body designs from Lao PDR and Myanmar can be seen in Figure 8 (Starkey and Cartier van Dissel, 2016).

Figure 8 Motorcycle-based three-wheelers in Lao PDR, China and Myanmar

In recent years, China has been promoting the use of electric powered motorcycles, although electric three-wheelers have not spread widely in China, as three-wheelers are not generally permitted as transport services vehicles there. Nevertheless, batteries and electric motors are being exported from China for use in electric three-wheelers. Bangladesh already has large numbers of 'Tom-tom' battery-powered passenger three-wheelers, and smaller numbers are being used in Nepal (see Figure 9). Equivalent vehicles are likely to spread in other countries if such vehicles are seen to have comparative advantages and/or governments intervene through subsidies or prohibition of fossil-fuel three-wheelers.

Figure 9 Examples of electric three-wheelers in Bangladesh, Nepal, China and India

In many low-income cities in Asia and Africa, scooter-based 'auto-rickshaws' or 'Bajajs' provide low-cost taxi services, that tend to be popular with users, but may antagonise car-owners who may see them as badly-behaved and the cause of urban congestion. Some countries have banned them as transport services, including China (Starkey, 2013) and Ghana (Bishop et al, 2018), and many countries have limited their operations, prohibiting them from particular roads or areas. Some cities, including Kathmandu and Monrovia have route-based three-wheelers, usually using higher-capacity vehicles, often with sideward-facing bench seats (see Figure 10).

Figure 10 Route-based three-wheeler public transport in Nepal, Ethiopia and Myanmar

The use of three-wheeler transport services in rural areas is less common, but is spreading in many countries, including Bangladesh, Ethiopia, Ghana (although currently banned), Myanmar, Nepal and Pakistan (see Figure 11). Rural three-wheeler services tend to use motorcycle-based designs, that are able to carry larger loads and cope with rougher roads. although scooter-based three wheelers operate on rural roads in Ethiopia (Metameta, 2017) and Nepal (Starkey, Workman and Hine, 2019).

Figure 11 Examples of rural three-wheelers in Nepal, Bangladesh and Ethiopia (two types)

Three-wheeler public transport is now well established in urban and rural areas in numerous countries in the global south, including Bangladesh, India, Sri Lanka and Nepal. Three-wheelers are used as point-to-point low-cost taxis or route-based public transport services in Africa, Asia, Latin America (Figure 12), the Caribbean and the Pacific. They may be powered by petrol (most common), diesel (declining), compressed natural gas or batteries (increasing).

Figure 12 Examples of three-wheelers in Colombia (two types), Nicaragua and El Salvador

2.2 Overview of three-wheelers in Pakistan

In the 1950s, road public transport in Pakistan included buses and passenger trucks, taxis and a variety of intermediate means of transport powered by humans and animals. Bicycle rickshaws and 'tanga' horse carts were quite widely used to transport people and goods. In both rural and urban areas, carts pulled by donkeys, mules, horses, oxen, buffaloes and camels were also common for transporting freight. Ownership of motorcycles and cars was low, particularly in rural areas.

In the late 1950s and early 1960s, factories were established around Karachi to make auto-rickshaws, initially using components derived from the Italian Piaggio 'Vespa' scooters. During the 1960s, 1970s and 1980s, such scooter-based, auto-rickshaw three-wheelers increased in numbers in Karachi and other large cities in Pakistan. They were used as a faster and more 'modern' means of point-to-point transport than the bicycle rickshaws that were widely used at that time. Factories were established in many cities, and increasingly used locally manufactured components. Initially, the auto-rickshaws had two stroke engines. These were made illegal in the early 2000s, and a subsidised 'green rickshaw scheme' speeded up replacement with 4-stroke engines or compressed natural gas (CNG). Two-stroke motorcycles and rickshaws have not been available for over 15 years, and the use of two-stroke engines appears to have ceased.

In 1994, the Jinan Qingqi Motorcycle Company of China established a joint Chinese-Pakistani venture with Sehgal of Pakistan. Based in Lahore, they started to assemble and manufacture motorcycle-based three-wheelers. Initially the factory used Chinese motorcycle components and locally manufactured superstructures. The bodies had three forward-facing seats behind the driver, and three rear-facing seats behind these. These 6-seater vehicles started to replace the 6-seater, horse-drawn 'tangas' used in the Punjab at this time (Hasan and Raza, 2015). Moving from animal power to a motorised three-wheeler was seen as a positive development that was welcomed by the authorities. At this time, public transport services were poor, and while double-decker buses operated on main roads in Lahore, crowded vans (particularly unpleasant for women) were common as transport services in urban, peri-urban and rural areas. With poor economic conditions and the rapid growth of big cities, there was increasing demand for transport services from rural to urban areas (Haider and Badami, 2004). So, the development of the motorcycle rickshaws as route-based transport services that could cope with the narrow, rough roads proved popular. The fact that they were affordable, open and less crowded than vans, enabled women and men to travel in a timely way, with a greater sense of freedom and security than other public transport options. At that time, there were no official standards for motorcycle rickshaws, and so their evolution responded to market demand.

These motorcycle-based three-wheelers had 'Qingqi' embossed and painted on their sides, to identify the brand. Soon the motorcycle three-wheelers became known in Pakistan as 'Qingqis'. Qingqi is now a commonly-used generic term ('proprietary eponym') for a motorcycle-based three-wheeler. Sometimes people use Qingqi to refer to auto-rickshaws and Plum Qingqi also manufacture small numbers of scooter-type auto-rickshaws that also bear the Qingqi brand name.

In 2005, the Pakistan part of Plum Qingqi was bought out by the Chinese part, so it is now a Chinese-owned company. The success of three-wheelers led to several other formal-sector manufacturers entering the market, including United Motorcycles and Omega Industries (manufacturers of Road Prince motorcycles). The manufacture of three-wheelers in Pakistan was estimated to have doubled between 2008 and 2014, and in 2015 annual production was estimated to be about 70,000 (motorcycle rickshaws and auto-rickshaws) from 12 major companies (Khatana, 2015).

The informal manufacturing sector is also very important in Pakistan, and artisanal motorcycle rickshaws or 'Qingqis' started to be produced in small workshops from motorcycle components, new or recycled axles and locally-made bodies. There are many small retailers of motorcycle rickshaws that supply new motorcycles (commonly United or Road Prince) attached to new bodies manufactured in local workshops. In recognition of this important market, some motorcycle manufacturers sell new motorcycles without back wheels, specifically for those who wish to attach them to a rickshaw body and rear axle.

There is now a diversity of three-wheeler designs in Pakistan, with many different configurations of freight bodies, passenger seating arrangements and propulsion mechanisms. The auto-rickshaw manufacturers have responded to the consumer satisfaction with 'Qingqi-like' configurations by producing six and nine seater auto-rickshaws with rear-facing seats (see Figure 13). The numbers of these bodies that are made and sold are much lower than the conventional 2/3-seater designs, partly because it is difficult to have them registered.

Figure 13 Examples of 6-seater and 9-seater auto-rickshaws with 'Qingqi'-type rear-facing seats

There are also auto-rickshaw loaders with sideways-facing seats that are often used as small school buses (see Figure 14).

Figure 14 Examples of auto-rickshaws with sideways-facing seats often used to carry school children

Similarly, motorcycle rickshaws have different configurations, including versions with sideways-facing seats that are often used to carry school children (see Figure 3). Freight models include flat-beds, pick-ups, cages and enclosed vans (see Figure 4).

Despite the wide diversity of designs, by far the most common three-wheelers in the cities of Punjab Province are the auto-rickshaws with 2/3 forward-facing seats and a parcel shelf behind the driver often carrying three rear-facing passengers.

By far the most common three-wheelers in rural areas (and peri-urban areas) are motorcycle rickshaws with three-forward facing seats and three-rear facing seats. For example, a count of 100 three-wheelers travelling along the main street of the town of PD Khan in June 2019, comprised 96 passenger motorcycle rickshaws and four freight motorcycle rickshaws (3 pickups and one cage). There were no auto-rickshaws counted then, although in other small rural towns perhaps 5-10% of three-wheelers may be auto-rickshaws. In the traffic count surveys, involving 24,000 vehicles, auto-rickshaws represented only 0.5% of rural traffic, while motorcycle rickshaws accounted for 12% of all traffic.

The use of '2/3' in relation to auto-rickshaw seats is because while they are often sold as 3-seaters (and in PSQCA standards and Punjab Department of Transport documents they have been referred to as 3-seaters), in Punjab, they are officially authorised to carry just two passengers. This will be discussed further in relation to the regulatory framework (Section 2.3).

It is difficult to know the precise number of three-wheelers in Pakistan as the national statistics do not make clear distinctions between motorcycles and three-wheelers. The Excise and Taxation department records three categories for registering two- and three-wheel motorised vehicles.

- "Motor Cycles 2 wheels"
- "Motor Cycles / Motor Rickshaws"
- "Others 3 Wheels".

Auto-rickshaws are not specified, but they may be included as 'Others 3 wheels' by some offices, but possibly as 'Motor Rickshaws' by others. More confusingly, the 'Motor Cycles 2 wheels' and 'Motor Cycles / Motor Rickshaws' categories are blurred as many motorcycle rickshaws have been registered as 'Motor Cycles 2 wheels". Pakistan is currently manufacturing almost 2 million motorcycles a year (PAMA, 2019). Some three wheelers are formally registered as motorcycles (which attracts a lower tax). Many of the motorcycle rickshaws made in small workshops may never be registered officially. The growth of motorcycles and three-wheelers, and the lack of one clear three-wheeler category, is shown in Table 1, with further details in Annex 2.

Table 1 Official statistics of registered motorcycles and three-wheelers in Pakistan (2004-14)

Year	Motor Cycles 2 wheels	Motor Cycles/Motor Rickshaws	Others 3 wheels	Total
2004	2,609,442	138,153	848,688	3,596,283
2014	10,341,326	429,319	1,376,369	12,147,014
Increase (%)	296%	211%	62%	238%

Source. Pakistan Bureau of Statistics (PBS), 2016

Based on discussions with officials of the Government of Punjab, the national statistics are problematic due to the lack of clarity in the registration of motorcycle rickshaws and the fact there is no system for recording the scrappage of old motorcycles and motorcycle rickshaws. The lack of 'deregistration' may inflate figures by 40%. According to the Punjab Excise and Taxation department, the 'best estimates' seem to suggest the current figure of 17.5 million motorcycles may represent 13 million machines in use, of which 20% (2.6 million) may be motorcycle rickshaws. In this research, the overall ratio of motorcycles to motorcycle rickshaws on rural roads was 7:1. On a road between two market towns, it was 3:1, and in the main street of a market town it was 5.5:1. These figures suggest the 20% estimate may not be far from reality. However, it could be an over-estimate, considering the large numbers of motorcycles in use in urban areas where there are few motorcycle rickshaws. So, the 'guestimate' of the current researchers is that perhaps 15% of the motorcycle fleet could be motorcycle rickshaws, giving a national total of about two million, of which about one million are used in Punjab Province.

The proportion of motorcycle rickshaws made by the formal sector is not clear. Many motorcycle rickshaws that display clearly embossed names such as Qingqi, United and Suzuki have actually been manufactured by small, informal-sector workshops. From observations during the surveys, combined with discussions with formal sector manufacturers and government officials suggest that perhaps half of all motorcycle rickshaws in use have bodies manufactured by small-scale workshops.

2.3 Current legal and regulatory framework for three-wheelers in Pakistan

2.3.1 Transport ordinances and rules

The current and historic regulatory and legal frameworks relating to the manufacture, registration and use of three-wheelers are complex and remain unclear to many of the stakeholders involved. This is partly due to the many different organisations involved (including several national institutions, the various provincial authorities and some municipalities with their own bylaws). There are also some contradictions between the various legislative orders, and the current practices of the various stakeholders. The regulatory framework has also to be seen in the context of the prevailing societal norms (as will be discussed in Section 2.4).

The main traffic regulations and rules in Punjab Province are determined by two key documents dating back to the 1960s.

- The Provincial Motor Vehicles Ordinances 1965 (PMVO, 1965). This has been regularly updated (Arif, 2018).
- The Motor Vehicles Rules, 1969 (MVR, 1969).

The Provincial Motor Vehicle Ordinances barely mention rickshaws or three-wheelers. The Motor Vehicle Rules does mention Rickshaw Cabs (auto-rickshaws) as public transport vehicles allowed to carry a maximum of two passengers and the driver. These must display 'Taxi' on their front and back screens. The document also mentions motorcycle rickshaws being authorised as private vehicles, able to carry a driver and two people, with 'Private' clearly on the front and back (MRV, 1969).

Since motorcycle rickshaws were first manufactured in significant numbers in the 1990s, they have been used mainly as public transport vehicles. This appeared to have been technically illegal, and over the years they were banned in some cities, notably Karachi. However, their banning was not popular with their regular users, or the operators themselves, and legal challenges were mounted. A judgement of the Supreme court ruled that motorcycle rickshaws (referred to in that document as 'Qingqi Rickshaws') were a legal form of transport provided they met certain conditions. These conditions were primarily the responsibility of the Provincial Authorities (Supreme Court, 2015):

- "Qingqi Rickshaws should be manufactured by duly registered and authorised constructors and manufacturers, according to the legally approved design, specifications and standards ensuring safety and convenience of not only the driver but also of its passengers;
- Qingqi Rickshaws shall obtain a certificate of fitness and a certificate of road worthiness from the concerned authorities
- Qingqi Rickshaws shall be duly registered with the relevant Excise and Taxation Department and their registration number shall be displayed
- Qingqi Rickshaws shall display the approved charges/fares for specified routes
- Qingqi Rickshaws shall have a seating capacity not to be more than four passengers excluding the driver
- Qingqi Rickshaw drivers shall have a valid driving licence while driving Qingqi Rickshaws
- Provinces shall ensure that the above conditions are fulfilled in every respect. Any of the Qingqi Rickshaws found to be plying on roads without fulfilling the above conditions, the officials of the relevant Departments shall be proceeded against not only departmentally but also on criminal side."

This judgment itself does not count as legislation, but it provides guidance to the Provinces to enact appropriate legislation and enforcement. The judgement was influenced by the evidence provided by a committee of Provincial Officials and some influential stakeholders including some from the formal manufacturing sector. It is likely that a standards document approved by the Punjab Transport Department in 2009 (PTD, 2009) may have been the basis for the standards set by the Supreme Court. There appears to be no record of why the maximum passengers were limited to four, as the vehicles invariably have bench seats and appear suitable for the current norm of six passengers. However, this was in keeping with the regulations from the 1960s (widely ignored) that auto-rickshaws should only carry two passengers on their bench seats.

2.3.2 Pakistan Standards and Quality Control Authority (PSQCA)

The organisation responsible for the three-wheeler standards is Pakistan Standards and Quality Control Authority (PSQCA). They are also responsible for inspecting three-wheeler manufacturers twice a year to ensure they are complying with the standards. There are seven authorised manufacturers (N.S. Auto Industries, United Auto Industries, Plum Qingqi Motors, D.S. Motors, Omega Industries, Pak Hero Industries, Toyo International Motorcycle). Other formal sector manufacturers and workshops are not authorised to make motorcycle three-wheelers. Factories are inspected for general technical and health and safety compliance by the Engineering Development Board (EDB).

PSQCA publishes standards for three-wheelers: PS4708. These were first developed in 2001, with revisions in 2005, 2008, 2009 and 2018 (PSQCA, 2018). The PSQCA Technical Committee for PS4708 comprises 23 formal sector manufacturers of motorcycles, three wheelers and cars. The PS4708 illustrates five types of

auto-rickshaws (see Figure 15) and the three passenger types are described as having two passenger seats (L5e-A), four passenger seats (L5e-B) and nine passenger seats (L5e-C).

Figure 15 Authorised auto-rickshaw models according to PSQCA

Source: PSQCA, 2018

There are no comparable illustrations of motorcycle rickshaws. The specifications for motorcycle rickshaws are not entirely clear. For example, in the same document, Table 6 (on page 67) refers to a 4+1 seater rickshaw (four passengers) while another Table 6 (page 23) refers to 6-seater rickshaws (PSQCA, 2018). In addition, Table 1 (page 63 of PSQCA, 2018) says a reverse gear is optional on a motorcycle rickshaw while another Table 1 of the same document (page 18 of PSQCA, 2018) has this sentence crossed out.

The recent requirements for motorcycle rickshaws to have front and rear safety gates, driver windscreens and handbrakes do not seem to feature clearly in the PS4708-2018 Standards (although Table 1 on page 63 says all categories of three-wheeler should have a parking brake). However, these specifications have been required in Punjab Province since 2009 (PTB, 2009).

2.3.3 Provincial authorities

The Provincial Authorities are responsible for enacting regulations relating to three wheelers and registering vehicles. This involves mainly the Provincial Transport Authorities and the Provincial Excise and Taxation Authorities. Again, there appears to be some confusion or lack of clarity, with different Provinces having different regulations and different enforcement policies. In July 2019, the Punjab authorities were not recognising any motorcycle three-wheelers for registration. Even legally-produced vehicles from authorised factories could not be registered. However, at the same time, Sindh Province (capital, Karachi) was registering both passenger and freight motorcycle rickshaws. In the same month, the Khyber and Pakhtunkhwa Province published an advertisement in Daily Pakistan saying that all motorcycle rickshaws must be registered under PSQCA and EDB standards or face strict action.

Technically, the Transport Department Punjab has the authority to 'approve' motorcycle rickshaws based on the inputs it received from its Technical Committee. The Committee inspect/examine the vehicles applying for approval of the Transport Department according to the Provincial Motor Vehicle Ordinance 1965, and Motor Vehicle Rules (MVR) 1969 and subsequent amendments (PMVA, 1965; MVR, 1969). In 2009, the committee established the technical specifications for 4-stroke engine (petrol or CNG) auto-rickshaws and motorcycle rickshaws (PTD, 2009). It is likely that these specifications were the basis of the Supreme Court judgement of 2015 (Supreme Court, 2015). The current Committee, constituted in June 2017, comprises nine members: four from Punjab Transport Department (Chief Transport Planner, Section Officer, Transportation Engineer and Senior Motor Vehicle Examiner), three university engineers (electrical and mechanical) from the University of Engineering and Technology, Deputy Director of Punjab Environmental Protection Agency and Deputy General manager from Lahore Transport Company. In 2018, this Committee produced technical specifications for loader-rickshaws (auto-rickshaw and motorcycle rickshaws). This included the requirement for a propeller shaft and reverse gear (PTD, 2018). Only the top range of factory-supplied motorcycle rickshaws (all largely assembled from Chinese components) have such propulsion systems.

In the past few years, the Punjab province has been authorising the registration of auto-rickshaws and loader auto-rickshaws, and allowing motorcycle rickshaws to be registered as motorcycles. This has been financially and logistically beneficial for motorcycle rickshaws as motorcycles only pay a taxation cost ('token') once and annual tests are not required. However, for the past few months the Punjab Transport

Department has stopped authorising any three wheelers. There were some temporary exemptions for top end loader motorcycle rickshaws (ones with reverse gears and a handbrake and mainly imported from China). The lack of registration of new vehicles is a source of great frustration for the formal sector manufacturers, whose sales have been affected, as have their import quotas. The informal sector carries on as before. The auto-rickshaw market has responded in an interesting way, with high prices now paid for second hand, already-registered auto-rickshaws that can be used in Lahore without being stopped as they already clearly display their licence plates.

Punjab Transport Authority suggests its current 'inability' to authorise any rickshaw registrations is because it has failed to update the old legislation. Such an update has been under consideration for over a year. Sindh Province has successfully updated its legislation, and so auto-rickshaws and motorcycle rickshaws can be registered in Sindh. With the procedure to legislate having apparently stalled for several months, conspiracy theories are circulating. One conspiracy theory was that the formal sector rickshaw manufacturers are trying to influence the authorities to clamp down on informally-made motorcycle rickshaws. Now that the formal-sector rickshaw manufacturers are suffering, a second theory was that the manufacturers of pickups and small cars are trying to remove all rickshaws to allow their markets to grow. While in both scenarios, the competing vested interests would certainly benefit from clamp downs, the Punjab authorities say such conspiracy theories are 'fake news'. There is no evidence that such conspiracies are occurring in Punjab Province.

2.3.4 Excise and Taxation

In Punjab Province, private vehicles are registered with the Punjab Excise and Taxation (E&T) Department under Chapter 3 of the Provincial Motor Vehicles Ordinance (MVO, 1965 and relevant updates). Public Service Vehicles (PSVs) are registered with Punjab Transport Department (PTD) under Chapter 4 of the Provincial Motor Vehicles Ordinance (MVO, 1965 and relevant updates).

Motorcycle rickshaws manufactured by the seven formal sector factories, have to obtain fitness certificates from the PTD. In the recent past, they could then be registered with E&T as motorcycle rickshaws. Recently, this process has been halted. Registered, authorised motorcycle rickshaws are required to have annual tests and fitness certificates and pay an annual token tax of PKR 700.

Motorcycle rickshaws manufactured by the informal sector are not considered as legal Public Service Vehicles, and so these are registered by E&T as motorcycles. Motorcycles have to pay a registration fee of 1% of the vehicle and a one-off token payment of PKR 1700. They do not have to have annual tests or pay annual tokens. As only the motorcycle is registered, the 'number' of the motorcycle rickshaw body is the same as that of the motorcycle. It may be noted that registering motorcycle rickshaws as motorcycles is beneficial to operators, as procedures are much simpler, and costs are lower. This simpler and cheaper procedure may have been encouraging the growth of the informal sector manufacturers.

Since 2016, the fitness certificates for vehicles in Punjab province have increasingly been issued by the Vehicle Inspection and Certification System (VICS), run by the private-sector Opus as a public-private partnership.

All manufacturing enterprises have to be registered with E&T for taxation purposes. Until recently, only the formal sector has been actively tracked to ensure fiscal compliance. In recent months, there has been a crackdown, with informal sector manufacturers being targeted and brought into the tax system.

2.3.5 National Transport Policy

National Transport Policy of Pakistan 2018 (Pakistan, 2018a) is still in a draft form, awaiting formal confirmation. The policy is optimistic with a vision of providing 'safe, affordable, efficient, durable and environmentally friendly means of transport, ensuring reliable access to jobs, markets, education and other services for all'. It stresses the importance of non-motorised means of transport and public transport services. It states 'rural roads will remain vital for providing accessibility to local communities and public services. Focus will be placed on provision of rural transport services, in addition to providing all-weather road infrastructure'. The emphasis on affordable and inclusive transport services will be very relevant when considering motorcycle rickshaws and alternative means of rural transport.

2.3.6 National Road Safety Strategy

The National Road Safety Strategy (Pakistan, 2018b) is an important document, which includes many photos of overloaded vehicles, of various types (but not rickshaws). Rickshaws are seldom mentioned, with more attention given to general road behaviour, speeds, car designs, crash helmets and the use of seat belts. It is noted that many road users have low awareness of risk, little regard for safety and frequently break road rules. It is acknowledged that motorcycles are particularly risky and are involved in 64% of crashes on the provincial road network (compared to 12% for rickshaws). It notes that numbers of vehicles in Pakistan are predicted to rise to 65 million in 2025 (more than three times the existing figures), with most of these being motorcycles. One long-term strategy is to provide incentives to move from small, vulnerable vehicles (motorcycles and rickshaws) to larger, mass-transit vehicles, although there are no details of how this might occur. Interestingly, the strategy provides a 2030 target of close to 100% of helmet use by motorcycle riders using national highways or on roads within large cities. This suggests a realistic, phased increase in enforcement, with a lower priority for rural areas (Pakistan, 2018b).

2.4 Prevailing norms in Pakistan relevant to this research

2.4.1 Driving behaviour

One of the criticisms of motorcycle rickshaws is that their drivers often behave badly. In discussions with the project team, certain informants (mainly urban-based professionals) cited speeding, overloading, erratic, unpredictable behaviour, driving on the wrong side of the road, using a mobile phone while driving and stopping in places where the flow of traffic is obstructed. Such claims are also made in newspaper articles and in some of the literature (Schmidt, 2016). No one would doubt that these faults can be observed in motorcycle rickshaws and that motorcycle rickshaw drivers would benefit from some good instruction in safety and empathetic driver behaviour: but so would most other vehicle drivers in Pakistan (Batool, 2012).

The bad driving practices used to criticise rickshaw drivers (whether auto-rickshaws or motorcycle rickshaws) can be seen right across the spectrum of motor vehicles in urban and rural Pakistan. From the observations of the team, it could be argued that the worst culprits are motorcycle drivers. This is partly due to the great manoeuvrability of motorcycles, which drivers exploit by changing trajectories frequently and even travelling against traffic flows in order to reach their required destinations quickly. Motorcycle drivers regularly overload, speed unnecessarily and often use mobile phones while driving.

Drivers of private cars, minivans, minibuses, buses and trucks can also be seen driving aggressively, at speed, ignoring on-coming vehicles, using mobile phones and overloading their vehicles. Their larger size and heavier weight provide real dangers to other vehicles on the road, particularly when combined with speed. Minibuses and buses also regularly stop where they obstruct traffic flows (often double parking at key places) and many private vehicles also stop in non-authorised places to enable easy access to shops and other premises.

Therefore, by societal norms, the drivers of motorcycle rickshaws do not seem to be exceptional. Clearly, there is an important need for widespread road safety education and training in Pakistan. Education in empathetic driving behaviour and road safety needs to be addressed across all vehicle types. Concentrating on improving education for just one type of driver (such as three-wheeler drivers) may be discriminatory, as it may stigmatise these drivers, when the problem is much wider, across all driving groups. In any case, it might not have major impacts as long as other drivers continue to drive their vehicles dangerously, and as long as societal norms do not disparage this poor driving.

2.4.2 Illegal operations

It has been reported that many motorcycle rickshaw and auto-rickshaw drivers are underage (Hisam, 2006; Tahir et al., 2018). This was not found to be the case in this research, as only 2% of motorcycle rickshaw operators were under 20 years. Visual observations suggest it is more common for motorcycle drivers to be underage than rickshaw drivers, and in the survey of 150 motorcycle users, 9% were under 20 years.

However, it is certainly true that many rickshaw drivers do not conform to the various requirements relating to driver's licences, insurance, vehicle testing and vehicle licensing. This is also true for motorcycles and other vehicles, although enforcement is generally stronger for vehicles with four wheels or more. Currently in Punjab, motorcycle rickshaws cannot be registered, so registration is not even an option. Part of the reason for 'illegal' operations, is that the various regulations can be confusing. For example, in Punjab, motorcycle rickshaws can be legally registered as motorcycles rather than motorcycle rickshaws, so they do not require annual tests. There is little public service information to help and educate people, and enforcement has generally been weak or non-existent, particularly in rural areas.

Informal sector workshops making motorcycle rickshaw bodies have been described as illegal: but they may not be aware of this. While ignorance of the law is not considered a valid defence, governments and authorities have a duty to inform the population of relevant regulations and to enforce these consistently. This should lead to good compliance over time.

While there are clearly compliance issues in the three-wheeler sector, this has to be seen in the light of societal norms relating to compliance. The issues of illegality, compliance and enforcement in Pakistan are complex, and many citizens do not understand all the regulations and/or feel the need to comply. This applies to stakeholders in the transport sector, as well as many people in other sectors. In meetings held with transport sector officials and private enterprises, the general impression was given that it was widely accepted that compliance with regulations was seldom a priority for individuals, enterprises or even enforcers. By such standards, the non-compliance in the motorcycle rickshaw sector is not exceptional and therefore may not be a priority issue.

2.4.3 Enforcement, un-enforcement and '*bhatta*'

Enforcement agencies for the motorcycle rickshaw sector include the traffic police that can enforce compliance with licensing and various traffic regulations (loading levels, speed, vehicle fitness, etc). One of the most visible examples of enforcement (or un-enforcement) by traffic police is the use of crash helmets for motorcycle drivers and passengers. While issues of licensing, vehicle fitness and speeding cannot be easily detected by the general public, whether or not motorcycle drivers and passengers are wearing helmets is apparent to all. So is the number of passengers travelling on motorcycles. Since the 1960s, it has been a legal requirement that motorcycle drivers and motorcycle passengers wear crash helmets, and that only one passenger may be carried on a motorcycle (Regulations 89 and 89A; Arif, 2018). The enforcement (or un-enforcement) of these regulations is clear to see. In Islamabad, and central roads in major cities, there is about 80% compliance with driver's crash helmets and only two passengers during working hours, but almost no compliance with passenger crash helmets. Compliance changes in the evenings in central Lahore and other cities, when whole families can be seen on motorcycles without crash helmets. In the suburbs and outskirts of the cities, compliance drops markedly, as it does in rural areas. During the project's traffic count surveys, over 11,000 motorcycles were recorded. The use of crash helmets was just 12% for motorcycle drivers. Very few passengers were seen wearing crash helmets. Of the 11,000 motorcycles counted, 45% carried more than two passengers (in addition to the driver). In the surveys of motorcycle owners, the self-reported 'always' use of crash helmets by drivers was 22%, and their use by women and children was extremely low (zero percent of the case of Lodhran and PD Khan).

The prevailing ethos or societal norm seems to be that there is little need to comply with such road regulations unless these are being enforced, as they are, to a certain extent, in specific city areas. From discussions during the surveys, such attitudes also cover the many less-visible issues relating to regulatory compliance and enforcement.

Rural enforcement officials are few, and they are not well-resourced in terms of salaries and equipment (they often work without official vehicles). They are working with, and living among, local populations that do not necessarily know the traffic rules, and do not regard compliance with regulations as important. The drivers of cars in rural areas are often high-status, well-connected people, while the operators of large buses and trucks may be part of strong and powerful associations that defend the interests of their members. On the other hand, the operators of three-wheelers are not powerful and most have numerous issues of non-compliance.

In Pakistan, '*bhatta*' demands and payments are ingrained in many sections of society. Some are one-off payments (bribes) to officers to avoid an official fine. For example, in the survey of motorcyclists, 22% reported being stopped by police, and paying about PKR 150 in '*bhatta*' to avoid receiving a penalty. Some payments may seem 'institutionalised' as flat-rate additional payments (without receipts) for specific services, such as obtaining certain official documents, including vehicle test certificates. Some are 'institutionalised' as monthly payments to ensure that transport operators are not regularly stopped and checked for compliance. For example, a focus group of operators in one of the research sites said they each had to pay PKR 500 a month to a local enforcement officer. If this was paid, drivers could operate without being harassed. If payments were not made, the individuals were visited with threats of confiscation of vehicles (full details are not reported here due to sensitivity of the subject and the potential repercussions for those concerned). Such societal norms are widespread, and many people in positions of some authority (including official inspectors) may abuse their positions to increase their own incomes.

For enforcement officials, there are very few advantages to themselves when people comply with regulations. There are a few exceptions, such as when traffic wardens are incentivised to issue fines for parking or traffic offences. However, it is generally in the interest of enforcement officials that people do **not** comply with regulations, as their non-compliance will make these people vulnerable to '*bhatta*' demands.

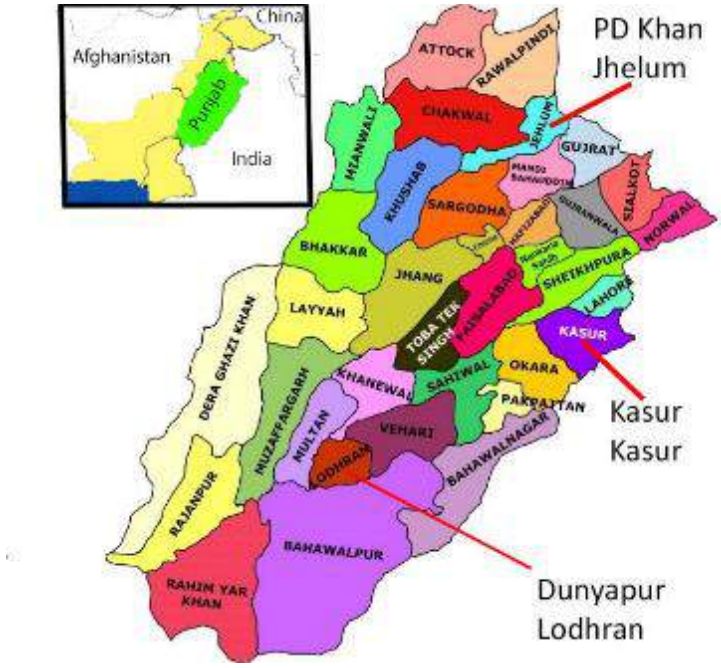
In much of Pakistan there is the 'perfect storm' of circumstances that favour non-compliance, with a combination of transport operators (and other citizens) feeling that compliance is only necessary where there is enforcement, and the enforcers feeling that compliance is actually undesirable as it provides no benefits to them.

3 Survey results: current situation in rural Punjab

3.1 Rural survey sites in Punjab Province

Three districts had been selected for the surveys. These provided a geographical spread with districts in north, east-central and southern Punjab. Their locations are illustrated in Figure 16.

Figure 16 Map of Punjab Province showing districts and the three districts selected for village surveys



Source: Politicpk (2019)

Within each of the districts, villages had been selected that appeared relatively representative of the local rural area. These were not on major highways and were not very close to large cities. They were connected by low-volume rural roads to nearby market towns, which were likely to act as small transport hubs for rural transport services. The villages selected are shown in Table 2.

Table 2 Villages selected for research studies

Division	District	Tehsil (SubDistrict)	Villages (Chaks)
Rawlpindi	Jhelum	PD Khan / UC# 06	Sodi Gujjaran
Lahore	Kasur	Kasur	Satu Ki
Multan	Lodhran	Dunyapur	384WB, 377WB

The various survey instruments used in this research were presented in full in the project's Progress Report (Starkey et al, 2019c), and are only summarised here.

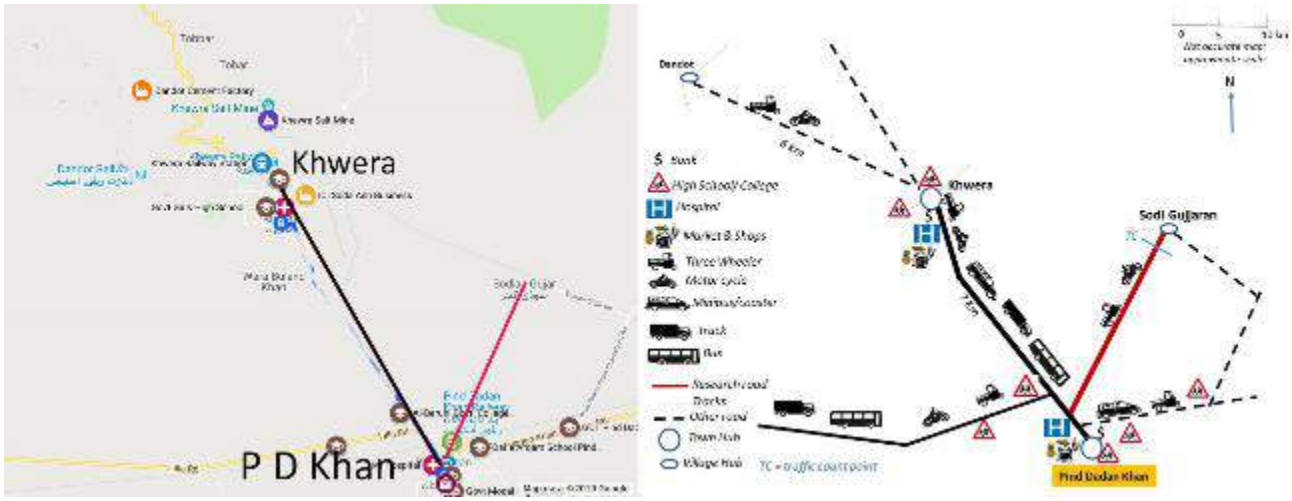
The surveys conducted in the villages included traffic counts which were undertaken in the second half of April 2019. These were 12-hour classified traffic counts (6 am to 6 pm) carried out over two days, recording all vehicle and pedestrian movements in each direction. The sites for traffic counts were selected according to the layout of the roads, with additional counts being made where there were several access roads to the village. The approximate locations of the traffic count points are provided in Figure 17, Figure 20 and Figure 22. In addition to the counts on low-volume rural roads, an extra two-day count was undertaken in Lodhran on a road connecting two market towns. This was not a major national highway, but was a small but busy inter-urban road with some village-to-market-town traffic. This was surveyed to allow some comparisons of the traffic mixes, and the relative importance of motorcycle rickshaws on such roads.

The user surveys provided information on people's travel patterns and their preferences. There were approximately 300 forms administered (100 per road). There was purposive sampling to ensure the surveys included women (approximately half of all users), students, older persons, people commuting and those with disabilities. As far as practicable, all transport services operators providing regular services along the village roads were surveyed to obtain data on their operations, costs, organisation and key issues. Surveys were undertaken to evaluate the mix of three-wheelers operating in the survey areas (including passenger and loader varieties of auto-rickshaws and motorcycle rickshaws). Fifty motorcycle owners living in the rural transport catchment areas being studied were also surveyed, because motorcycles have been increasing rapidly in the villages. They are seen to be an important alternative to motorcycle rickshaws, although, being used mainly by men, they present some gender issues for rural transport.

3.2 Survey findings in Jhelum

Pind Dadan Khan (UC #06), known as PD Khan, is a small but busy market town situated in Jehlum District in Rawalpindi Division in northern Punjab, and has a population of 35,000. It acts as a small hub for about 40-50 villages, up to 25 km away. Villagers come to PD Khan for schools, a clinic, shops and for ongoing bus transport to cities on the main road. There are long-distance bus services to Jehlum and Rawlpindi. The main means of rural transport are private motorcycles, motorcycle rickshaws and pickups. The area is considered relatively poor and culturally conservative. This can cause women problems as they tend to be very dependent on their male relatives who own motorcycles for their transport needs. The nearby environment is saline (there are important salt mines and chemical plants in the vicinity), but there is also some small-scale agriculture around Sodi Gujjaran. However, many of the villagers depend on various local employment opportunities, including those associated with cement and gypsum production. On the small connecting roads, one issue is poor road condition, while on the busy main roads, one concern often mentioned was safety, due to speeding vehicles. An indication of the position of PD Khan and the research area is provided in the maps shown in Figure 17.

Figure 17 Map (left) and schematic diagram (right) of survey site in Jehlum



The survey road is a village-to-market-town road that runs from Sodi Gujjaran to PD Khan (shown as the red line in the right hand map of Figure 17). One interesting feature of this road is that that pickups (with enclosed backs and sidewards seats) run regular transport services throughout the day. Arrangements have been made between the motorcycle rickshaws and pickup operators that share a transport hub at Sodi Gujjaran (see Figure 18). They run to an informal 'timetable' in which vehicles depart in agreed order when they are full, but wait for a maximum of twenty minutes, after which they depart, even if they are not full. The operators have also agreed that there should be three motorcycle rickshaws between each pickup departure, so they are sharing the transport market between them.

Figure 18 Transport hub at Soli Gujjaran with pick-ups and Qingis sharing the transport market

Figure 19 shows the road when one of the traffic counts was underway.

Figure 19 A traffic count on the road from Soli Gujjaran to PD Khan

The key statistics of the traffic counts for the Sodi Gujjaran to PD Khan road are given in Annex 1 and summarised in Table 3. From this it can be seen that most (80%) of the traffic comprised motorcycles, motorcycle rickshaws and passenger-carrying pickups. These carried most of the people travelling along the road (82%). As on all roads surveyed, motorcycles were by far the most common vehicles.

Table 3 Summary of traffic counted on two days on the Sodi Gujjaran to PD Khan road

	Motor cycle	Walk	Bi-cycle	Cart	Pick-up	Carry-van	Car	Truck	Qingqi	Freight Qingqi	Auto-rick shaw	Minibus Midibus Bus	Total
Number vehicles	**1,882**	164	76	39	**96**	47	86	163	**567**	21	-	23	**3,164**
% vehicles	**59**	5	2	1	**3**	1	3	5	**18**	1	0	1	**100**
Number passengers	**4,442**	512	117	57	**1,554**	343	401	307	**3,786**	41	-	425	**11,985**
% passengers	**37**	4	1	0	**13**	3	3	3	**32**	0	0	4	**100**

The pickups and motorcycle rickshaws operate between a waiting hub in the village of Sodi Gujjaran and travel about 8 km to the transport terminal in PD Khan. The transport terminal in PD Khan is close to the market and shops and provides shaded parking for vehicles (pickups, minibuses and motorcycle rickshaws) using many different rural routes. This allows easy transfers for people going to, or coming from, different destinations. The operators would like some terminal facilities in Sodi Gujjaran, as their hub is close to a swamp and has no shade or fresh water.

The pickups and motorcycle rickshaws have an agreement to run to an approximate timetable, meaning the maximum waiting time is 20 minutes even if the number of waiting passengers is low. Departures are more frequent when there are many waiting passengers. There are three motorcycle rickshaw departures followed by a pickup departure throughout the day. The peak times are in the mornings and evenings, with much less traffic during the day. Both vehicle types charge the same basic fare (PKR 25), but motorcycle rickshaws charge more for freight, so those travelling with goods prefer to travel by pickup. Motorcycle rickshaws may charge PKR 15 for 20 kg of freight and PKR 25 for 50 kg of freight (although prices are

negotiable). Pickups may charge PKR 20 for 50 kg of freight. On this route, both motorcycle rickshaws and pickups charge the same passenger fares, which works out at about PKR 3 per kilometre or USD 2 cents a kilometre. This is consistent with other fares for low-volume rural transport services in Pakistan, but low compared to other countries. The motorcycle charges for small freight are high at PKR 50-90 per tonne-kilometre, but this is also in line with freight charges for low-capacity vehicles.

The pickups and motorcycle rickshaws operate services to carry about 500 school children to and from PD Khan. These are based on monthly subscriptions, and individual operators have their own clients. The cost to the parents is about PKR 800 a month. The school services carry large numbers of children per vehicle. All vehicles have a tendency to overload, with pickups often carrying more than 20 passengers, with some passengers travelling on top of the vehicles.

There are about 25 motorcycle rickshaws that pass through Sodi Gujjaran from villages further away, and they may pick up passengers, even though they are not part of the timetable arrangement. A coaster bus passes through the village, carrying workers to a cement works, but this is not a public transport service.

There are also rent-a-cars and carry vans operating on the route, offering point-to-point taxi services. They are less crowded and more expensive and tend to be used by professionals and more affluent people for carrying school children, commuting and shopping trips.

Twenty-five motorcycle rickshaw operators and four pickups share this route. The operators can only be sure of two full return trips per day, as there are more vehicles than required for the transport demand. The operators cannot ask anyone to leave the market, as everyone needs a job. The operators think the market is declining due to increased use of motorcycles, but for the moment, motorcycle rickshaws are indispensable.

3.3 Survey findings in Kasur

Satu Ki is a village in Kasur District, situated 20 km away from Kasur city in central-east Punjab. It is connected to three small towns: Mustafa Abad, 12 km to the east; Rao Khanwala, 6 km to the south; Raiwind, 12 km to the west. This is illustrated in Figure 20. It has a total population of 11,000, with about 2,000 hectares of good agricultural land. There is an elementary school in the village but high school children have to travel to the nearby towns (about 10-12 km), with some boys using bicycles and girls tending to use motorcycle rickshaws and pickups. There is said to be a high dropout rate for girls in the high schools. This is thought to be associated with poor transport services, as male relatives may not be available to take girls to and from school on their motorcycles. While girls generally want good secondary and higher education, lack of available transport makes some of them drop out. Boys generally do not face the same problem as they can more easily walk, cycle or take public transport independently. As the village is relatively close to Lahore, some people commute by motorcycle or by an early morning midibus (coaster). Minibuses and midibuses are not generally available in the daytime. There are some pickups, but most people who do not own transport depend on motorcycle rickshaws.

Satu Ki has three access roads to the three local towns, and also two other roads to the west that pass through the village of Mir Mohammed and are also used by people in that catchment area. Traffic counts were recorded on all five of these roads in order to obtain a clear understanding of the various transport patterns and the mix of vehicles. The approximate traffic count locations are shown in Figure 20. Figure 21 shows one of the traffic counts sites.

Figure 20 Map (left) and schematic diagram (right) of survey site in Kasur

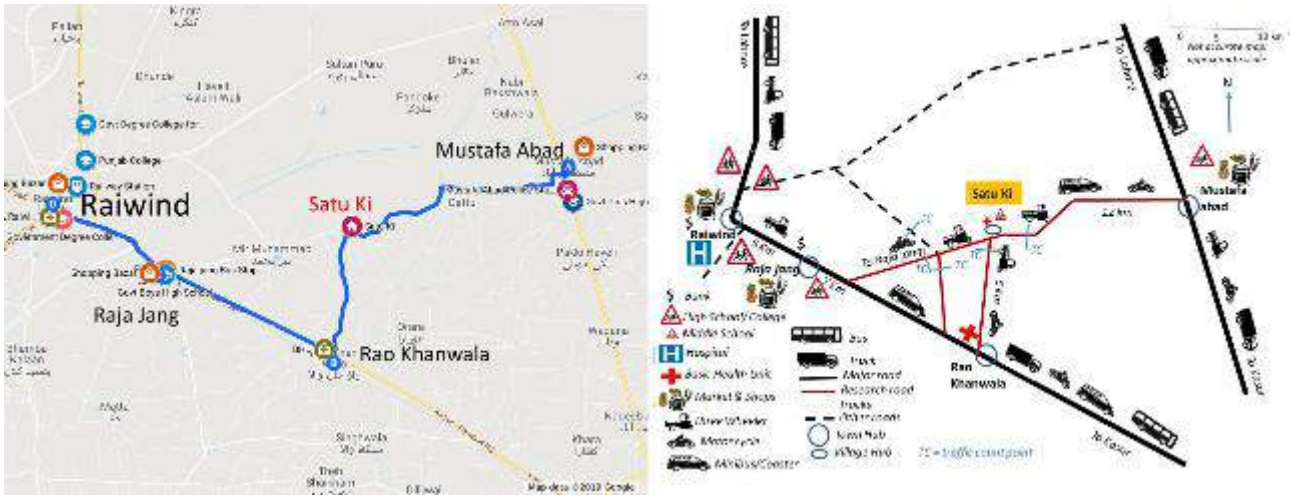


Figure 21 One of the traffic count sites by Satu Ki

The five access roads linking Satu Ki and the neighbouring village of Mir Mohammed to the neighbouring towns were all surveyed over two days. The key statistics of the various traffic counts are given in Annex 1 and summarised in Table 4. From this it can be seen that most (69%) of the traffic comprised motorcycles, and these carried 59% of those travelling. Compared with other sites, there were many movements of non-motorised transport: 16% of counts were for pedestrians, bicycles and animal-drawn carts. Three-wheelers (motorcycle rickshaws, auto-rickshaws and loader rickshaws) accounted for 8% of all movements, carrying 14% of all those travelling. Excluding those who travelled on motorcycles, motorcycle rickshaws and auto-rickshaws carried 57% of those travelling in passenger vehicles (including cars, pickups, and midibuses). Cars were the next most important means of transport for passengers, but only accounted for 4% of passenger movements (or 18% of passenger vehicles excluding motorcycles).

Table 4 Overall summary of ten traffic counts (two days each on five roads) on Kasur roads

	Motor cycle	Walk	Bi-cycle	Cart	Pick-up	Carry-van	Car	Truck	Qingqi	Freight Qingqi	Auto-rick shaw	Minibus/ Midibus/ Bus	Total
Number vehicles	8039	992	289	732	144	114	295	226	535	231	87	22	11706
% vehicles	69	8	2	6	1	1	3	2	5	2	1	0	100
Number passengers	14756	2179	366	1118	534	545	943	525	2706	500	358	291	24821
% passengers	59	9	1	5	2	2	4	2	11	2	1	1	100

As in other areas, the large change in recent years has been the growth of motorcycle traffic, and now it is estimated that 80% of households own a motorcycle. Motorcycles are all owned and operated by men. Some men carry family members to school and carry female relatives to work or for other purposes. However, women generally depend on motorcycle rickshaws for shopping visits and travel to medical facilities. Once the two commuter midibuses (known as 'Coasters' after a widely-used Toyota model) have left for Lahore each morning, there are no other public transport services available other than motorcycle rickshaws (and two auto-rickshaws that are part of the motorcycle rickshaw queuing arrangements at Satu Ki). There are rent-a-cars and carry-vans available for point-to-point taxi services, but these are much more expensive than the rickshaws and are only used by the more affluent members of the community. Some auto-rickshaws based at Mustafa Abad and the nearby village of Daftu, also provide point-to-point taxi services along Mustafa Abad to Satu Ki road.

Motorcycle rickshaws are important for carrying children to school, and individual operators have their own clients they serve. Pickups with sideways facing seats are also important for the school runs. One transport entrepreneur based in Satu Ki has obtained several old vehicles (including a pickup and minibus) that are used exclusively to carry children to school on monthly contracts. Increasingly, children are carried on motorcycles, and the more affluent parents use carry vans. Female students generally prefer enclosed pickup 'school vans' to the motorcycle rickshaws that are exposed and considered less safe. The poor road infrastructure, with numerous potholes, makes motorcycle rickshaws relatively uncomfortable.

Most traffic movements are in the morning and evening 'rush hours', with few people travelling after these times. The motorcycle rickshaws wait at hubs in Satu Ki and Mir Mohammed, and depart in turn, once they have six passengers. People needing to travel, but without the resources to charter a vehicle, have to wait for long periods (perhaps two hours around midday). This discourages travelling. Operators would prefer to operate on a more regular timetable, and passengers say they would be willing to pay more for a regular service. However, the operators are worried that they will not find enough passengers to pay for the fuel they expend. As with other locations, the operators know there are too many motorcycle rickshaws for the transport demand, but they do not feel they can alter the situation.

The auto-rickshaw operators that work with the motorcycle rickshaws say that people (notably women) prefer their vehicles, but unless they are hired for point-to-point assignments, they join the queue and so customer preferences do not help them. They have higher operating costs than motorcycle rickshaws, but feel they have insufficient other work opportunities, and so join in with the motorcycle rickshaw operators.

Fares for motorcycle rickshaws from Satu Ki are around PKR 15-40, depending on the destination, and at PKR 3 per kilometre are in line with other fares for low-volume public transport in Pakistan. Small amounts of accompanied freight (up to 20 kg) are seldom charged by the motorcycle rickshaws. Larger quantities (e.g. 50 kg) cost PKR 50-80 per tonne-kilometre, which is expensive but not unreasonable (and in line with other locations). Both freight and passenger rickshaws are widely hired to carry new purchases (such as a refrigerator) from local towns to Satu Ki.

3.4 Survey findings in Lodhran

The survey site in Tehsil Dunyapur, Lodhran District in the Multan Division in southern Punjab was established as an irrigated settlement area in 1929, with most settlers coming from Khushab (300 km away). The whole area comprises a grid of access roads and tracks, with the rural roads (all narrow but paved) zig-zagging through the area with numerous right-angle bends (not shown on the diagrammatic map). The villages are known as Chaks and most are still identified by the numbers they were given during the settlement scheme.

The selected study road starts at Chak 377 WB and passes through Chak 384 WB and on to a national highway (N5) which, on this section, runs from Lodhran (46 km south) to Multan (35 km north). Two kilometres along the highway from the road junction is the busy market town of Basti Malook (20,000 people). Basti Malook is not only on the national highway, but it is also at a crossroads with quite busy roads to Dunya Pur (to the east) and Shujaabad (to the west). Besides its market and shops, Basti Malook has numerous workshops for the servicing of motorcycles and motorcycle rickshaws. The location of the small villages of Chak 377 and 384 and their context is shown in Figure 22.

Figure 22 Map (left) and schematic diagram (right) of survey site in Lodhran

The rural road section from Chak 377 to the main road is about 10 km, with quite busy rural traffic, mainly motorcycles, motorcycle rickshaws and animal-drawn carts. The motorcycle rickshaws have a small transport hub at Chak 377 (see Figure 23), and generally travel to Basti Malook via Chak 384 as this is a good paved road with transport demand along it. However, with the grid pattern of tracks and roads, there are a vast number of possible route permutations that can be taken. As several people in the villages have jobs in Multan, and many have relatives in Khushab, there is one daily early morning bus to Multan and on to Khushab, with a daily service in the other direction that arrives in the late afternoon.

Figure 23 Transport hub at Chak 377 and traffic around Chak 384 on the road towards Basti Malook

Chak 384 has a population of 2,600 and about 800 ha of agricultural land. Agricultural yields, including wheat and cotton are good, and this seems to be reflected in a relatively high ownership of motorcycles in this and the surrounding villages. The local motorcycle rickshaw operators reported that their transport market has been declining for several years due to expansion in the numbers of motorcycles. While animal-drawn carts are still common (pulled by a single ox, buffalo, donkey, mule, horse or camel), there has also been an increase in privately-owned 'loader' motorcycle rickshaws to assist with farm transport, local businesses and family errands.

Chak 377 has a primary school for boys and a high school for girls and Chak 384 has a high school for boys and an elementary school for girls. From initial discussions, it appears the educational drop-out rate is low, including for girls. There is one basic health unit (medical dispensary) in Chak 384 which is not functional. For medical attention, people tend to travel to private clinics in Basti Malook or to hospitals in Multan or Lodhran.

The traffic count locations are illustrated in Figure 22. Table 5 shows the summary of the traffic count findings on the road between Chak 377 to Basti Malook. Further details are provided in Annex 1. As with other sites, most (60%) vehicles were motorcycles accounting for 47% of people travelling. Motorcycle rickshaws (passenger and freight) accounted for 10% of movements and 15% of people travelling. Motorcycle rickshaws accounted for 35% of passenger vehicles (excluding motorcycles) with similar volumes of passengers travelling in carry vans (33%) and cars (27%).

Table 5 Summary of traffic counted on two days on the Chak 377 to Basti Malook road

	Motor cycle	Walk	Bi-cycle	Cart	Pick-up	Carry-van	Car	Truck	Qingqi	Freight Qingqi	Auto-rick shaw	Minibus/ Midibus/ Bus	Total
Number vehicles	1,385	117	132	68	33	82	149	123	106	105	9	4	2,313
% vehicles	60	5	6	3	1	4	6	5	5	5	0	0	100
Number passengers	2,909	445	196	119	61	679	556	324	721	183	37	12	**6,242**
% passengers	47	7	3	2	1	11	9	5	12	3	1	0	100

Most of the issues on the road from Chak 377 to Basti Malook are very similar to the other research areas. Motorcycles are increasingly important, and regarded as high-status for men who cannot afford a car. The motorcycles are driven my men, who sometimes carry female relatives and children. Most motorcycle owners have jobs in Multan or other places away from the villages. When they obtain motorcycles (increasingly affordable with instalment payments), they seldom themselves travel in motorcycle rickshaws. Some motorcyclists ride to Basti Malook and leave their motorcycles in a safe place, while they take public transport (mini-buses or Coaster midibuses) to Multan.

Carry-vans are important for the more affluent families, being used to carry school children and people commuting. Many women depend on the motorcycle rickshaws, but complain about the long waits for a full load outside peak periods. Most women interviewed would be willing to pay a little extra for a less-crowded service (the operators frequently carry nine passengers). The tariffs charged by motorcycle rickshaws for passenger fares and the carriage of 50 kg of freight are similar to those charged on the other roads surveyed. The daily long-distance buses to Khusab are widely used from time to time to visit relatives (85% of residents have relatives there). The long distance fares (PKR 400 to Khusab) work out at about PKR 1.6 per passenger-kilometre which is typical of long-distance buses and cheaper than the low-capacity motorcycle rickshaws. The freight costs on the large buses work out at about PKR 8 per tonne-kilometre, which is almost 10% of that charged by the motorcycle rickshaws, but both are in line with comparable types of transport in other countries.

While there is an obvious hub (stand) with tree-shade at Chak 377, there is no specific terminal at Basti Malook, so motorcycle rickshaws wait for passengers on a service road, outside specific shops. The operators are depressed about their future prospects that they feel is being eroded by motorcycles. People are even replacing animal-drawn carts with loader motorcycle rickshaws, and then use these to carry their families (and give lifts to their friends), so further reducing the passenger market. Of the low-volume roads surveyed, this road had by far the highest proportion of loader rickshaws.

In addition to the traffic counts on the survey road (Chak 377 to Basti Malook) and two extra traffic counts were undertaken on the road between Basti Malook and Dunyur Pur. This a small but busy inter-urban road between two market towns. It is not a major inter-city highway, but it is an inter-urban road, with much more traffic than all the other low-volume rural roads surveyed. While some of the traffic on this road would be through traffic between the towns, other traffic would be village-to-town traffic from the villages on, and nearby, the road. The results are summarised in Table 6 , with further details in Annex 1.

Table 6 Summary of traffic counted on two days on the Dunyur Pur to Basti Malook road

	Motor cycle	Walk	Bi-cycle	Cart	Pick-up	Carry-van	Car	Truck	Qingqi	Freight Qingqi	Auto-rick shaw	Minibus/ Midibus/ Bus	Total
Number vehicles	3,654	103	140	143	49	343	613	293	705	621	19	2	**6,685**
% vehicles	55	2	2	2	1	5	9	4	11	9	0	0	**100**
Number passengers	7,418	246	191	273	417	3,346	1,946	294	4,233	1,236	159	12	**19,771**
% passengers	38	1	1	1	2	17	10	1	21	6	1	0	100

The main road had about three times the numbers of vehicles and passengers as were travelling on the local roads. While the mix of traffic was broadly similar, motorcycles accounted for a lower proportion of vehicles (55%) and passengers (38%) than most other roads surveyed. Motorcycle rickshaws were important (11% of vehicles, 21% of passengers, 42% of travellers in non-motorcycle passenger vehicles). Motorcycle rickshaw loaders represented 9% of vehicles, which was far higher than any other road surveyed. Indeed, on this road almost twice the number of motorcycle freight rickshaws were observed than all the other seven roads put together. Similarly, more cars and carry-vans were recorded on the highway than all the other roads together. Surprisingly, perhaps, there were not many high-volume passenger vehicles (buses, midibuses or mini-buses). This may be because this road linked two small market towns, that were on different roads (with many passenger services) leading to the important city of Multan.

3.5 Passenger numbers from the traffic counts and gender implications

Table 7 summarises the numbers of travelling people counted on all surveyed roads, disaggregated for gender and age (children). While additional tables are available in Annex 1 showing the traffic count results disaggregated by road, this dataset is based on an aggregation of all traffic counts, to provide a picture of the various modes of transport used by the 60,000 people counted in the rural Punjab surveys.

Table 7 People travelling during all traffic counts, disaggregated for gender (trucks not included)

	Motor cycle	Walk	Bi-cycle	Cart	Pick-up	Carry-van	Car	Qingqi	Freight Qingqi	Auto-rick shaw	Minibus/ Midibus/ Bus	Total
Men	20,227	1,321	597	1,171	1,030	1,887	2,264	4,600	1,289	220	353	**34,959**
Women	5,376	844	58	141	638	1,445	974	4,047	438	169	86	**14,216**
Children	3,922	1,217	215	255	898	1,581	608	2,799	233	165	301	**12,194**
Total	**29,525**	**3,382**	**870**	**1,567**	**2,566**	**4,913**	**3,846**	**11,446**	**1,960**	**554**	**740**	**61,369**

As is shown in Table 7, the main mode of transport used by women (and men) was the motorcycle. Although women represented only 18% of people travelling on motorcycles, this accounted for 38% of all travel by women. The next most important mode for women was the motorcycle rickshaw, with women representing 35% of all motorcycle rickshaws passengers. Of the various motorised public transport options for women, motorcycle rickshaws were by far the most important (55% of public transport journeys by women). This was followed by carry vans (20%) and cars/rent-a-car (13%) which are expensive forms of transport that are not affordable for daily use by most rural women. Other forms of transport used by women were pickups (9% of women's journeys on transport services) and auto-rickshaws (2%), with buses (minibuses, Coasters and large buses) accounting for only 1% of women's travel by transport services. The availability of low-cost motorcycle rickshaws for transport is particularly important for women, and, on many roads, are currently indispensable for the less affluent, rural women for day-to-day transport, due to the lack of other public transport options.

3.6 Perspectives of transport users

3.6.1 Sample sizes

Three hundred people were interviewed across the three rural areas studied (100 per research site) to understand their opinions on the different transport modes. These were village residents who were 'users' of transport services and/or personal means of transport. About one half of those interviewed were women. In addition, 150 owners of motorcycles (all men) were surveyed to understand their perspectives and the ways their vehicles were being used. Initially the data sets were disaggregated to see differences between the three research areas and some of the differences are highlighted in this report. However, since the main aim of the research was to understand the overall transport situation in rural areas of the Punjab, for many statistics, the data was aggregated, combining responses from all three areas. This allowed a sample size of 300 for single questions, and up to 900 where respondents were asked to provide three different examples of their travel experiences. In the following sections, the N number cited is the

sample sizes for the statistics produced. With user surveys on rural transport services, the median average is often more appropriate than the mean average, as extreme examples have less influence. The median may therefore be more in line with the experiences of most people. However, the median is not appropriate when dealing with bi-modal distributions, in which case the mean average may be more appropriate, or a graphical representation of the distribution. In the following sections, all three options have been used, to present the data in ways that strengthen the understanding of the issues raised.

3.6.2 Vehicle ownership and use

Car ownership among households is quite low (13% of the 300 users), and unsurprisingly ownership was skewed, with 100% of respondents in the highest income bracket (over PKR 100,000), owning cars (see Table 8). The level of ownership is partly due to their high price, but also because of the lack of good roads and some narrow village streets that make it difficult for private cars to be kept in people's compounds. In contrast, motorcycle ownership is high, as shown in Table 8. Overall, 91% of the 300 transport users surveyed reported there was at least one motorcycle in their household. Motorcycles are less inconvenienced by poor roads and they can reach most village compounds.

Table 8 Frequency of ownership of cars and motorcycles among three income groups

Mode	Ownership frequency (%) in the income groups		
	PKR <50000	PKR 50000 to 100000	PKR >100000
	N=207	*N=87*	*N=6*
Motorcycle ownership	87%	99%	100%
Car ownership	4%	29%	100%

From discussions with users, the people without cars sometimes hire carry vans and rent-a-cars for specific trips. While the more affluent do this quite regularly for shopping and family outings, those with fewer resources only hire rent-a-cars and carry vans for medical emergencies and significant family events, such as weddings.

3.6.3 Passenger fares, freight costs and typical journeys

People were asked the fares they paid for public transport and the costs of freight. There were only minor differences between the three roads, so these statistics are based on the overall dataset. The typical prices are shown in Table 9. As is normal worldwide, economies of scale allow large vehicles to charge less per passenger-km. For the people surveyed, bus fares per passenger-km were about half those of motorcycles and pickups. However, what is very noteworthy is the fares for the smaller vehicles are extremely low compared to comparable village-to-town transport in other countries. For example, in his review of transport services issues in Asia, Starkey (2016b) suggested the cost of low-capacity vehicles in rural areas was generally 5-10 USD cents per passenger-km, while the motorcycle rickshaws and pickups in Punjab are charging 2 USD cents per passenger-km.

Table 9: Median average cost per passenger-km for public transport vehicles

N	Transport Mode	Median average fare per passenger-km	
		PKR	*USD cents*
	Fare-based travel		
N= 229	Qingqi	3.13	2.01
N= 48	Pickup	3.13	2.01
N= 15	Coaster	1.67	1.07
N= 25	Large bus	1.50	0.96
	Hired vehicles		
N= 48	Rent a car (assuming 4 people)	14.3	9.16
N= 82	Carry van (assuming 6 people)	6.20	3.96

Rent-a-cars and carry vans are hired like point-to-point taxis, and from the survey data they cost PKR 57 and PKR 37 per kilometre respectively. For comparative purposes, in Table 9 their cost per passenger-km is estimated based on carrying four people and six people respectively. With lower loading levels, they would naturally be even more expensive per passenger-km. While rent-a-cars (with a full load) are over four times more expensive per passenger-km than motorcycle rickshaws, they are more convenient (no waiting) and more comfortable and prestigious. When giving examples of their travelling, 81 people cited use of rent-a-cars, which were mainly for long trips (the median distance was 86 km). Carry vans (with a full load) are only twice as expensive per passenger-km as motorcycle rickshaws and are also more convenient, comfortable and prestigious. For these reasons they are widely chartered by commuters, groups of parents sending children to school (often with high loading levels) or family outings. However, as shown in Table 10, only 37 people cited use of carry-vans, and generally in the context of long trips (the median distance was 95 km). This may be because the carry-vans used for school trips and regular commuting are arranged on a monthly contract with the owners, and so were not considered individual journeys for the purposes of the survey. Table 10 also provides some idea of people's use of motorcycles and private cars for journeys. It might have been expected that the median distance for motorcycle journeys would be low and similar to motorcycle rickshaws on which the median journey cited was 10 km. Such short motorcycle journeys would be characteristic of countries where motorcycle taxis are widely used. However, in the Pakistan survey, the median distances cited for motorcycles was 53 km. This is because motorcycles are widely used by men to commute to cities and towns. Such motorcycles are not available on a daily basis for short trips to the nearby town.

Table 10 Mode of transport based on all the roads (hired or personal) to travel away from village

Mode	Median average distance *(km)*	Median average journey time *(min)*	Median average frequency *(per month)*
Family motorcycle *(N= 295)*	53	65	31
Family car *(N= 44)*	100	92	9
Carry van *(N= 37)*	95	94	12
Rent –a-car *(N= 81)*	86	93	2

While most users could provide information on passenger fares, fewer were able to give the costs of particular weights of accompanied freight they sometimes travelled with. However, sufficient information was provided to give some estimates of these charges, with pickups being cheaper than motorcycle rickshaws (generally vehicles with lower capacity charge more). These are summarised in Table 11. In most countries, the cost of small-scale freight is extremely variable and much greater than consolidated loads in large trucks. The costs reported are quite low, compared to small-scale freight costs in other countries. The cost of accompanied freight on short distances in the small pickups and motorcycle rickshaws in Punjab was similar to the cost of medium distance freight on large buses in Nepal or passenger trucks in Timor Leste (Starkey, 2009; Starkey, Tumbahangfe and Sharma, 2013).

Table 11: Median average accompanied freight cost (for loads between 10 kg and 100 kg)

Sample	Transport mode	Median average cost per tonne-km	
size		*PKR*	*USD cents*
N= 85	Motorcycle rickshaw	83.3	53.4
N= 18	Pickup	60.6	38.9

The people surveyed who arranged for unaccompanied freight (N=77) generally hired a motorcycle rickshaw, for shopping and sacks, or loader rickshaws for larger items (such as a new fridge). They paid a flat rate for the distance. Since the rickshaws were not fully loaded, the costs per tonne-km were higher than accompanied fright at PKR 112 per tonne-km (USD cents 72). Again, this is modest by international standards for low-volume freight over short distances.

The survey investigated not only the use of motorcycle rickshaws, but also the other means of transport people used for various purposes. Table 12 summarises typical (median) characteristics of journeys by the available means of public transport. Most journeys were by motorcycle rickshaw, typically to the nearby town that was about 10 km away. Pickups were the second most common means of public transport cited by users, but nearly all those users were in Jehlum District, where the pick-ups ran to an informal timetable in cooperation with motorcycle rickshaws. Coasters and large buses were used less frequently and for longer journeys. However, the use of these buses was an example of a clear bi-modal utilisation, with some people commuting to cities 25 days a month, while others used them only occasionally to visit cities.

Table 12 Mode of public transport to travel away from village

Mode	Median average distance *(km)*	Median average journey time *(min)*	Median average frequency *(per month)*	Median average normal fare paid *(PKR)*	Median average waiting time *(min)*
Motorcycle rickshaw *(N= 229)*	10	18	9.7	24	22
Pickup *(N= 48)*	12	20	5.3	25	15
Coaster/Minibus *(N= 12)*	30	45	2	60	25
Large bus *(N= 25)*	45	60	2	60	25

3.6.4 Travel to school

Rural residents were asked how their children currently travelled to school and what would be their preferred means of transport. Most children walked or took a motorcycle rickshaw, with transport by private motorcycle being third most common mode. The main reasons for this were convenience and cost. The preferred mode would be a pickup, with motorcycle rickshaws dropping to fifth preference, as shown in Table 13.

Table 13 Transport of children to school: current practices, reasons and aspirations (N=265)

Current method	Rank	Reason for this	Rank	Preferred mode	Rank
Walking	*1*	Convenience	1	Pickup	*1*
Motorcycle rickshaw	*2*	Price/cost	2	Walking	*2*
Family motorcycle	*3*	Safety	3	Family motorcycle	*3*
Pickup	4	No alternative	4	School bus	4
School bus	5	Other	5	Motorcycle rickshaw	5
Bicycle	6			Car	6
Other motorcycle	7			Bicycle	7
Car	8			Minivan	7
Minivan	9			Other motorcycle	8

Table 14 compares how people send their children to school, disaggregated by family income group. For the motorised options, the patterns are very similar for the different groups, but non-motorised transport (walking and cycling) is mainly used by the less affluent families.

Table 14: The use of different modes of school transport with respect to income level

Income level	<50,000 *(PKR)*	50,000 to 100,000 *(PKR)*	>100,000 *(PKR)*
Current method	*(N = 177)*	*(N = 83)*	*(N = 5)*
Walking	54	7	0
Bicycle	8	0	0
Family motorcycle	31	15	1
Other motorcycle	4	5	0
Motorcycle rickshaw	45	25	0
Pickup	19	17	2
Minivan	4	2	0
Car	2	3	2
School bus	6	9	0

3.6.5 Willingness to pay

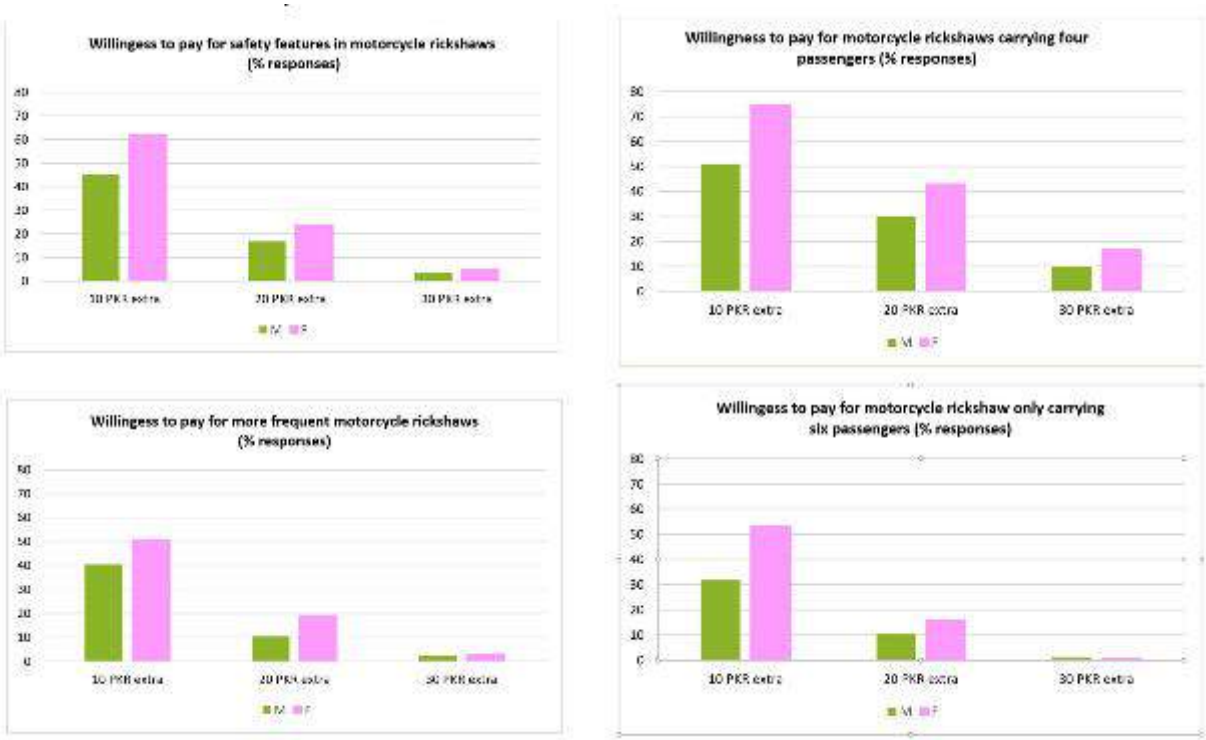
People were asked if they would be willing to pay extra for improvements to motorcycle rickshaw and pickup transport services, including safety features, less crowding and more frequent services. The results are presented in Table 15. The suggested possible increases were PKR 10, 20 or 30. To put this in context, the median average fare paid for motorcycle rickshaws was PKR 25. Therefore, the three 'willingness to pay' options can be thought of as +40%, +80% and +120% (although percentages were never mentioned in the questions). The overall results are summarised in Table 15. This shows that most respondents (61%) would be prepared to pay 40% extra for there to be only four people in a motorcycle rickshaw. In general, about half the respondents were willing to pay a significant increase in fares (40%) for safer, less crowded and more frequent vehicles. However, this trailed off as price increases rose, with very few willing to pay double the current fare price for the suggested improvements. Willingness to pay extra for improved pickup services was slightly lower. This might be because they are not regularly used, except in Jhelum where they already run to a timetable.

Table 15 'Willingness to pay' for possible improvements to motorcycle rickshaws and pickups (N=299)

Possible improvements	Increase in fare *(PKR)*	Willingness to pay *(% responses)*
Motorcycle rickshaws		
Motorcycle rickshaws have safety features: hand brake, indicator, lights and rear gate	10 (+40%)	52%
	20 (+80%	20%
	30 (+120)	4%
Motorcycle rickshaws carry maximum of 4 passengers (2 people per bench seat)	10 (+40%)	61%
	20 (+80%	35%
	30 (+120)	13%
Motorcycle rickshaws carry maximum of 6 passengers	10 (+40%)	41%
	20 (+80%	13%
	30 (+120)	1%
Motorcycle rickshaws travel after every 15 minutes	10 (+40%)	45%
	20 (+80%	14%
	30 (+120)	3%
Pickups		
Pickups carry maximum of 10 passenger	10 (+40%)	40%
	20 (+80%	10%
	30 (+120)	1%
Pickups travel after every 15 minutes	10 (+40%)	30%
	20 (+80%	5%
	30 (+120)	3%

As the sample comprised 173 men and 126 women, the dataset was disaggregated for gender to see if men and women had similar views. The results are presented in Figure 24, in which the lighter, pink bars represent the responses of women. In all cases, women were more willing than men to pay for service improvements. They were particularly willing to pay something extra for reducing passenger numbers to just four (the current legal limit) and introducing safety equipment (the current manufacturing standard).

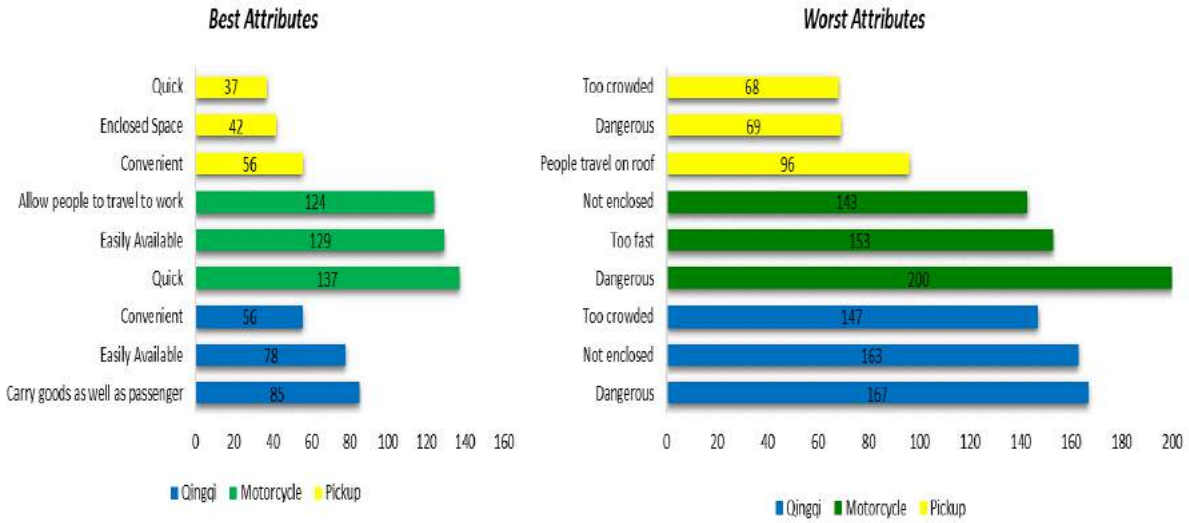
Figure 24 Willingness to pay charts showing percentage responses disaggregated by gender



3.6.6 User perceptions of the different vehicle options

As part of the 'user' survey, 300 rural residents were asked about their attitudes to the various forms of transport available. Users were asked their opinions on the best and the worst attributes of motorcycle rickshaws, pickups and motorcycles. The results are summarised in Figure 25. For all modes, issues of availability and convenience were clearly appreciated features, with the ability to carry freight important for motorcycle rickshaws and journey time for motorcycles. For the worst attribute, all modes were considered dangerous (motorcycles standing out with most responses). Overcrowding was an issue with both motorcycle rickshaws and pickups, and the fact that motorcycle rickshaws are not enclosed was an issue. Interestingly, all three transport types received more criticisms than accolades. The different number of responses may have been due to the fact that pickups were only a common form of public transport in Jhelum, and not in the two other study areas.

Figure 25 Perceived best and worst characteristics of transport types



Further questions were asked to users on their satisfaction with different attributes of the various public transport services available. The satisfaction was recorded on a five-point Likert scale, and the results were scored and ranked. Table 16 summarises the top five attributes for motorcycle rickshaws, pickups and the various sizes of 'buses'. While cost is important for all modes, it tops the features for motorcycle rickshaws: the best thing about them is their low cost. Safety and security are considered the most important features for pickups and the larger transport options. The larger the vehicles, the greater satisfaction with levels of comfort.

Table 16 Ranked attributes for motorcycle rickshaws, pickups and larger public transport vehicles (N=300)

Motorcycle rickshaw	Rank	Pickup	Rank	Minibus/Coaster/Bus	Rank
Cost	*1*	Safety and Security	1	Safety and Security	*1*
Availability	*2*	Travel time and Frequency	2	Cost	*2*
Safety and Security	*3*	Cost	3	Comfort	*3*
Travel time and Frequency	4	Comfort	4	Availability	4
Comfort	5	Availability	5	Travel time and Frequency	5

3.6.7 Safety and security

From their attitudes to rural transport types, it is clear that transport safety and security are in the minds of men and women. In the 'user' surveys, people were asked about their personal experiences over the past year. No security incidents (where people were robbed, harassed or assaulted) were reported in the user surveys (see Table 17), nor in the surveys of operators or motorcyclists. While the concern for security is considered an important gender issue, in practice both women and men seem comfortable to travel on the rural roads without fear of being robbed or assaulted.

Table 17 Safety and security incidents during past year reported by transport users (N=300)

Transport type	Safety incidents in past year	Security incidents in past year
Family motorcycle	73	0
Family car	10	0
Carry-van	7	0
Rent-a-car	9	0
Motorcycle rickshaw	42	0
Pickup	7	0
Minibus	6	0
Coaster/Large bus	8	0

Information on safety incidents (crashes) were recorded in the surveys of users, motorcycle operators and transport operators. The rural residents (transport users) were asked if they, or a member of their family, had been involved in some form of safety or security incident during the past year. Fifty-four percent of respondents reported an incident, which were mostly (71%) related to motorcycles (45%) and motorcycle rickshaws (26%). It is difficult to draw many conclusions from the various safety incidents reported. The vehicles with four or more wheels appear to have had more-or-less comparable numbers of crashes, while the two-wheelers and three-wheelers appeared much riskier. The crashes occurred within villages (often involving motorcycles or animals), on the link roads and on the main roads. The main causes appear to have been driver error, driver speed and poor road conditions. The main outcomes were vehicle damage and minor injuries, although some severe injuries were reported, notably for motorcyclists and their passengers. The safety-related information obtained is summarised in Table 18, in which the data categories relating to vehicles, causes, locations and outcomes are ranked (approximately) in the order of the numbers of citations by respondents.

Table 18: Summary of safety incidents reported by users, motorcyclists and transport operators

	Transport users *(N = 300)*	Motorcyclists *(N = 150)*	Motorcycle Rickshaw operators *(N = 41)*	Other Transport Operators *(N=19)*
Total number of reported safety incidents in last year	55	33	12	3
Percentage of respondents reporting incidents	18%	22%	29%	16%
Number and percentage of respondents who reported incidents				
Motorcycle	40 (13%)	33		
Motorcycle rickshaw	9 (3%)		12	
Pickup	3 (1%)			1
Carry Van	1 (<1%)			
Rent-a-car	1 (<1%)			
Bus, Coaster, Hiace	1 (<1%)			2
Family car	-			
Accident location (% of reported incidents)				
On main road	34%	45%	58%	33%
On village-to-town road	47%	39%	33%	67%
In our village	9%	12%	-	
In town	7%	3%	-	
Other	2%	-	8%	
Other vehicle involved (% of reported incidents)				
Motorcycle	18%	13%	33%	67%
Animal cart	16%	22%	17%	33%
Pickup	17%	10%	-	-
Bicycle	17%			
Tractor	7%	13%	25%	-
Motorcycle rickshaw	7%	13%	-	
Car	7%	10%	8%	-
Carry van	4%	-	-	-
Bus	-	6%	8%	-
Other	6%	13%	8%	-
Main consequences (% of reported incidents)				
Minor injuries	44%	45%	33%	67%
Vehicle damage	40%	24%	50%	-
Severe injuries	16%	30%	17%	33%
Fatality	-	-	-	-
Main causes of crash (% of reported incidents)				
Other driver error	19%	8%	11%	-
Other driver speed	17%	15%	22%	-
Driver speed	13%	20%	11%	-
Road problem	17%	2%	22%	33%
Driver error	8%	5%	22%	33%
Overloading	6%	12%	11%	-
Poor light	6%	25%	-	-
Animal	5%	8%	-	33%
Vehicle problem	3%	3%	-	-
Dust	1%	-	-	-
Load-shifting	1%	-	-	-
Other	1%	2%	-	-

Of the 150 motorcyclists interviewed, 33 (22%) reported a safety incident in the past year. Of the 38 motorcycle rickshaw operators surveyed, 12 (31%) reported a safety incident in the past year. These

occurred on the road to the main road or on the main road, they involved motorcycle rickshaws, tractors or animals, and were caused by driver error, driver speed and poor road condition. None appeared serious.

Clearly, crashes do happen, for a variety of causes, but it is difficult to draw firm conclusions, apart from the fact that two-wheelers and three-wheelers appear relatively risky, with motorcycles appearing the more dangerous. Poor driver behaviour (speed and errors) and bad road conditions appear contributory factors.

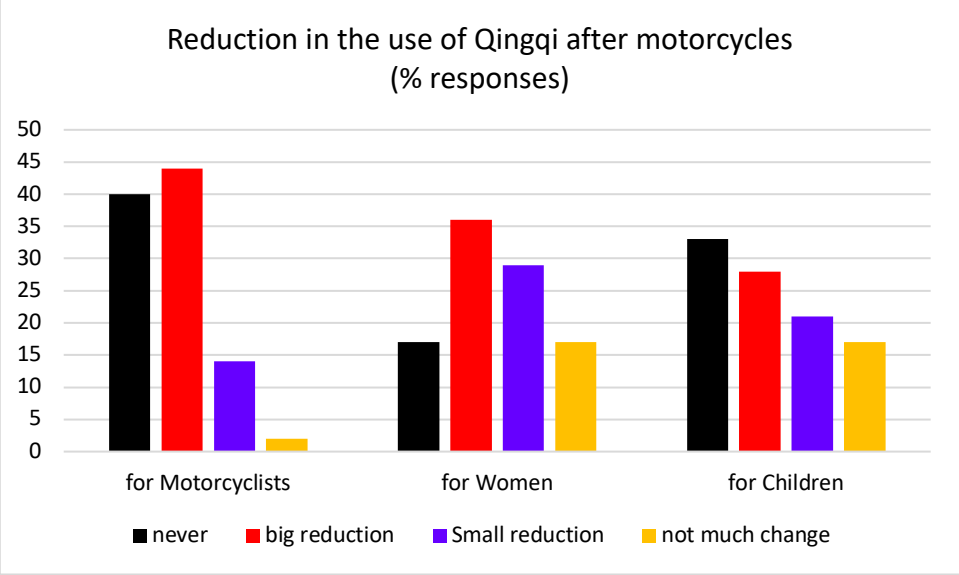
3.6.8 Motorcycle owners

It is clear that the rural transport situation is changing with the rapid and ongoing adoption of motorcycles by men. Therefore, in each of the research areas, 50 residents (all men) were asked how their acquisition of a motorcycle had changed transport patterns. In all three districts, men mainly used their motorcycles for personal mobility, family and domestic transport, work-related transport and commuting to urban employment. They confirmed that the ownership of a motorcycle had greatly reduced their use of motorcycle rickshaws, as shown in Table 19, with 84% saying the reduction had been very great. They reported that the use of motorcycle rickshaws had declined for women and children in their families, but this was not so large, with 46% suggesting the reduction had been quite minor for women. Children had been more affected than women, with 61% of motorcyclists saying children had greatly reduce their travel on motorcycle rickshaws. This is illustrated in Figure 26.

Table 19: Reduction in the use of motorcycle rickshaw after motorcycle (N = 150)

Reduction in the use of motorcycle rickshaws	For motorcyclists *(%)*	For women in the family *(%)*	For children *(%)*	Total *(%)*
Never	40	17	33	30
Big reduction	44	36	28	36
small reduction	14	29	21	22
Not much change	2	17	17	12

Figure 26 Reduction in the use of motorcycle rickshaws following motorcycle adoption (N=150)



3.7 Perspectives of the operators

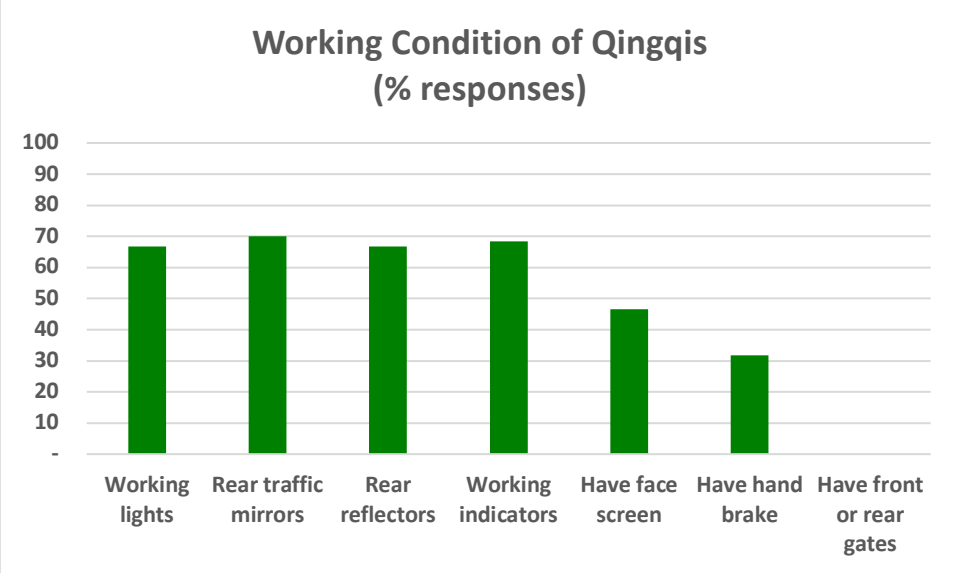
Despite widely-repeated assertions (based on urban-based reports), most motorcycle rickshaw drivers in rural Punjab are not ‘under-age’. Most are able-bodied, mature men with families, who are trying to earn a livelihood. Table 20 gives the average ages of the operators interviewed, with an average of 33 years for motorcycle rickshaw operators, while drivers of larger capacity vehicles had an average age of 42. Although ages were self-reported, they are entirely consistent with other observations and family status.

Table 20 Declared ages of the operators and motorcycle users interviewed

	Sample size	Average age	Drivers under 20	% under 20
Motorcycle rickshaw	41	33	1	2%
Motorcycles	150	33	13	9%
Other vehicles	29	42	0	0%

Compliance with administrative formalities is generally low for all modes of transport, and particularly for motorcyclists and motorcycle rickshaws, many of whom do not even have driving licences. Figure 27 shows that about one third of motorcycle rickshaw operators stated they did not have working lights, reflectors, indicators and/or rear mirrors. Only 30% had a handbrake and none had the front or rear gates that are now required for all new motorcycle rickshaws.

Figure 27 Self-reported condition and safety features of motorcycle rickshaws (N=38)



It was clear from the operators' survey responses and discussions with operators of all forms of transport services that the passenger market is changing due to the rapid adoption of motorcycles in rural areas. This is reducing the demand for transport services and making the larger forms of transport (mini-buses, Coasters and large buses) only viable in rural areas if they operate commuter services to cities or (in the unusual case of Lodhran) provide access to far-off family members.

All transport operators surveyed were asked about their major problems (they could cite more than one critical problem). For the motorcycle rickshaws it was the increasing use of motorcycles and a declining market. Motorcycle ownership was also affecting the buses, but they did not see their market (mainly commuters and travellers to cities) declining. All operating groups mentioned the problem of police 'harassment', but the pick-up operators felt this most strongly. All operators were aware of the high levels of competition for market share, which was perceived as a problem. This is summarised in Table 21.

Table 21: Problems facing by operators while operating on their normal route

Motorcycle rickshaw *(N = 38)*	Rank	Pickup/Carry-van *(N = 6)*	Rank	Hiace/Large Bus/Coaster *(N = 6)*	Rank
Increasing ownership of motorcycles	1	Harassment from police/officials	1	Increasing ownership of motorcycles	1
Declining market	2	Too much competition from other vehicles	2	Too much competition from other vehicles	1
Other	3	Increasing ownership of motorcycle	3	Harassment from Police/officials	3
Harassment from Police/officials	4	Declining market	4	Too many buses	3
Too many of motorcycle rickshaws	5	Too many pickups	4	Other	5
Too much competition from other vehicles	6	Other	6	Declining market	0

For all the small-scale transporters, and motorcycle rickshaws in particular, there is generally an over-supply in the market. On all roads, operators would benefit from there being fewer of their type of vehicle. However, the various informal associations do not stop new members joining, making the situation worse for all operators. None of the operators of pickups, motorcycle rickshaws and auto-rickshaws are making a good living. On all roads, operators would be willing to give up their current transport work, if there were a good alternative income. They do not see such opportunities and so they feel obliged to continue in what appears to be a poor and declining market.

During discussions, operators recognised the descending spiral of long waiting times leading to lower transport demand and even longer waiting times. They would be willing to consider an informal timetable arrangement (as is the situation in PD Khan) that gives a maximum waiting time during off-peak periods. However, they do not have the financial flexibility to incur cash losses if the resulting passengers are insufficient to pay for the cost of their fuel. They could risk their time and their overheads for an initiative designed to stimulate the market by providing frequent services, but they could not risk losing the cost of their fuel. That is how tight their margins are.

One group of operators in Kasur agreed to try to run a pilot project that would ensure there were motorcycle rickshaws every twenty minutes. This was on the understanding that during the trial period they would receive a subsidy for each trip to cover fuel use. However, their routes were also operated by motorcycle rickshaws coming in the other direction, and it was difficult to get an agreement between the various associations in the time available. Nevertheless, this exploratory initiative did suggest that operators are willing to consider mechanisms to improve their transport services, provided they are not loss-making.

3.8 Perspectives of the formal manufacturers

The formal manufacturers are very concerned by the problems with registering vehicles in the Punjab. This is greatly reducing their current sales and will lead to lower production of authorised motorcycle rickshaws. Most manufacturers have already diversified, and so are not fully dependent on motorcycle rickshaws. Several make most of their income from the production and sale of motorcycles, and some have started to produce low-cost cars and pickups. These companies could probably survive the removal of motorcycle rickshaws from the market, although they all believe their products serve an important market.

A second major concern expressed by all manufacturers contacted is the current high inflation rate and the increase in commodity prices. They recognise that their market (motorcycle rickshaw dealers and buyers) is very sensitive to price increases.

All formal manufacturers contacted recognised there is an over-capacity in the sector that, with market competition, is keeping their margins on motorcycle rickshaws very narrow. With the current high inflation rate, and the need to raise prices frequently, timing is crucial as price rises lead to noticeable shifts in

purchases, with the last to raise prices benefiting, provided they earn enough to buy their more expensive new supplies.

The formal manufacturers recognise that the demand for motorcycle auto-rickshaws has been growing and is likely to continue to grow (unless it is suppressed by a government clampdown). To improve their own market share, they would like to eliminate informal sector production that has been growing and now accounts for over half the market. At the same time, they are wary of the manufacturers of pickups, which they believe to be trying to eliminate rickshaw loaders (motorcycle rickshaw and auto-rickshaw freight models) that have been diminishing the market growth of pickups, particularly for small-scale urban freight distribution and deliveries.

The approved manufacturers are frustrated by the red tape of having to deal with many different regulatory organisations, including PSQCA (twice yearly inspections for output standards), EDB (inspections for factory safety), E&T and the Provincial Transport Department. They have to maintain good relations with all of these bodies. They comply with inspections and have 'inspection models' for technical checks. Whether the formal manufacturers fully adhere to the spirit behind the regulations is a matter of debate. It would be a very idealistic company that would reduce its sales potential by fully complying with regulations that were not being rigorously enforced and were for specifications that purchasers were not demanding.

None of the manufacturers are currently considering the large-scale production of electric vehicles. There have been some trials with electric scooter motorcycles, but the current market demand appears very low. There are numerous problems for electric vehicles in Pakistan, particularly as 'load-shedding' power cuts are still widespread. They are aware of the potential market opportunities for electric vehicles but understand that currently fossil-fuel powered vehicles have a performance and price advantage.

3.9 Perspectives of the informal manufacturers

There are many informal-sector manufacturers of motorcycle rickshaw bodies. In many parts of Punjab Province (including Basti Malook in Lodhran), the only motorcycle rickshaw bodies available are made by 'unauthorised' workshops. Sellers of motorcycle rickshaws around Lahore are often in contact with several informal manufacturers, and buy in bodies to attach to the motorcycles preferred by their clients, such as United and Road Prince. The price of different motorcycles and bodies on the day of purchase is often the deciding factor.

The manufacturers (and some of their clients) argue that their bodies are better being stronger, heavier and more robust. They have very rapid feedback-loops with their suppliers and clients (much more sensitive than the formal manufacturers) and so they can adjust and rapidly evolve their designs in accordance with the wishes of their customers. Such rapid feedback is considered highly important and so the informal manufacturers are confident they are supplying the market with what they want. They comply with standard safety equipment (lights, indicators, rear axle brakes), but no examples of front or rear safety gates have been observed (indeed no formal sector safety gates have been seen by the researchers outside the factories). However, the informal manufacturers could add these to all models without problems (other than a small price rise), should the market demand these.

The informal sector manufacturers face three major problems. The most immediate is the current high inflation that is increasing the cost of steel and other inputs. This is affecting their output prices in a market that is very sensitive to price increases. It is worrying for the whole market chain, as many buyers pay by instalments (they have to). However, in times of high inflation, fixed instalments are dangerous to sellers, as their overall income from a product may not be sufficient to obtain a comparable replacement to sell.

The second problem is a chronic long-term issue that is thought to be faced by most businesses in Punjab Province. Officials of various kinds create or threaten problems and demand '*bhatta*' to allow work to carry on. The 'officials' can be employed by local government, regulatory authorities or even by utilities such as electricity. While this can be irritating and time-consuming, the system works by officials claiming modest and affordable amounts of '*bhatta*', leaving the businesses to keep on running and be profitable (so there will be money for the next round of '*bhatta*' negotiations).

The third and most critical problem for the informal sector are current campaigns by officials to close down 'illegal' operations. There appear to be two campaigns: one to close down unauthorised manufacturers of motorcycle rickshaws and another is to bring more businesses and small-scale manufacturers into the tax net. One informal sector operator (employing about twenty workers) explained that his workshop had been visited by officials (he did not know who), who forced him to close for several months. He was then allowed to start again (without explanation) on the condition he pays tax (he does not know how much). While the story cannot be verified, it seemed entirely credible. Officials did not offer information or advice or provide suggestions. There was no advanced warning, no education and no assistance offered: there were only commands from some officials who had power. Officials in the Punjab administration suggested that this would be normal, and that such informal manufacturers would simply re-locate and start again in another location. From the point of view of the informal manufacturers, it is not that simple, as they have existing premises, equipment and loyal staff, and wish to continue with good livelihoods, meeting local market demands.

Discussions with informal sector workshops and motor rickshaw suppliers suggest that they have little knowledge of technical standards, health and safety regulations, employment conditions, environmental regulations or the formal accounting and fiscal compliance procedures. They were unaware of any schemes to train them, inform them and allow them to improve their standards. They simply feared being shut down for reasons they did not understand.

3.10 Perspectives of the regulatory and enforcement authorities

There are many different regulatory and enforcement authorities concerned with the supply and operation of motorcycle rickshaws. The authorities have statutory duties to develop and enforce high standard specifications, and that is what they are trying to do. This is consistent with the aspirations of the government to improve the country. It is required by their official mandates and is in tune with the professional desire of the various officers for the high standards associated with their various professions.

Most individuals involved are qualified professionals. They believe they are acting in the best interests of Pakistan, by raising design and quality standards. High quality transport, health and safety and environmental standards are clearly in the interests of Pakistan as it industrialises and becomes increasingly wealthy. They are improving standards and implementing the current law and regulations. They are aware of many stories about the dangerous behaviour of motorcycle rickshaws and can see dangerous driving behaviour as they themselves drive to work in their cars (or possibly motorcycles). Such people tend to overlook the nuanced complexity of the various issues and want immediate enforcement of high standards.

That being said, discussions with the Punjab Excise and Taxation and Transport Department suggested officials have a great understanding of the importance of motorcycle rickshaws for rural people. They expressed sympathetic attitudes towards motorcycle rickshaw operators and to informal sector manufacturers, and realised that enforcement would have to be achieved gradually so as not to disrupt rural transport services.

Enforcement could be straightforward, if the country was uniformly wealthy and the norms of Pakistan society favoured compliance with regulations and safe driving practices. Pakistani migrant workers who drive taxis and buses in countries like Abu Dhabi appear to have no problem with regulatory compliance, since in such countries, traffic enforcement and compliance are the norms. However, it is widely observed and acknowledged that people (including the elites) in Punjab Province do not necessarily comply with legal requirements. It is also abundantly clear to all that all types of vehicles exhibit inappropriate driving behaviours.

Transport regulations have been in force since the 1960s, that allow a maximum of two people per motorcycle and that require motorcyclist and pillion passengers to wear crash helmets. These are widely ignored throughout Pakistan. People point to the case of certain roads in Lahore and large sections of Islamabad where they claim there has been successful enforcement that proves enforcement works. However, while it is true there are fewer infringements by motorcyclists on those particular roads, the enforcement is only partial. The use of helmets by pillion passengers is still very small. In the evenings, overloading is common, and many drivers do not wear helmets. If the authorities are not even able to

enforce helmet wearing fully in Islamabad and on clearly designated roads in Lahore, where police are numerous, there is little prospect of enforcement in rural areas, with many roads and very few police officers. That is unless something changes that encourages people to comply through rewards or threats.

The current 'improved' specifications for passenger motorcycle rickshaws have been approved in Punjab Province since 2009, but they are only just being enforced in the formal sector factories, and they have yet to have any impact on the people of Punjab Province. These are the realities that the regulatory and enforcement authorities have to deal with.

What makes the issue more complicated is that the users and operators of motorcycle rickshaws are generally poor, disadvantaged people (with rural women counted among the disadvantaged). They currently depend on motorcycle rickshaws for their mobility and their livelihoods. Appropriate enforcement (nudging to gradually better standards) would be beneficial for all. Crackdowns could have unintended consequences and be detrimental to disadvantaged people.

However, as one Punjab Excise and Taxation official observed, crackdowns never last long in Pakistan, and things quickly go back to 'normal'. Their department, he suggested, should be concentrating on gaining tax revenues from the wealthy, rather than bringing poor motor rickshaw operators and small-scale workshops into the tax net.

3.11 Environmental perspective

Compressed natural gas (CNG) is an alternative fossil fuel that has fewer noxious emissions. It is frequently promoted as the technology of choice for city centres, including in Pakistan. However, supplies of CNG are not consistent in Pakistan. Punjab Province does not have its own supplies but imports them from Sindh and Khyber Pakhtunkhwa. There are often shortages in the winter due to its use for heating, and the other provinces are not obliged to export to Punjab. While there are many rickshaws that use CNG in Karachi and other cities, its use in Lahore appears to be declining as some CNG stations have closed (Express Tribune, 2015). All auto-rickshaw manufacturers produce vehicles that can be run on CNG (sometimes with small adaptations required). While motorcycle rickshaws can be adapted to run on CNG, very few operators do so. The use of CNG for three-wheelers in rural areas is minimal. There are few comparative advantages for CNG in rural areas of Punjab at this time, and this is unlikely to change.

A more realistic and long-term potential option for Pakistan would be to move towards electric vehicles. This is extremely likely in the medium to long term as countries are increasingly adopting strategies to ban the sale of petrol and diesel vehicles within 15-25 years. The Pakistan government envisages 30% of its operating fleet will be electric by 2030 (Express Tribune, 2019). In 2017, India announced plans to legislate that all cars sold after 2030 should be electric, and in 2019, it has been suggested that three-wheelers should be all-electric by 2023 and all two-wheelers by 2025 (BBC, 2019). These are extremely ambitious targets, particularly if (as is implied), these dates refer to operating vehicles rather than new vehicles. Generally, proposals to go electric are phased in over time and space. Thus, in Fiji's public transport plans, new fossil-fuel-powered vehicles bought just before the ban on sales, would still be able to have several years of use before scrappage. In this case, the older, more polluting vehicles would be moved out of cities and only allowed to operate in rural areas where pollution levels are much lower and where it will take longer to establish the necessary charging infrastructure (Haworth and Starkey, 2017).

Electric vehicles are only 'green' from the point of view of the global environment (climate change) if the electricity comes from renewable resources. However, most of Pakistan's electricity is made using fossil fuels and does not count as 'green' (Arshad, 2019). In such circumstances, electric vehicles can still be beneficial for the local environment, particularly in city centres with high concentrations of exhaust emissions. In contrast, the levels of noxious gasses and particulates due to exhaust emissions are generally extremely low in rural areas, so local environmental issues do not necessitate electric vehicles.

Currently, in most of the world, electric vehicles are more expensive and have lower ranges and loading potential than fossil fuel engines. In the countries and cities where electric vehicles are being adopted, the take up is generally driven by government incentives (financial and/or operational) and/or by strictly enforced government regulations prohibiting alternative vehicles. The rapid growth of electric scooters (motorcycles) in China is largely in response to urban regulations that are strictly enforced. In rural China,

fossil fuel motorcycles remain popular due to their greater power and larger range. In India, where democratic processes make it problematic to ban the omnipresent petrol motorcycles from cities, the adoption of electric scooters is very low, despite small financial incentives (subsidies).

The rickshaw manufacturers in Pakistan, who were interviewed, felt that with unreliable electricity supplies (power cuts and load-shedding is still quite common) there is little incentive to start producing electric three-wheelers. Currently, the convenience and performance of electric options is perceived as inferior to fossil-fuel models (which is why the huge Indian market for three-wheelers and motorcycles is still dominated by petrol models). However, things could change rapidly if there were incentives for electric vehicles and/or sanctions against petrol models.

In Pakistan, there have been several small initiatives to develop electric three-wheelers. In 2015, the Japanese company Zar Motors launched its 'E-Trike' in Pakistan. This was a lightweight, electric-powered auto-rickshaw as shown in Figure 28 (left example). It was claimed it could travel 95 kilometres following a seven-hour charge with a modest top speed of 40 kph (Express Tribune, 2015). They sold for about PKR 330,000 (165% of the price of an auto-rickshaw or 330% of the cost of a motorcycle rickshaw). They did not catch on, as they were considered slow, with no real advantage for the user or the operator (although there would have been environmental benefits for the city of Lahore where they were tested).

In 2019, Zar Motors launched an updated version with quicker charging, a better range, slightly higher speed and a car-like superstructure, with glass windows, as shown in Figure 28 (right example). The price has also come down to PKR 220,000-300,000, although this is still more expensive than the more powerful auto-rickshaws, and much more than motorcycle rickshaws. With only two seats, and little space for more than two adult passengers, it appears to be aimed at a high-end three-wheeler taxi market. This may be welcomed by people such as female students, professional commuters or older persons, who do not have their own vehicles, but who do not wish to use over-crowded public transport.

Figure 28 Examples electric autorickshaws produced in Pakistan by Zar Motors

The electric vehicle industry is changing very rapidly, with batteries becoming lighter, cheaper and with greater capacity. In the medium term (within five years), electric three-wheelers are likely to be cheaper and much more competitive in terms of their performance. Prior to this, Pakistan cities could legislate to restrict fossil fuel vehicles, in the interests of local air pollution. Electric three-wheelers are increasingly important in some countries, and they could become part of integrated plans to improve air quality in Pakistan's cities. This would likely require significant financial incentives and enforcement and does not seem a realistic prospect in the short term. It would seem even less likely for electric three-wheelers to be promoted and strictly enforced in rural areas.

4 Economic and financial appraisal models

4.1 Scenarios and options

4.1.1 Description of scenarios

In order to conduct financial and economic appraisals of motorcycle rickshaws in the Punjab province, we put forward four different scenarios to be analysed, plus one baseline scenario. Each of them represents a different policy or strategy, which could potentially affect the motorcycle rickshaws market. These scenarios are summarised in Table 22.

Table 22: Scenarios for financial and economic appraisals

Scenario	Option	Description
1 (Base)	Business as usual	The status quo in which underlying dynamics stay as they are: no seating regulation is enforced, and the number of passengers traveling in a motorcycle rickshaw often surpasses six.
2	Seating regulation six seats	The maximum number of passengers per motorcycle rickshaw is enforced at six passengers.
3	Seating regulation four seats	The maximum number of passengers per motorcycle rickshaw is enforced at four passengers.
4	Investment in training	Through investment in training for the drivers of motorcycle rickshaws, they organise informal timetables so that schedules for their services become more predictable. As a result, patronage goes up and more motorcycle rickshaws enter the market, leading to a 20% increase in sales.
5	Capital cost increase	Safety standards are enforced, leading to a 20% rise in capital costs and tighter margins for operators – but presumably lower safety risks.

The first scenario represents business as usual, where no new policies are enforced and the number of passengers travelling in a motorcycle rickshaw regularly exceeds six passengers. This scenario is the baseline against which all other scenarios were compared.

Throughout the passenger and traffic counts conducted in the investigation, only 53% of the observed motorcycle rickshaws carried seven or fewer people, and only 20% carried five or fewer people, with one of them being the operator. Scenarios two and three represent the enforcement of seating regulations for motorcycle rickshaws: in scenario two, the maximum is six passengers per vehicle (until recently, motorcycle rickshaws have been marketed as ‘six-seaters’); in scenario three the limit is four passengers (the official capacity of motorcycle rickshaws since 2009).

If motorcycle rickshaws were to have a strict capacity of either four or six passengers, this would dramatically alter the underlying economics and business feasibility for the operators. The rural transport market seems to be competitive enough that motorcycle rickshaw drivers are price-takers; if restrictions on the number of passengers are enforced, then this would potentially affect revenue and operating margins (the excess of revenue over operating costs). It may also be that operators would collectively increase tariffs; however, it is unlikely that their turnover would increase.

The simplest modelling option for such restrictions are that more motorcycle rickshaws would be used to carry the same number of passengers (e.g. 12 waiting passengers would require two or three motorcycle rickshaws if the limits were six or four passengers, respectively). Nevertheless, it is more likely that some users might shift to other transport options, while the least affluent might even be unable to afford public transport if prices rise. For more affluent men, motorcycles would be the most likely alternative mode of transport, as motorcycle rickshaws operators already feel they are losing customers to motorcycle use. In the traffic counts, 63% of vehicles were motorcycles, and 47% of all travellers counted were on motorcycles.

In scenario 4, there is an investment in training for the motorcycle rickshaw drivers. The training would focus on the concept of a timetable, so that drivers are working when demand for transport is greatest and drive in a more predictable way, i.e. following a timetable. Safety will also be a major part of the training, emphasising driving techniques, the use of safety equipment and measures and how to reduce crash and casualty rates. As a result of having a more predictable transport service, patronage increases and more motorcycle rickshaws enter the market, leading to a 20% increase in sales. A one-off amount of PKR 155 million was included in the appraisal to represent the costs of the training programme.

Alternatively, it may be that a policy of enforcing technical safety standards is rolled out. For this reason, a scenario with greater capital costs – scenario 5 – is used to assess the viability of enforcing upgrades to motorcycle rickshaws. Such upgrades could include the protective passenger gates that have been obligatory since 2009 but are seldom seen in the current vehicle fleet; or rather involve greater costs by requiring vehicles to have driveshafts rather than chain drives, as stated in the most recent loader motorcycle rickshaw specifications.

4.1.2 Structure of appraisals

Motorcycle rickshaws affect several different stakeholders and, as such, several perspectives are considered in the financial and economic analyses:

- Financial analysis: conducted from the perspective of motorcycle rickshaw operators.
- Economic analysis: conducted from the perspective of users and society as a whole.

These perspectives differ because, from an operator's perspective, cashflows are the only factor to account for in making commercial decisions, whereas transport users can consider factors such as time saved and risk of injury, and society as a whole can further account for variables that affect communities, such as the environmental impact of a certain transport mode.

While the operators, users and government are the key stakeholders of interest in these analyses, consultation was also made with operators and users of other vehicles, the manufacturers who develop the vehicles, and the dealers who sell the vehicles to operators.

The social discount rate used in the economic cost-benefit analysis was 12%. This was taken from the Asian Development Bank guidance (Zhuang et al., 2007). Further, the IMF World Economic Outlook forecasts 5% long term inflation growth rates (IMF, 2019), so this was the rate used to inflate cash flows in the financial appraisal. No financial discount rate was applied to these appraisals.

4.2 Key assumptions

The main assumption behind the economic and financial appraisals is about the modal shift: how people would change their chosen means of transportation in response to changes in the motorcycle rickshaws market. In our analyses, each scenario (except for scenario 1, the baseline) reflects a different change in this market – accordingly, people's preference for transport also changes with each scenario. The logic behind this is explained in the following sections.

4.2.1 Number of motorcycle rickshaws

There is a large informal sector for motorcycle rickshaws and other transport services in Pakistan, so estimating the total number of motorcycle rickshaws used in the Punjab is challenging. This is made more difficult by the understanding that some are no longer actively in use (there is no deregistration of old or scrapped vehicles), and due to issues around vehicle legality in some areas, some motorcycle rickshaws are registered as motorcycles.

In the face of these limitations, we assume that the number of active motorcycle rickshaws is equal to the number of registered motorcycle rickshaws in the Punjab (PBS, 2016). The most recent data we have for this is 272,425 motorcycle rickshaws in 2015, which is the number we used in our appraisal.

4.2.2 Number of days worked

We assumed each of the 272,425 motorcycle rickshaws works for 260 days per year, which is equivalent to the number of weekdays in a year.

4.2.3 Transport mode change

We used the passenger and traffic counts (a detailed disaggregation can be found in Annex 1) to estimate how the proportion of vehicles travelling on the road and passengers using them might change if the demand for motorcycle rickshaws is suppressed. This is summarised in Table 23.

Table 23: Passenger and traffic split with and without motorcycle rickshaws

	With motorcycle rickshaws		Without motorcycle rickshaws	
	Vehicles	Passengers	Vehicles	Passengers
Motorcycle rickshaw	8.0%	18.2%	0.0%	0.0%
Motorcycles	62.7%	47.0%	68.1%	57.5%
Carry Vans	2.5%	7.8%	2.7%	9.6%
Pickups	1.3%	4.1%	1.5%	5.0%
Pedestrians	5.8%	5.4%	6.3%	6.6%
Other	19.7%	17.5%	21.5%	21.4%

In the '*Without motorcycle rickshaws'* columns, we set the percentage of motorcycle rickshaws and passengers traveling in them to 0%, and then proportionally distributed the corresponding amount left (8% in the case of vehicles) by the other means of transportation. This means it is estimated that, for example, out of the 8% of passengers which would need to have an alternative mode of transportation if they could not use motorcycle rickshaws, 62.7% would opt for motorcycles, 2.5% for carry vans, 1.3% for pickups, 5.8% would walk, and 19.7% would use other means of transport.

4.2.4 Number of passengers per vehicle

Subsequently, we wanted to know how many vehicles would be required to transport the extra passengers that would not travel in motorcycle rickshaws if the demand for this mode of transportation were to be suppressed. We used the traffic and vehicle count to estimate the number of passengers per vehicle (this table can be found in Annex 1: Traffic Count Statistics). Table 24 shows the passenger numbers assumed for each type of vehicle.

Table 24: Passengers per vehicle (besides the driver)

Vehicle type	No. passengers
Motorcycle rickshaw	6.0
Motorcycles	2.0
Carry Vans	8.4
Pickups	8.0

By putting the estimates of *Transport mode change* (Table 23) together with the number of *Passengers per vehicle* (Table 24), for every 1,000 motorcycle rickshaw passengers that would need to have an alternative mode of transport, one might expect an increase of 341 motorcycles, 3 carry vans, 2 pickups and 63 pedestrians, while there would be 167 fewer motorcycle rickshaws.

4.2.5 Number of extra vehicles per scenario

Finally, we can estimate what the size of the vehicle fleet would be in each of the proposed scenarios, measured in *number of extra vehicles* when compared to the baseline, scenario 1. This is summarised in Table 25.

Table 25: Number of extra vehicles per scenario

	Motorcycle rickshaws	Motorcycles	Carry vans	Pickups	Pedestrians
Scenario 1	-	-	-	-	-
Scenario 2	-	11,931	118	247	8,830
Scenario 3	-	27,272	270	565	20,183
Scenario 4	27,243	-	-	-	-
Scenario 5	-27,243	17,045	169	353	12,615

4.3 Economic appraisal framework

The economic analysis takes account of the wider costs and benefits of motorcycle rickshaws beyond cash flows: this includes environmental costs, loss of output from accidents, and the value of time savings from taking alternative means of transport. It is done by comparing scenarios 2 to 5 with the baseline scenario 1, through assessing the differences in costs and benefits between the two scenarios.

For motorcycle rickshaws, the net benefits for a given scenario are calculated as:

$$Total\ Benefits - Total\ Costs = Net\ Benefits$$

The $Net\ Benefits$ are then discounted using a 12% discount rate, which is taken from the Asian Development Bank's guidance (Zhuang et al., 2007).

$Total\ Benefits$ has been defined on the basis of the categories of costs and benefits identified in the surveys undertaken for this study. These include:

- $Safety\ benefits$: this variable reflects the difference in average economic loss caused by accidents between the different scenarios and the base case, which vary with the number and type of vehicles travelling on the road – a higher number of vehicles travelling on the road is assumed to lead to a higher number of accidents, and hence higher accident costs.
- $Environmental\ costs$: the costs associated with vehicle emissions of greenhouse gases.
- $Fuel\ savings$: the difference in fuel costs when compared to the base case.
- $Value\ of\ time\ savings$: the opportunity cost of the time that a traveller spends on his/her journey, which varies according to the mode of transport chosen. For example, if users end up switching from motorcycle rickshaws to carry vans, they can expect a shorter journey time on average, and hence greater time savings. Under scenario 4, there may also be some benefits from reduced waiting times, as a result of a more regular service.
- $Value\ of\ lost\ trips$: the economic valuation of trips that were not made because of some change in the market. For example, if the price of a motorcycle rickshaw trip were to increase, some users might no longer be able to afford their journeys; if the journey they intended to take was long enough, they might not be able to walk to their destination as an alternative, and hence the trip would be foregone. An explanation of how this value was estimated is included in section 4.4.5.
- $Number\ of\ generated\ trips$: the estimated increase in traffic relative to the base case.

And $Total\ Costs$ are the sum of:

- $Capital\ costs$: fixed, one-time expenses incurred on the purchase of vehicles.
- $Operation\ and\ maintenance\ costs\ (O\&M)$: the costs associated with operating and maintaining vehicles.

4.4 Derivation of key economic assumptions

In this section we explain the calculations behind the data making up the costs and benefits.

4.4.1 Safety benefits

Reliable accident data that can be monetised for the purpose of economic analysis is difficult to come by. Users asked gave a 17% incidence rate for motorcycle rickshaws; because they were being asked, mortality rates could not be confirmed on this basis (Klair and Arfan, 2016). 486 casualties were recorded in twelve months between 2014 and 2015 in Karachi (Muhammad et al., 2017). With 186,837 recorded motorcycle rickshaws in Sindh (according to the Excise and Taxation Department), this equates to 0.26% of motorcycle rickshaws experiencing an accident that year. In contrast, motorcycles are seen as more dangerous, with a 2.19% chance of accident and 0.718% of registered motor cars (Pakistan Today News Desk, 2017).

For the purpose of simplification, these were taken as the core annual probabilities of accident for analysis: 0.26% for motorcycle rickshaws, 2.19% for motorcycles, and 0.718% for other motor vehicles.

The economic losses of accidents are mainly related to loss of future output, medical treatment expenses and administrative expenses. This value is challenging to obtain, and so was taken and adapted from India using a rate of INR 437,342 and a PKR/INR exchange rate of 2.33 to obtain PKR 150,000 for these economic costs per injury (Kadiyali, 1982). The expected economic losses from accidents are summarised in Table 26**Error! Reference source not found.**.

Table 26: Expected economic loss from accidents per vehicle per annum

	Probability	Expected Economic Loss
Motorcycle rickshaws	0.26%	390 PKR
Motorcycles	2.19%	3,285 PKR
Other	0.718%	1,077 PKR

Safety benefits were first calculated for each type of vehicle considered in the analysis, v, and for each scenario, s:

$$Safety\ benefits_{v,s} = Extra\ vehicles_{v,s} * Expected\ economic\ loss_{v}$$

Where s represents the different scenarios being appraised, and thus will be a number from 2 to 5 (as there is no need to do these calculations for the baseline, scenario 1), v stands for vehicle type (motorcycle rickshaw, motorcycle, carry van, pickup or pedestrian). $Extra\ vehicles$ is the extra number of vehicles in circulation compared to the baseline scenario, and $Expected\ economic\ loss$ is equal to the probability of accidents times the economic loss of accidents per vehicle type, per year.

Then the total safety benefits per scenario were calculated by summing the safety benefits of all vehicle types:

$$Safety\ benefits_{s} = -\sum^{v} Safety\ benefits_{v,s}$$

4.4.2 Environmental costs

Road transport vehicles use several types of fossil fuels. Motorcycle rickshaws specifically use two types of fossil fuel-based product: motor spirit, and lubricants and greases. When used, these different types of fuel emit different levels of carbon dioxide, one of the major air pollutants. Here, we will use kilogrammes of carbon dioxide equivalent per terajoule ($kgCO_2e/TJ$) as the unit to measure changes in air pollution, caused (in this case) by road transportation.

The table below, adapted from Table 27 in Stiebert (2016), shows the estimated level of emissions of carbon dioxide equivalent per terajoule for the fuels used by motorcycle rickshaws: motor spirit and lubricants and greases.

Table 27: Carbon dioxide emissions by fuel type in Pakistan

Fuels	Emissions *(kgCO2e/TJ)*
Motor spirit	72,131
Lubricants and greases	36,796

In total, the use of motor spirit seems to be responsible for a greater proportion of carbon dioxide emissions than lubricants and greases. If 100% of the emissions caused by motor spirit is equal to 72,131 kgCO2/TJ, and 100% of the emissions caused by using lubricants and greases is equal to 36,796 kgCO2/TJ, what proportion of these emissions is linked to the use of motorcycle rickshaws?

To find out, we have to look at the amount of motor spirit and lubricants and greases being used by motorcycle rickshaws. Table 28 shows us just that: the percentage of total consumption of motor spirit and lubricants and greases for each vehicle type. This table was adapted from Table 24 in Stiebert (2016).

Table 28: Consumption of total motor spirit and lubricants and greases per vehicle type

Vehicle type	Motor spirit	Lubricants and greases
Motorcycle rickshaws	5.7%	4.5%
Motorcycles	18.3%	15.0%
Other	76.1%	80.5%

The table above indicates that motorcycle rickshaws consume 5.7% of all motor spirit used, and 4.5% of the total lubricants and greases used. If we put together this percentage of fuel usage with the carbon dioxide emissions for each type of fuel, we can get an estimate of the air pollution generated by different vehicle types, as shown in Table 29.

Table 29: Carbon dioxide emissions by vehicle type in Pakistan (in kgCO2e/TJ)

	CO2 emissions from motor spirit *(kgCO2e/TJ)*	CO2 emissions from lubricants and greases *(kgCO2e/TJ)*	Total CO2 emissions *(kgCO2e/TJ)*
Motorcycle rickshaws	4,111	1,656	5,767
Motorcycles	13,200	5,519	18,719
Other	54,892	29,621	84,512

From here we can infer that motorcycle rickshaws are linked to a total estimated air pollution level of 5,767 kgCO2e/TJ, whereas motorcycles are associated with an estimated air pollution level of 18,719 kgCO2e/TJ. We will now divide this by the number of registered vehicles, so as to be able to estimate the emissions caused by one single motorcycle rickshaw or motorcycle.

Table 30: Carbon dioxide emissions by vehicle in Pakistan (in kgCO2e/TJ)

	Total CO2 emissions *kgCO2e/TJ*	Registered vehicles	CO2 emissions per vehicle *kgCO2e/TJ/vehicle*
Motorcycle rickshaws	5,767	544,792	0.011
Motorcycles	18,719	12,476,856	0.002
Other	84,512	4,693,780	0.018

Table 30 shows that, while in total motorcycles overwhelmingly create the greatest contribution to carbon dioxide emissions, on a per vehicle basis a motorcycle is estimated to be less polluting than a motorcycle rickshaw or the average form of alternative transport. We can also look at this at the passenger level. Given

that our observations showed an average of 2 passengers per motorcycle and 6 passengers per motorcycle rickshaw (plus driver), this indicates that motorcycles will emit 0.0010 kgCO2e/TJ per passenger, while motorcycle rickshaws will emit an average of 0.0018 kgCO2e/TJ per passenger.

The appropriate shadow prices for each $kgCO_2e/TJ$ lacks any official figures, and so were adapted from Indian figures of INR 448 (Murty et al., 2006), using a PKR/INR exchange rate of 2.33. This gives a shadow price of PKR 1,044 per kilogram of carbon dioxide output. On this basis, the environmental impact per month is estimated to be PKR 0.92 for a motorcycle rickshaw and PKR 0.13 for a motorcycle.

For each type of vehicle, v, and scenario, s, environmental costs were calculated as:

$$Environmental\ costs_{v,s} = Extra\ vehicles_{v,s} * Emissions_v * Cost\ of\ emissions_v$$

Where $Emissions$ is the amount of kgCO2e/TJ emitted per vehicle, and $Cost\ of\ emissions$ is the shadow price of emissions per vehicle per year. To calculate the total environmental costs for each scenario, we summed the environmental costs for all vehicle types:

$$Environmental\ costs_s = -\sum^{v} Environmental\ costs_{v,s}$$

4.4.3 Fuel costs

Though typically included within the vehicle operating costs category, in our appraisal fuel costs were included as a category of its own to reflect the way Fuel Costs were measured in the surveys. Using data from the surveys conducted, it was assumed that motorcycle rickshaws used an average of 18 litres of fuel every month, while motorcycles used 23 litres on average. For sake of ease, PKR 100 per litre of fuel was applied as a midpoint between different fuel sources. On this basis, it was assumed that the average motorcycle rickshaw driver would pay PKR 19,300 per year on fuel and a motorcyclist would pay PKR 28,100 per year on fuel.

Fuel costs for each type of vehicle were calculated as:

$$Fuel\ costs_{v,s} = Extra\ vehicles_{v,s} * Fuel\ price * Fuel\ usage_v$$

Where $Fuel\ price$ is the price of fuel per litre, and $Fuel\ usage$ is the average amount of fuel used by vehicle type in a given year. Thus, total fuel costs were given by:

$$Fuel\ costs_s = -\sum^{v} Fuel\ costs_{v,s}$$

4.4.4 Value of time savings

According to our survey statistics, motorcycles typically travel at 36.7 km/h on journeys, whereas motorcycle rickshaws typically travel at 22 km/h. Further, average journey distances made by motorcyclists were 8.4 km, whereas motorcyclists typically travelled an average of 15.7 km.

The value of time statistics used were taken from 'The Project for Lahore Urban Transport Master Plan in the Islamic Republic of Pakistan' (JICA, 2012). They are summarised in Table 31. As the current study was conducted in 2019, we used the 2020 figures as the best available estimates.

Table 31 Value of time assumptions

	2010	2020	2030
	(PKR/min)	*(PKR/min)*	*(PKR/min)*
Car / Truck	3.68	5.03	7.49
Motorcycle	1.81	2.47	3.68
Motorcycle rickshaw	1.34	1.83	2.73
Bicycle	1.34	1.83	2.73
Wagon	1.43	1.96	2.91
Bus	1.42	1.94	2.89
Air conditioned bus	2.23	3.05	4.54

For each vehicle type, the value of time savings were calculated as:

$$VOTS_{v,s} = Trips_{v,s} * \left(Distance_v * \frac{60}{Speed_v}\right) * VOT_v$$

Where $VOTS$ is the value of time savings for vehicle v in scenario s, $Trips_{v,s}$ is the total number of trips done on vehicle v in scenario s, $Distance$ is the average distance of a trip done on vehicle v, $Speed$ is the average speed at which vehicle v travels and VOT is the value of time associated with using vehicle v. The value of time savings for scenario s was calculated through:

$$VOTS_s = \frac{VOTS_{motorcycle} + VOTS_{carry\ van} + VOTS_{pickup} + VOTS_{pedestrian} - VOTS_{qingqi}}{2}$$

The value of time savings for motorcycle rickshaws is subtracted from that of motorcycles, carry vans, pickups and pedestrians. Further, the rule of a half was applied to reflect the movement up or down along the transport demand curve.

Where the number of motorcycle rickshaws is likely to increase, and service patterns become more regular, such as in scenario 4, there may be a benefit from passengers having to wait for a reduced amount of time before boarding. To analyse this, we have applied a version of the 'rooftops' model, which predicts the pattern of arrivals at a bus stop, or in this case, at a recognised pick up point. Standard theory suggests that when no timetable exists, passengers will arrive at a pick up point in a uniform manner, with average wait times being closely related to the time between services, normally assumed to be half the time between services (so if there is 30 minutes between services, average wait time would be 15 minutes). In this case a reduction in the time between services, would result in a reduced average wait time. Where a timetable exists (and is publicised) the pattern of arrivals changes, with people tending to arrive closer to the expected time of the service. In this case, it can be assumed that average wait time might reduce to say 25% of the time between services. Where there is a combination of these two effects, the overall impact will be even greater.

For this analysis, no current information regarding wait times was available. It was therefore assumed that, based upon the survey results, the maximum time that anybody would be prepared to wait is 1 hour, so average wait time would be 30 minutes. Under scenario 4, the average wait time is likely to reduce to 25% of 30 minutes, so 7.5 minutes. This gives a benefit of 22.5 minutes per trip, which has been used.

4.4.5 Value of lost trips

The reasoning behind the value of lost trips calculation is based on the assumption that the value of lost trips would be greater where users' willingness to pay was higher, i.e. where people attach more value to a trip. The survey of users had enquired about people's willingness to pay extra for various features of motorcycle rickshaw services. The scenarios being appraised correspond to each of the features people were asked about, and can be summarised as:

- Scenario 2: "Motorcycle rickshaws carry only 6 passengers"
- Scenario 3: "Motorcycle rickshaws with 2 people per bench seat (four passengers in total)"

- Scenario 4: “Motorcycle rickshaws travel after each 15 minutes” (a proxy to the proposed training programme for motorcycle rickshaw operators, whose ultimate purpose would be to institute a timetable for more regular services)
- Scenario 5: “Extra safety features: handbrake, indicator, lights and rear gate”

We used the survey data on willingness to pay to draw conclusions about which changes to the motorcycle rickshaw market people would value the most (this data can be found in the *Perspectives of users S*ection 3.6.5). We used this to estimate how much they would be willing to pay for a trip in each scenario.

It turns out that users would be most willing to pay for the changes proposed in scenario 3, i.e. the seating regulation of a maximum of 4 people per motorcycle rickshaw; after this scenario, they would be most willing to pay for the security improvements introduced in scenario 5, and for the more frequent services that would be a consequence of scenario 4. The scenario for which they would be less willing to pay is 2, where the seating regulation would be enforced at a maximum of 6 passengers.

This hierarchy for how much more people would be willing to pay for each scenario was used to estimate the value of lost trips. Using a base cost of PKR 20 per journey, we assumed users’ willingness to pay for a trip in each scenario, and hence the value they would attribute to the trip, would be:

- Scenario 2: 20 PKR
- Scenario 3: 30 PKR
- Scenario 4: 25 PKR
- Scenario 5: 25 PKR

Thus, the value of lost trips was calculated by:

$$Value\ of\ lost\ trips_s = Trips_s * Proportion\ of\ lost\ trips_s * Value\ of\ trip_s$$

Where $Trips$ represents the number of trips done in scenario s, $Proportion\ of\ lost\ trips$ equals the percentage of total trips which are foregone in this scenario, and $Value\ of\ trip$ is the value that users attach to each trip, assuming that this value will be greater where willingness to pay is higher.

4.4.6 Number of generated trips

The number of generated trips was calculated only for scenario 4, where we assume there will be an increase in the demand for motorcycle rickshaws, hence a greater number of total trips taken and an increase in motorcycle rickshaw traffic.

$$Number\ of\ generated\ trips_s = Extra\ trips_s * \left(Distance_{qingqi} * \frac{60}{Speed_{qingqi}} \right) * VOT_{qingqi}$$

Where $Extra\ trips$ is the total number of additional trips done in scenario s when compared to the baseline, $Distance$ is the average distance of a trip done on a motorcycle rickshaw, $Speed$ is the average speed at which a motorcycle rickshaw travels and VOT is the value of time associated with using a motorcycle rickshaw.

4.4.7 Capital costs

For the economic appraisal, survey data on the purchase cost of vehicles was used. This is summarised in Table 32.

Table 32: Average purchase value per vehicle type from survey data

Vehicle type	Purchase value *(PKR)*
Motorcycle rickshaw	129,088
Motorcycle	57,051
Pickup	541,667
Carry van	660,833

The capital costs of vehicle v in scenario s were estimated as follows:

$$Capital\ costs_{v,s} = Extra\ vehicles_{v,s} * Cost_v$$

Where $Extra\ vehicles$ is the extra number of vehicles v in circulation compared to the baseline scenario, and $Cost$ is the purchase value of vehicle v. The total capital costs for scenario s were given by summing the capital costs for all vehicles:

$$Capital\ costs_s = \sum^{v} Capital\ costs_{v,s}$$

An exception to this is scenario 4, where the proposed policy would be to invest in training for the motorcycle rickshaw operators – in that case, the capital costs reflect the estimated costs of investing in such a training programme.

4.4.8 Operation and maintenance costs

Though typically included within the Vehicle Operating Costs category, in our appraisal the Operation and Maintenance costs were included separately, reflecting the way the data was collected in the surveys. During the surveys, data on maintenance cost, tyres and '*bhatta*' expenditures per vehicle type was collected. This data was then averaged and used as the basis for the calculation of the operation and maintenance (O&M) expenditure per vehicle type, as per the following equation:

$$O\&M_v = Maintenance\ costs_v + \frac{Front\ tyre_v + Back\ tyre_v}{6} + Bhatta_v$$

The data used for this is shown in Table 33.

Table 33: Average operation and maintenance costs per vehicle type per month, derived from survey data

Vehicle type	Maintenance cost *(PKR)*	Front tyre *(PKR)*	Back tyre *(PKR)*	*Bhatta (PKR)*	Total O&M costs *(PKR)*
	PKR	*PKR*	*PKR*	*PKR*	*PKR*
Motorcycle rickshaw	1,560	1,398	1,927	125	2,240
Motorcycle	823	1,398	1,927	150	1,527
Pickup	3,333	7,333	7,667	100	5,933
Carry van	2,558	4,667	5,083	0	4,183

O&M costs for scenario s were calculated through:

$$O\&M_s = \sum^{v} Extra\ vehicles_{v,s} * OPEX_v$$

Wherein $Extra\ vehicles$ is the extra number of vehicles v in circulation compared to the baseline scenario, and $OPEX$ is the yearly operating and maintenance expenditure of vehicle v (including maintenance costs and tyres).

4.5 Financial appraisal

4.5.1 Financial appraisal framework

A financial model was prepared to analyse the cost and revenue streams of the different scenarios under appraisal. The main purpose of this model was to assess the financial feasibility of scenarios 2 to 5 from the

perspective of motorcycle rickshaw operators, building a picture of their future financial position through the calculation of key metrics.

The financial appraisal incorporates all aspects of costs, with capital costs being covered either on an upfront or instalment basis, to demonstrate the sensitivity of investment value for a large upfront cost as opposed to smaller, recurring instalments.

Inputs to the financial analysis included passenger fares, capital costs of the vehicle, vehicle operating costs and fuel costs. Taxation is not accounted for as there is no obvious rate of tax to incorporate. Motorcycle rickshaws operate in the informal sector and their enterprises are not taxed directly.

For each scenario, free cash flow was thus calculated as:

$$Revenue - Capital\ Costs - Accident\ Costs - Fuel - VOC = Net\ Benefit$$

And net income was calculated following:

$$Revenue - Depreciation - Accident\ Costs - Fuel - VOC = Net\ Income$$

4.6 Definitions of key financial assumptions

In this section we explain the calculations behind the factors accounted for in the financial appraisal.

4.6.1 Revenue

A primary benefit for operators (and cost for users) is the fare for using transport services. From a financial perspective, this will be the primary determinant as to whether investing in a vehicle is deemed worthwhile.

Data on monthly revenue was collected from each operator and was supplemented by the understanding that motorcyclists do not use their vehicle commercially and thus make no revenue. The monthly revenue was then multiplied by 12 in order to understand the level of annual revenue for operators, and hence their annual turnover. This is shown in Table 34.

Table 34: Average revenue according to operators, survey data

Vehicle	Monthly revenue *(PKR)*	Annual revenue *(PKR)*
Carry van	28,083	336,996
Midibus (Coaster)	38,000	456,000
Minibus (Hiace)	32,250	387,000
Large bus	900,000	10,800,000
Pickup	18,000	216,000
Motorcycle rickshaw	18,256	219,072
Autorickshaw	19,333	231,996
Motorcycle	0	0

The motorcycle rickshaw revenue recorded aligns with operators in PD Khan who said they earned up to PRR 600 on school days and PKR 400 on non-school days (with school being a primary reason for travel).

4.6.2 Capital costs

Motorcycle rickshaws

The capital costs for this project are incurred by motorcycle rickshaw operators primarily through two means: either a one-time initial cost, or through regular instalments. Based on the mean response of the surveys, a unit cost of PKR 129,088 as a one-time initial cost was applied. This can broadly be corroborated in meetings with operators and suppliers, where new motorcycle rickshaws typically cost PKR 85,000-105,000 (though second-hand ones could be substantially less).

When paid through instalments, the total payment by the operator is typically PKR 22,857 as a deposit payment, with 20 monthly instalments of PKR 4,000. This is akin to focus group interviews with operators, in which it was stated that motorcycle rickshaws were often bought on credit and repaid across 2-3 years, and that instalments ranged between PKR 3,000 and PKR 5,000.

For income accounting, these capital costs need to be depreciated across their natural lifespan. Using estimates of the time of manufacturing, time since the purchase of the vehicles and the difference between valuation at purchase against valuation at present, one can use straight-line depreciation to understand how long the time is between original manufacturing and the time at which the vehicles are worthless. Using averages of these estimates, it appears that 12 years is the expected lifespan for a motorcycle rickshaw at purchase.

Motorcycles

The upfront capital cost of a motorcycle was PKR 57,051 on average. For motorcycles paid through instalments, the average deposit was PKR 19,800 with 16 instalments of PKR 2,450. Using the technique described above yielded an estimate of 13 years of expected lifespan at purchase.

4.6.3 Accident costs

Using a similar methodology to that used in the economic appraisal, the annual probabilities of accident used in the financial analysis were 0.26% for motorcycle rickshaws, 2.19% for motorcycles, and 0.718% for other motor vehicles.

When monetising accidents, repair costs for minor accidents can be taken from one study to include PKR 500 for motorcycle rickshaws, PKR 1,000 for motorcycles and PKR 12,000 for minivans and midibuses (Kazmi and Zubair, 2014). These figures were included in our analysis as financial costs.

We calculated the yearly expected financial loss from accidents by multiplying the probability of accident by the estimated financial costs of accidents, as shown in Table 35.

Table 35: Expected financial loss from accidents

Vehicle	Probability of accident	Expected Financial Loss *(PKR)*
Motorcycle rickshaw	0.26%	1.3
Motorcycle	2.19%	21.9
Other	0.72%	86.2

4.6.4 Fuel costs

Though typically included within the vehicle operating costs category, in our appraisal fuel costs were included as a category of its own to reflect the way fuel costs were measured in the surveys. As with the economic appraisal, we used data collected in the surveys to assume that motorcycle rickshaws used an average of 18 litres of fuel every month, and 23 litres for motorcycles. For sake of ease, PKR 100 per litre of fuel was applied as a midpoint between different fuel sources. On this basis, it was assumed that the average motorcycle rickshaw user would pay PKR 19,300 per year on fuel and a motorcyclist would pay PKR 28,100 per year on fuel.

4.6.5 Operating and maintenance costs

Operating and maintenance costs (O&M) were determined solely on the basis of surveyed operators. VOC included maintenance payments, regular payments to the authorities, and costs for occasional tyre replacements (assumed once every three months).

This gave motorcycle rickshaw payments a regular VOC of PKR 2,240 per month, or PKR 26,874 per year. For motorcycles, these values were PKR 1,527 and PKR 18,330 respectively.

4.7 Economic appraisal results

The economic appraisal results can be seen in Table 36 which presents the net present value and economic internal rate of return (EIRR) for scenarios 2 to 5, when compared to scenario 1.

Table 36: Economic appraisal results for motorcycle rickshaws

	NPV *(PKR)*	EIRR
Scenario 2	-3,235,996,703	less than zero
Scenario 3	-8,466,233,222	less than zero
Scenario 4	2,980,547,501	29.2%
Scenario 5	-919,186,132	less than zero

The net present value (NPV) of the investments represents the present value of the difference between the benefits and the costs associated with each scenario, in this case using a discount rate of 12% per annum. The economic internal rate of return represents the discount rate that would produce an NPV of zero. If the EIRR is more than 12% then this would reflect an investment which would pass the usual benchmark for economic viability. In this case, Scenario 4 is the only scenario with a positive EIRR of 29.2%. This represents an investment with good value for money.

4.8 Financial appraisal results

The results of the financial appraisal can be viewed in the context of financial performance indicators, such as net present value (NPV) and internal rate of return (IRR). In the financial analysis case, the results vary depending on whether the capital costs are covered by an upfront payment or through several instalments, which can be seen respectively in Table 37 and Table 38. Due to the nature of the cash flows associated with these options, it is not possible to calculate a reliable internal rate of return.

Table 37: Financial results with upfront payment

	NPV *(PKR)*	IRR
Scenario 1	1,297,276	cannot be calculated
Scenario 2	1,029,912	cannot be calculated
Scenario 3	702,770	cannot be calculated
Scenario 4	1,647,847	cannot be calculated
Scenario 5	1,258,781	cannot be calculated

Table 38: Financial results with instalment payments

	NPV *(PKR)*	IRR
Scenario 1	1,060,939	cannot be calculated
Scenario 2	821,796	cannot be calculated
Scenario 3	494,654	cannot be calculated
Scenario 4	1,439,731	cannot be calculated
Scenario 5	1,009,041	cannot be calculated

The results of this analysis can also be viewed as financial statements, in which the bottom-line represents what a motorcycle rickshaw operator would expect to take home at the end of each month. The financial statements on a monthly basis can be outlined in cash flow and net income terms. Table 39 shows what the financial income would be like on an instalment payment basis for scenario 4, the best-case scenario. Effectively, operators would expect PKR 7,000-8,000 when paying instalments, and once the instalments are paid, this cash flow then rises nearer to PKR 14,000 per month. After fuel and vehicle operating costs,

the operating margin is typically 35-40%, which is strong. However, when viewed in absolute terms, prospects are poor for motorcycle rickshaw operators.

We have presented the results of the financial appraisal for scenario 4 below, as this reflects the most viable scenario of those tested.

Table 39: Financial statements for motorcycle rickshaws, scenario 4

Model Period Ending	08/2019 *(PKR)*	09/2019 *(PKR)*	10/2019 *(PKR)*	11/2019 *(PKR)*	12/2019 *(PKR)*	01/2020 *(PKR)*
Cash Flow						
Revenue	21,907	21,997	22,086	22,176	22,267	22,357
Capital Cost	(26,857)	(4,000)	(4,000)	(4,000)	(4,000)	(4,000)
Accident Cost	(1.3)	(1.3)	(1.3)	(1.3)	(1.3)	(1.3)
Fuel	(1,830)	(1,837)	(1,845)	(1,852)	(1,860)	(1,867)
Vehicle Operating Cost	(2,240)	(2,249)	(2,258)	(2,267)	(2,276)	(2,285)
Net Benefit	**(9,020)**	**13,910**	**13,983**	**14,056**	**14,129**	**14,203**
Income						
Revenue	21,907	21,997	22,086	22,176	22,267	22,357
Accident Cost	(1.3)	(1.3)	(1.3)	(1.3)	(1.3)	(1.3)
Fuel	(1,830)	(1,837)	(1,845)	(1,852)	(1,860)	(1,867)
Vehicle Operating Cost	(2,240)	(2,249)	(2,258)	(2,267)	(2,276)	(2,285)
Net Benefit	17,837	17,910	17,983	18,056	18,129	18,203

PKR 14,000 per month is approximately USD 3 per day, which is low in the context of income. Thus, while motorcycle rickshaws are economically and financially sound in terms of investing money, as a means of income they are best viewed as worthwhile in the absence of alternative investments. This sentiment was reflected in discussions with operators, who would have been happy to switch to other employment, if suitable opportunities had been available.

Looking at the worst-case scenario – scenario 3, where the seating regulation is enforced to a maximum of 4 passengers per motorcycle rickshaw (which is the current legal limit, although this is not generally enforced), the financial statements are as shown in Table 40.

Table 40: Financial statements for motorcycle rickshaws, scenario 3

Model Period Ending	08/2019 *(PKR)*	09/2019 *(PKR)*	10/2019 *(PKR)*	11/2019 *(PKR)*	12/2019 *(PKR)*	01/2020 *(PKR)*
Cash Flow						
Revenue	12,414	12,465	12,516	12,566	12,618	12,669
Capital Cost	(26,857)	(4,000)	(4,000)	(4,000)	(4,000)	(4,000)
Accident Cost	(1)	(1)	(1)	(1)	(1)	(1)
Fuel	(1,830)	(1,837)	(1,845)	(1,852)	(1,860)	(1,867)
Vehicle Operating Cost	(2,240)	(2,249)	(2,258)	(2,267)	(2,276)	(2,285)
Net Benefit	**(18,513)**	**4,378**	**4,412**	**4,446**	**4,481**	**4,515**
Income						
Revenue	12,414	12,465	12,516	12,566	12,618	12,669
Accident Cost	(1)	(1)	(1)	(1)	(1)	(1)
Fuel	(1,830)	(1,837)	(1,845)	(1,852)	(1,860)	(1,867)

Vehicle Operating Cost	(2,240)	(2,249)	(2,258)	(2,267)	(2,276)	(2,285)
Net Benefit	8,344	8,378	8,412	8,446	8,481	8,515

This demonstrates, that while financially sound from an investment perspective, the net benefit for operators is so meagre that, while still better than nothing, leaves the operator in poverty.

4.9 Sensitivity tests

The sensitivity tests for the economic appraisal were conducted as follows:

- **Sensitivity test 1 (ST1):** NPV and EIRR were calculated after decreasing the capital costs by 20%
- **Sensitivity test 2 (ST2):** NPV and EIRR were calculated after increasing the total benefits by 20%
- **Sensitivity test 3 (ST3)**: NPV and EIRR were calculated after decreasing the discount rate by 2% (from 12% to 10%)

Table 41 shows the baseline NPV results for all scenarios under the economic analysis, as well as the results of two sensitivity tests used to assess the robustness of these results.

Table 41: Economic appraisal sensitivity test results

		Baseline analysis	ST1	ST2	ST3
Scenario 2	**NPV** *(PKR)*	-3,235,996,703	-3,076,563,497	-3,434,382,638	-3,541,738,163
	EIRR	Less than zero	Less than zero	Less than zero	Less than zero
Scenario 3	**NPV** *(PKR)*	-8,466,233,222	-8,101,814,467	-9,133,620,655	-9,292,811,798
	EIRR	Less than zero	Less than zero	Less than zero	Less than zero
Scenario 4	**NPV** *(PKR)*	2,980,547,501	3,636,304,615	5,106,981,971	3,668,428,864
	EIRR	29.2%	37.1%	39.9%	29.2%
Scenario 5	**NPV** *(PKR)*	-919,186,132	-691,424,410	-899,145,280	-913,664,213
	EIRR	Less than zero	Less than zero	Less than zero	Less than zero

The implications of the sensitivity tests for the four alternative scenarios are as follows.

- **Scenario 2**: In ST1, the NPV increases and the EIRR remained N/A. In ST2, the NPV decreases. This decline in NPV occurs because, in the case of scenario 2, the benefits had a negative sign to begin with; thus, increasing them by 20% means that their value would become more negative, which in turn would result in a reduction of the NPV. This is because aspects like safety benefits, fuel savings and lost trips – all accounted for in the benefits of this scenario – were smaller than those in baseline scenario 1. The NPV decreased in ST3, when the discount rate was reduced from 12 to 10%, and the EIRR remained N/A.
- **Scenario 3**: The NPV was increased with ST1, where capital costs are decreased, while the EIRR remained N/A. In ST2 (and similarly to what happened in the tests for scenario 2), the NPV decreased and the IRR remained N/A. The NPV decreased in ST3, when the discount rate was reduced from 12 to 10%, and the EIRR remained N/A. These declines in NPV occur because, in the case of scenario 2, the benefits had a negative sign to begin with; thus, increasing them by 20% means that their value would become more negative, which in turn would result in a reduction of the NPV
- **Scenario 4**: In this case, the baseline EIRR was already positive. In ST1, both NPV and EIRR increase, with the EIRR continuing to be above the desired 12% benchmark. In ST2, the EIRR is further improved and surpasses 12%. This is because, in the case of scenario 4, the total benefits were positive to begin with, and thus increasing the benefits by 20% has a positive impact on both the NPV and EIRR of this scenario. In ST3 the NPV remains higher than in the base scenario, although when the discount rate was reduced from 12 to 10%, the EIRR reduces to the original 29.2%.
- **Scenario 5**: In both ST1 and ST2, the NPV increased for scenario 5. The NPV also increased slightly in ST3, when the discount rate was reduced from 12 to 10%, and the EIRR remained N/A.

4.10 Explanation of the results

4.10.1 Economic appraisal implications

With the exception of scenario 4, which had an NPV of PKR 2,980,547,501, the other scenarios considered in the economic analysis had negative NPVs, and thus may not represent good value for money from the perspective of motorcycle rickshaw users and society as a whole. This is because the different scenarios tested require changes which may carry more costs to society when compared to the status quo. Most of the measures put forward in these scenarios (with the exception of scenario 4) would lead to a greater demand for motorcycle rickshaws than what the fleet could withstand; for example, scenarios 2 and 3 would do this through the enforcement of a maximum number of passengers. Therefore, some of the people that used to travel on motorcycle rickshaws would not be able to do so anymore: there would be displaced demand for this mode of transportation. As such, and based on the data collected through the survey, new vehicles would potentially enter the market to accommodate for this displaced demand for motorcycle rickshaws - a hypothesis which is reflected in the economic analysis.

A few examples of negative economic impacts brought on by these scenarios versus the baseline scenario are:

- **Greater capital costs**: in scenarios 2, 3 and 5, new motorcycles, carry vans and pickups would enter the market to accommodate for the excess transport demand; this would ultimately lead to greater capital costs than the baseline scenario. Larger capital costs can also be found in scenario 4, which requires an initial investment in training for the motorcycle rickshaw operators.
- **Greater O&M costs:** in a similar fashion, the introduction of new motorcycles, carry vans and pickups would imply a rise in the costs of operating and maintaining vehicles when compared to scenario 1. The exception to this was scenario 5, where the size of the motorcycle rickshaw fleet was assumed to decline with the increase in capital costs, prompted by stricter safety regulations – in this case, the O&M costs decreased in comparison to scenario 1.
- **Smaller safety benefits:** having a greater number of vehicles in circulation would increase the chances of accidents happening, and lead to greater accident costs than in the baseline case.
- **Greater environmental costs:** introducing more vehicles to satisfy excess transport demand would lead to increased emissions of greenhouse gases, and thus increase the environmental costs versus scenario 1.

Although the NPVs for scenarios 2, 3 and 5 are negative, with economic internal rates of return that are less than zero, both measures are positive for scenario 4. This shows that scenario 4 (*Investment in training)*, represents a good investment.

4.11 Financial appraisal implications

The results indicate that the proposed reforms have a tangible impact on the value of the motorcycle rickshaws. The worst-case scenario (scenario 3) represents a 45% loss and 55% loss in total net profit for operators for upfront and instalment payments respectively. The best-case scenario (with incomes boosted) increases the present value by nearly a third.

The total benefits-to-cost ratios for every option indicate the overall benefits outweigh the costs for operators. However, the benefits of the current situation are greater than the various enforcement scenarios. From the models, it appears that the use of motorcycle rickshaws is better for the operators and provides greater economic welfare for society than a greater use of motorcycles (which is likely to be the reality in the coming years).

One major issue is that the total present value for motorcycle rickshaws is low for an income-generating asset dedicated to one person (the operator) who is not able to invest and use other motorcycle rickshaws simultaneously. This is confirmed by the opinions of the operators themselves, who feel that trying to earn a living by owning a motorcycle rickshaw is only attractive for people without other options. It is better than nothing, but it does not provide a good livelihood for the head of a family. The various enforcement

scenarios would all make the current situation worse for the motorcycle rickshaw operators, and risk making their situations unsustainable.

The models developed could be used to explore various scenarios relating to future strategies. For example, if it were to be suggested to replace motorcycle rickshaws with auto-rickshaws, this would entail a 170% increase in capital costs, combined with a possible reduction to two legal passenger seats. The implications of the survey findings and the appraisals will be explored in the following section.

5 Implications for policies and strategies

5.1 Key issues arising

5.1.1 Motorcycle rickshaw service characteristics

There may now be two million motorcycle rickshaws in Pakistan, half of which are in Punjab Province. This is a huge increase since they were first introduced in the 1990s. Most operate as route-based services in rural areas, small towns and city suburbs. They are low-cost vehicles offering low-cost transport for low-income people.

In city centres, auto-rickshaws offer point-to-point taxi services. Their small size, manoeuvrability, low cost and cheap tariffs make them convenient vehicles in congested urban streets. While they are much cheaper to buy than their 4-wheel taxi competitors, auto-rickshaws are more expensive to buy and to run than motorcycle rickshaws. They are seldom seen far from city centres. Their higher costs and smaller seating capacity (2/3 seats, nominally) make them less suited to route-based transport services than the motorcycle rickshaws.

While motorcycle rickshaw and auto-rickshaw numbers have been steadily growing in the past three decades, motorcycles numbers have been growing exponentially, a trend that is set to continue in the coming years, with trebling of motorcycle numbers by 2025 (Pakistan, 2018b). The low cost of motorcycles (PKR 57,000 new) and their availability though modest instalment payments makes them increasingly popular in urban and rural areas. On the rural roads surveyed, motorcycles accounted for 63% of all vehicle numbers and 47% of the people travelling along the road (by all modes). This is increasing the mobility of men (with sufficient resources), with some benefits to rural women who can be carried by their male relatives. Motorcycles appear to be the riskiest form of transport due to driver behaviour, lack of protection, overloading and the thoughtless driving of other road users.

Motorcycle rickshaws are a low-cost, low status transport for those without cars or motorcycles. They are popular with many rural women and men. Motorcycle rickshaws are often the only available low-cost transport for journeys to market towns and clinics. On none of the roads studied were there any ‘conventional’ transport services (Hiace minibuses, Coaster midibuses or large buses) operating regularly between the villages and the nearby towns. A few buses may start in some villages and provide commuter services to cities in the early morning, with return in the evenings, but these are not suitable for the short journeys to the markets, clinics and local schools required by rural residents, particularly women with families.

5.1.2 Gender issues and the effects of increasing motorcycle use

Motorcycle rickshaws are currently indispensable for low-income rural women. Very few rural families own cars. The more affluent rural women can use hired, expensive, point-to-point taxis services (carry-vans and rent-a-cars) for the transport of themselves, their families and their school children. Most rural families now own motorcycles. In the user surveys, 91% of people interviewed had at least one motorcycle in their household. Motorcycles in rural areas are invariably driven by men. They may carry female relatives, but in traffic counts of 15,000 rural motorcycles, only 18% of travellers were women. While male relatives may carry women for specific trips, it is very difficult for women (and non-motorcycle-owning men) to undertake multipurpose trips (shopping, clinics) without their own transport or some regular transport services. Many men leave their villages early in the morning (by motorcycle or by other transport) and so are unavailable to assist the women of their household with transport. In the absence of an available male relative with a motorcycle, women must choose between staying at home, walking or using public transport. Most rural roads surveyed had no viable alternatives to motorcycle rickshaws. However, on one busy rural road in Jhelum, pickups and motorcycle rickshaws shared the passenger market (with a joint informal timetable). This option was not available on the other roads surveyed, where motorcycle rickshaws were the only public transport services operating regularly.

The overall market for rural passenger transport services is declining, due largely to the rapid growth in the use of personal motorcycles. This is decreasing the economic viability of low-cost transport services such as

motorcycle rickshaws, and so makes the prospects for larger public transport vehicles (pickups or minibuses) on such village-to-market routes even less viable. The small-scale freight market seems to be prospering, with 'loader' motorcycle rickshaws increasingly carry loads that used to be carried by people or animal-drawn carts.

5.1.3 Motorcycle rickshaws as a source of employment and livelihoods

While motorcycle rickshaws are widely perceived as a low-status form of transport, operating a motorcycle rickshaw is seen as a reasonable employment opportunity by low-income men. The low cost of motorcycle rickshaws, and the availability of new or second-hand machines through instalments, makes it feasible for someone to buy a motorcycle rickshaw with a deposit of only a few thousand rupees.

As operating motorcycle rickshaws is seen as reasonable employment, more operators than are required by the transport demand have entered the market, reducing the earning potential for others. In a classic 'tragedy of the commons' scenario, it is in every operator's interest that there are fewer operators, but no one sees it as in their individual interest to withdraw, particularly as they see no other work opportunities. Many operators would prefer to operate other vehicle types (auto-rickshaws, pickups, minivans, minibuses), if there were an opportunity. They would also withdraw from the transport market if offered alternative, suitable employment.

Despite widely circulated myths, rural motorcycle rickshaw drivers are not 'underage' but family men (their average age in the survey was 33). Like most rural people in Pakistan, they have not had much education or training relating to road safety, safe driving and empathetic consideration for other road users. They try to maximise their meagre income by carrying more people. Passengers generally accept this, although women do not like to travel in crowded vehicles.

5.1.4 Regulatory framework, enforcement and compliance

The regulatory framework of motorcycle rickshaws is complex and confusing, and most stakeholders do not fully understand all the issues. The Supreme Court has ruled motorcycle rickshaws are legal, provided they conform to certain standards, including manufacture by approved factories. Most, if not all, motorcycle rickshaws on the road do not currently conform to these standards. To add complexity, the Punjab Transport Department is not currently authorising the licensing of any motorcycle rickshaws, whether made in authorised factories, or not. Sindh has different regulations and is currently licensing motorcycle rickshaws and auto-rickshaws. This adds to the confusion and provides opportunities for producers and buyers to benefit by exploiting the regulatory divergence.

There are currently seven formal sector factories authorised to manufacture motorcycle rickshaws. However, half the current production comes from informal-sector workshops. Informally-made rickshaw bodies appear popular with users and operators, and the close feedback between workshops, sellers and operators allows workshops to fine-tune designs to the needs of their clients. The small workshops do not follow 'best-practice' procedures for production, health and safety, but they are run by skilled artisans, proficient at their businesses. Most have received no information, support or training to improve their practices. There appears no evidence to suggest that artisanal production is intrinsically poor or unsafe.

Whether or not informal workshops should be closed and whether the current Pakistan Standards for motorcycle rickshaws are entirely appropriate will be an important issue relevant for future production. More critical in the short term, is the current operation of the existing fleet of two million motorcycle rickshaws. While there may be problems to fix in some vehicles, the vast majority appear roadworthy. From observations and survey findings, the problems related to safety are arguably very seldom due to technical issues: they are largely due to operational issues (how they are loaded and driven) and the behaviour of other road users.

Like many people in Pakistan, motorcycle rickshaw operators do not feel they need to comply with vehicle and traffic regulations, unless these are enforced. In rural areas enforcement is minimal, and is seldom genuine enforcement but rather '*bhatta*' discussions.

The issues related to motorcycle rickshaws are not new. The problem of non-compliance and non-enforcement has been continuing for years. Non-compliance and non-enforcement are common in Pakistan and occur throughout the transport sector. Arguably, the rapidly increasing number of motorcycles presents a bigger problem, in terms of road behaviour (helmet compliance, overloading, speed and poor driving).

5.2 Possible actions and reactions

From the issues emerging, there are various actions that could be taken in the short, medium and long terms. Some issues relating to motorcycle rickshaw operators are behavioural. They are not specific to this type of transport, but are societal issues. If problem attitudes and behaviours are embedded throughout society, trying to tackle one small sector will not really help, if the norms surrounding them do not change. This need not be an argument for 'laissez-faire' but rather a more ambitious long-term vision of improving all transport options and other sectors in Pakistan.

Poor driving and road safety are real concerns and need great attention in the whole country. Trying to improve the knowledge and behaviour of one small group of drivers is always desirable, but in reality, it will not make a large difference if all the other drivers they meet continue to drive selfishly and dangerously. Road safety training and education should be a priority for the whole country, not just for the drivers of motorcycle rickshaws.

Non-compliance and non-enforcement in rural areas are other societal issues that need to be addressed throughout the transport industry, and in other sectors. It is unreasonable to expect motorcycle rickshaws to conform with regulations, and for rural police to enforce them, if motorcyclists and other forms of transport are similarly culpable. Reform must be consistent within and across sectors and be accepted in principle by the people and the enforcers. This will not be a quick or easy task.

In addition to the general actions of improving road safety, compliance and enforcement in Pakistan, there appear to be five key options for possible strategies. The various actions are not necessarily exclusive (there could be combinations of more than one and/or the phasing-in of actions over time).

- Maintain the current status quo in terms of rural enforcement
- Enforce seating rules and loading levels, limiting loading to six passengers
- Enforce design standards and close non-authorised workshops, limiting loading to four passengers
- Promote improved operating procedures and safety standards through training
- Promote alternative transport services, leading to a reduction in demand for motorcycle rickshaws.

Maintaining the status quo in terms of rural enforcement is the easiest option and the default. This would be a good option for the rural people (operators and users) who are actually benefitting from the current situation. Under this scenario, overloading would continue and the current level of crashes (which is low on rural roads) is likely to continue. Rural women would complain a little as they like less-crowded vehicles (however, they also say they prefer crowded vehicles to no vehicles at all). The current status quo for motorcycle use on the rural roads is unlikely to be maintained, as motorcycle adoption would continue relentlessly. Over time, this would make the public transport market increasingly difficult for operators, some of whom might give up operating.

The enforcement of seating rules and loading levels would be very difficult. Compliance and enforcement are problematic in all of Pakistan, particularly in rural areas. There are few enforcers and few incentives to comply and enforce. Indeed, the incentives are for non-compliance. Even in repressive countries with strict enforcement, traffic rules tend to be broken outside the confines of the cities and towns. There might be scope for working with local associations and encouraging self-regulation and the development of timetables, particularly if this could be combined with some incentives. Limiting motorcycle rickshaws to four passengers should lead to more frequent services, and greater numbers of trips per day per motorcycle rickshaw (albeit with higher fuel costs and less income unless fares rose substantially). This could be shown to work on a pilot basis, but rolling out the schemes widely would require funds, training and dedication.

The enforcement of current design standards and the closing of non-authorised workshops has been the intended policy of Punjab Province for ten years. There have been some moves in that direction in recent months. If implemented, this policy will be popular with the formal-sector manufacturers of rickshaws, and those wanting a more industrialised, formal-sector economy. However, it will remain unpopular with the even larger-scale pickup-manufacturing factories that want to see the end of three-wheelers. If implemented, it would certainly cause short-term suffering and distress to the workshop owners and their employees. Given the sensitivity of local authorities to unpopular closures and job losses, together with the track record of Punjab Province on this issue over the past decade, sustained enforcement appears very unlikely.

Improving operating procedures and safety standards would be undertaken through an externally funded training programme for operators. The main objectives of this training programme would be to encourage the adoption of a timetable approach to operation, explain the safety benefits of different driving styles, and encourage the fitting and use of safety equipment. The end result of this training will be a more reliable service, and a more user-friendly timetable throughout the day. Safety training will enhance driver performance ensuring fewer crashes and casualties. Together it is expected that these two will increase demand for motorcycle rickshaw services, which in turn will encourage more operators to purchase vehicles.

Raising design standards would be a long-term operation, which would take years to have an impact, given the existing fleet of two million motorcycle rickshaws and the time needed to develop, test and implement the improved designs. The quickest option would probably be to adapt an auto-rickshaw design, but with two rows of seats (as some current models) to make them more suitable for route-based operations. Current auto-rickshaws have many desirable features, including good windscreens, drive shafts (as opposed to chain drives), reverse gears and an enclosed environment providing protection from weather and privacy for the passengers. They have a proven track record for a long, reliable operational life. While they are mainly used world-wide as urban point-to-point vehicles, their small-scale use in rural areas has been noted in several countries, including Pakistan. All the current manufacturers of motorcycle rickshaws also make auto-rickshaws, so a move to adapted auto-rickshaw designs would be feasible. Such a move could be combined (in the medium term) with the production of battery-operated options. As noted, electric vehicles are not likely to be economically viable in Pakistan, but they may be in a few years. The main problem, is that motorcycle rickshaws are market-driven, and have spread due to their low purchase price and low operating costs. They have even been spreading inwards into the cities (key auto-rickshaw territory), being only stopped by bans and enforcement in these locations. Auto-rickshaws have been available for more than three decades, during which time they will have been tried out in rural areas many times, but they have generally not been considered optimal for rural route-based operations. The key problem is their cost. They are around 170% more expensive than motorcycle rickshaws. Their widespread use in rural areas would probably push up transport costs and fares, accelerating motorcycle adoption and reducing travel for poorer people, particularly women. It would take more than a decade for any such initiative to start to have a positive impact in rural areas, by which time motorcycle ownership will be extremely high, and low-cost, small-scale public transport may be mainly used by women, older persons and young people (including school runs).

The promotion of alternative transport services might be possible based on more stable and safer four-wheel designs. Minibuses are expensive to buy and only commercially viable with large loads (16 people). These are not generally financially viable for short-distance transport in rural areas: their 'niche' is operating on high-demand routes over distances of more than 20 km. They often provide premium, express services on main roads, or commuter-type village-to-city services at peak periods. It is said that the bus and minibus operators have strong associations that vigorously defend their routes against potential competition.

Smaller transport options include pickups (with sideways facing benches) and carry vans (nominally carrying six people). Their capital and running costs are greater than auto-rickshaws, and very much more than motorcycle rickshaws. This would make new vehicles adhering to legal seating limits unviable as low-cost public transport options. Currently cheap, old carry-vans are available, but they are not being used except on school runs (over-crowded on low cost services) and as point-to-point taxis (that are expensive). Some

pickups are being used, but they survive by overloading passengers. Their financial model only works if they take large numbers of school children or many more adults than is legally allowed. Apart from the rush hours of school runs and commuter journeys, the transport demand during the day on most roads is low, and it takes a long time to fill-up a motorcycle rickshaw (leading to complaints), and even longer to fill up a pick-up. The interesting example of pick-ups collaborating with motorcycle rickshaws in Jhelum shows that pick-ups can provide rural transport services on busy roads with high transport demand, but probably not if they adhered to legal loading levels. As noted before, the issue of electric vehicle options is not very relevant at the moment, as these are not yet available or financially viable. However, in the medium to long-term, low volume transport services (and personal means of transport) are likely to be electric.

Some of these strategies, and possible consequences and unattended consequences are shown in Table 41.

Table 41 Some possible actions, intended and unintended consequences

Possible action	Intended consequence	Possible other consequences	Implications of other consequences
Maintain the status quo	Rural people (and rural women in particular) retain sustainable, low cost, transport services	Rates of overloading (high) and crashes (quite low in rural areas) continue	Continued criticisms of motorcycle rickshaws from the media and urban elites Continued moves towards motorcycle adoption, benefiting mainly men
Enforce seating rules and loading level	Better comfort and safety	Higher fares	Greater move to more motorcycles, benefiting mainly men Less demand Fewer people travel, especially women, with consequences for family welfare More walking Unemployment of operators due to market reduction
		More vehicles on the road, particularly in peri-urban areas, although current over-supply may absorb some of this	Greater congestion and pollution but more low-income employment
Enforce design standards and close non-authorised workshops	Better vehicle quality and safety and strengthening of the formal industrial sector	Unemployment of workshop artisans and those in the informal supply chain. Elimination of the current rapid feedback between supply and demand	Disadvantaged, poorer people suffer at the expense of the formal sector. Fewer innovative workshops and repair facilities
Training in operation and safety	More reliable, user-friendly services, with fewer crashes	The cost of transport may rise slightly in the short term, as more empty, or less than full running occurs	In the short term, some passengers may be priced off motorcycle rickshaw services
Raise design standards	Better vehicle quality and safety in the medium to long term	Rural transport prices rise	Greater move to more motorcycles, benefiting mainly men Less demand Fewer people travel, especially women, with consequences for family welfare More walking Unemployment of operators due to market reduction
Promote alternative transport services	Safer and better forms of rural transport services	Sustainable motorcycle rickshaws eliminated Rural transport prices rise	Greater move to more motorcycles, benefiting mainly men Less demand Fewer people travel, especially women, with consequences for family welfare More walking

6 Stakeholder workshop

6.1 Objectives, logistics and presentations

NTRC hosted a workshop on motorcycle rickshaws on 5 September 2019 to disseminate and discuss the initial findings of this research and involve key institutional stakeholders in formulating recommendations for realistic strategies. About 100 participants attended, with a wide range of high-level stakeholders from federal and provincial government, statutory authorities, the manufacturing sector, road safety organisations, academia and the international development sector. The Chief Guest, who opened the workshop, was the Secretary, Ministry of Communications. A detailed report of this workshop has been prepared (Starkey et al., 2019e).

The objective of the morning session was to allow the research team to share their initial findings and emerging issues with participants, including lessons from other countries. The team gave two presentations summarising the preceding content of this current report.

The afternoon workshop session enabled participants to discuss the key issues emerging and try to develop realistic strategy options to overcome constraints and improve the situation. Four key areas for discussion had been identified. Participants selected their preferred group of topics and debated some of the key questions and issues raised. Their observations and conclusions are summarised in the following sections.

6.2 Group discussions

6.2.1 Motorcycle rickshaw use: safety, compliance and enforcement

Group briefing: *Motorcycle rickshaws are not intrinsically dangerous if used correctly in a safe environment. They can be made unsafe by dangerous practices (e.g. overloading) and the behaviour of other road users. Dangerous driving and non-compliance are common in all modes of transport, in urban and rural areas. Enforcement in rural areas is particularly difficult (worldwide). How can driving and operating behaviour be addressed realistically? In what timescale? What are realistic, enforceable passenger numbers for three-wheelers on low-volume rural roads? How can we encourage or incentivise operators to comply? Can enforcement be realistically phased in? What is a realistic time-scale to propose?*

The group members felt that enforcement of motorcycle rickshaw safety regulations and compliance was realistically possible within one to three years, if there was a concerted effort and appropriate enforcement and inducements. A strict enforcement campaign should be initiated against under-age motorcycle rickshaw drivers across the country. A special awareness campaign should be initiated harnessing the support of local communities as well as law enforcement agencies.

The group proposed the introduction of a new category of driving licences for three-wheeler public transport (motorcycle rickshaws and auto-rickshaws). This would be along the lines of the special requirements for Public Service Vehicles (PSV) and Heavy Goods Vehicles (HGV). Motorcycle rickshaw drivers would have to undertake mandatory training and pass a test, before the licensing authorities would issue these licences.

There was a need to more clearly define and implement appropriate vehicle registration mechanisms and operational regulations for motorcycle rickshaws. These should include the current legal maximum of four passengers, which the group believed was enforceable. Where practicable, motorcycle rickshaws should be restricted to rural roads.

Existing motorcycle rickshaws that do not comply with official standards should be identified and modified to ensure compliance. The government should facilitate this through incentives, such as interest-free loans to pay for the necessary changes. The manufacturers of motorcycle rickshaws could assist the process by having outreach schemes allowing low-cost modifications to bring all vehicles up to current standards.

6.2.2 Motorcycle rickshaw specifications: policies, standards, registration and manufacturing

Group briefing: *The federal government and provincial policies on rickshaws are not always clear and sometimes appear contradictory. What should the policies be? Are three-wheelers part of the future of Pakistan? Is there a need to alter current registration procedures in the Punjab? Are the latest technical standards now appropriate? Do rickshaw passengers really need gates? How can the small-scale workshops now making motorcycle rickshaws be assisted to improve their products so that they comply with standards? What should happen to the one million operating motorcycle rickshaws that have already been made by the informal sector?*

Currently, there is no clear alternative to three-wheeler motorcycle rickshaws for rural transport services, so they should be allowed to continue to operate until viable alternatives become available. The two million existing motorcycle rickshaws cannot be eliminated, but they could be regulated, through improved vehicle testing and registration procedures.

The Provincial Transport Authority should allow all existing motorcycle rickshaws to be legally recognised vehicles. The Excise and Taxation Departments should register them as 'motorcycle rickshaws'. Registration should be facilitated by allowing operators to register their vehicles at a district level. Registration should require the operators to obtain fitness certificates from Vehicle Inspection and Certification System (VICS) centres. VICS should develop and implement appropriate testing and certification procedures for motorcycle rickshaws.

Pakistan Standards and Quality Control Authority (PSQCA) and the Punjab Transport Authority (PTA) should have uniform policies for motorcycle rickshaws and auto-rickshaws enabling approved models to be registered and operated. Further work is needed on the PSQCA standards. In particular, the current designs of the front and back gates suggested for motorcycle rickshaws need to be altered to make them safer and easier to operate. Current designs can be inconvenient and unsafe, particularly if they protrude from the vehicle when open.

The informal sector workshops that manufacture three wheelers need to be assisted to be registered and regulated by specific government departments (e.g. the Provincial Transport Authority). They should be assisted to conform to PSQCA standards (although these may need further development to ensure they are appropriate for all types of workshop).

Pakistan should benefit from the studies on rickshaws carried out in other south Asian countries such as India, Bangladesh, Nepal and Myanmar in order to develop appropriate policies for three wheelers in the coming three years. Research conducted in Pakistan, such as this study, should lead to policy and strategy implementation, and not left on the shelf.

6.2.3 Motorcycle rickshaws benefits: mobility for women and improving the image

Group briefing: *Poor rural women currently depend on motorcycle rickshaws as their only available and affordable public transport in villages: how can their rights to mobility be preserved and their transport needs met? For women, men and school children, motorcycle rickshaws are invaluable in the rural areas and are 'optimising' low-cost transport, allowing convenient mobility and linking villages to the main transport networks. How can their status, image and reputation be improved to reflect their important current role in Pakistan society?*

Women would benefit from good, appropriate designs and consistent manufacturing. Women prefer the seating to be more enclosed and with physical barriers between rows. Forward-facing seats allow passengers to be aware of what is ahead, so two rows of forward-facing seats separated by a physical screen might be appropriate. The designs of motorcycle rickshaws (and any gates that are fitted) should allow women to board and alight easily, even when carrying children and/or goods. Current designs can tip embarrassingly if a large person boards the back seat of an unloaded motorcycle rickshaw.

There was a need for improved operator behaviour and awareness, and this could be achieved through the development of a new training curriculum and specific operator training and testing, with a new category of driving licences for small-scale public transport operators. There should be clear identification of both vehicles and their operators (e.g. visible registered numbers on tabards) to allow offending vehicles and

their operators to be easily identified by the public. Associations could be encouraged and facilitated to enforce good practices, and also assist with developing informal operational timetables to increase transport frequency and the fairer sharing of the market between existing operators.

The group concluded that the image of the motorcycle rickshaw could be improved through the better behaviour of drivers, which would be linked to the proposed new licensing and training system and the anticipated cooperation with associations/unions assisting self-regulation. The government should develop a positive policy guideline on the future of motorcycle rickshaws, which would be proactive in promoting good practices, with soft loans available for investments in improved technologies and processes. This should encompass federal level institutions (including the Ministry of Communications that might be the initiator), provincial government and local government. This policy would recognise both the importance of motorcycle rickshaws for the mobility of women, children and men and stress the need to improve standards. The group felt it was realistic to start these initiatives in six months and allow five years for their full implementation.

6.2.4 Beyond motorcycle rickshaws: the vehicles providing transport services in the future.

Group briefing: *What could be realistic and affordable alternatives to motorcycle rickshaws? Would it be realistic to promote carry vans (6 seats), pickups with sideways facing seats ('12 seats') or auto-rickshaws (4-9 seats) as long-term replacements? These are all much more expensive vehicles. What are the financial implications and who would pay this? How to phase in the new vehicles (who pays)? How to phase out the existing fleet in an equitable way (who pays)? What are realistic timescales? Battery 2, 3 and 4-wheelers are increasingly used in some countries (generally with subsidies). In the long term, battery power is likely to be appropriate and affordable in Pakistan, but currently, it is unlikely to take off without subsidies. There are also electricity issues at present (unreliable and high carbon). How can we phase in battery-powered rickshaws or their replacement vehicle types? What will be a realistic timescale for this?*

A small four-wheeled vehicle, similar to a golf-buggy, is likely to be the most appropriate type of vehicle for small-scale transport services in future. These should be more stable and safer than three-wheelers, and easily accessible from the sides (including for women with children, older persons and people with hand luggage). More-expensive vehicles would not be financially-viable for small numbers of passengers. Electric 4-wheel vehicles could be phased in, starting in areas of high demand (in cities). There should be subsidies for these vehicles that should be developed and made through collaboration with manufacturers.

It will be difficult to phase out the existing fleet of motorcycle rickshaws unless the alternatives are similarly priced or cheaper. That is why subsidies may be needed from the outset. Given there are about two million motorcycle rickshaws in current use, and no tested and proven replacements immediately available, it is likely to take 15-20 years to phase out the motorcycle rickshaws.

Battery-powered vehicles will be common and 'mainstream' in the medium-to-long term. They should be promoted immediately, with the aid of subsidies, publicity, training and infrastructure support. The Ministry of Science and Technology has already promoted prototype battery-powered three-wheeler vehicles that include solar energy panels. This initiative and others should be encouraged, with subsidies, to promote the development of appropriate, robust, battery-powered vehicles (three-wheelers and/or four wheelers). The subsidies and promotion should start immediately, so the technology becomes accepted and embedded on a small scale within a few years. From that point, it will still take much time for the mass phase-in, ensuring there are suitable numbers and designs of cost-effective vehicles to replace the existing fleet.

6.2.5 Workshop closure

At the workshop closure, that included the presentation of certificates, participants were assured that a workshop report would be circulated and that all discussions and group recommendations would be considered in the final phase of the research project. In completing their anonymous evaluation forms, participants rated the workshop very highly. Further details of all aspects of the workshop are in the workshop report (Starkey, et al., 2019e).

7 Conclusions

7.1 Motorcycle rickshaws: highly beneficial and optimising but not perfect

Since the 1990s, motorcycle rickshaws have spread rapidly in Punjab through market forces. There are about one million of them in Punjab (two million in Pakistan). They are cheap to buy and to operate and allow operators to charge low fares. They are widely used for linking people in villages with nearby market towns and service centres. The fares charged are very low compared to small-scale, village-to-market transport in other countries. In rural areas, large public transport vehicles starting in villages are generally financially unviable, except for once-daily journeys to cities, for access to jobs and markets. Smaller-scale vehicles are needed to link villages with market towns, clinics and secondary schools. In Pakistan, motorcycle rickshaws are the main vehicles meeting this market. In the rural surveys undertaken, apart from some early-morning commuter buses, motorcycle rickshaws were the only route-based transport services (although on one route they shared their routes with pickups). Motorcycle rickshaws accounted for about half of all passengers in vehicles (excluding motorcycles), with most of the others travelling in much more expensive options (cars and carry vans). Women are particularly dependant on motorcycle rickshaws, with 55% of their public transport journeys in them. Not only do motorcycle rickshaws provide transport services throughout the day, they do so for very affordable fares. Therefore, motorcycle rickshaws have been 'optimising' the rural transport services by providing low-cost services throughout the day, to link villagers with market towns, medical facilities, and transport links (buses to other towns and cities). It would not be viable for transport services using Hiace minibuses or Coaster midibuses to serve individual villages, but the motorcycle rickshaws provide efficient, stratified, feeder-services that allow villagers to access the national bus network throughout the day.

On one road in Jhelum, the 'optimising' has been greatest, as the operators have themselves developed an informal timetable, and have subsequently shared this system with pickup operators. The informal timetable means that no passengers wait for more than 20 minutes. On other roads, most motorcycle rickshaws wait for a full load before leaving, and so out of peak periods passengers may have to wait for over an hour. Long waits discourage travel. Frequent timetabled services encourage travel. As a result of this informal-private-sector, optimising strategy, people come to the village transport terminal at any time of the day, knowing they will be transported soon. This increases overall transport demand, improving the lives of villagers and the operators.

Motorcycle rickshaws may be optimising the rural transport market, in terms of throughout-the-day services at a low cost, but they are certainly not 'perfecting' it. There are several unsatisfactory issues. They are widely regarded as relatively unsafe vehicles, although serious crashes on small rural roads are few. It is argued that safety problems are primarily due to poor driver behaviour (including overloading), poor road condition and to other road users, and not to the vehicles themselves. Nevertheless, the survey found that only about half the operating motorcycle rickshaws had working indicators, even fewer had handbrakes and none had the 'safety gates' that are now part of the official design standards. Motorcycle rickshaw operators tend to overload, if they can, as this increases their meagre profits. Such overcrowding is particularly unpopular with rural women who depend on their services. However, all rural vehicles, including motorcycles, tend to overload, and enforcement is particularly difficult in rural areas worldwide. It is faint consolation that motorcycles are widely understood to be even more dangerous than motorcycle rickshaws, as indicated by the Punjab surveys and national statistics.

7.2 Increasing motorcycle use a fundamental issue

The rapid growth of motorcycle rickshaws, driven by private sector initiatives, has been impressive. However, this has been dwarfed by the even more dramatic increase in motorcycle numbers in the past two decades. Motorcycles were the most common vehicles on all roads surveyed, and everyone noted they are changing the transport situation and reducing the need for rural transport services for some people (mainly men). Most rural households now have at least one motorcycle (our survey of 300 people in rural Punjab found 91% were in motorcycle-owning households). The trend is predicted to continue, with one suggestion that numbers will treble by 2025 (Pakistan, 2018b). Our survey found that with the adoption of motorcycles in a household, the use of motorcycle rickshaws decreased greatly for men, but less so for the

children and women in that household. This confirms the views of motorcycle rickshaw operators that the biggest threat to their livelihoods comes from the declining public transport market due to motorcycle use. It also confirms our conclusion that motorcycle rickshaws are a key gender issue, and rural women are currently dependent on them. At present, rural women in Punjab do not generally either drive motorcycles or ride as passengers unless it is with a male relative. The implication is that the increasing use of motorcycles, and declining motorcycle rickshaw services could marginalise rural women. Moreover, this research and national documents point to the dangerous nature of motorcycles, frequently exacerbated by overloading and poor driving practices. All initiatives relating to motorcycle rickshaws (or any replacements) should be aware of the growing use of motorcycles, and the implications of this for rural transport and road safety.

7.3 Gender issues a vital consideration

As noted, transport is a key gender issue in Pakistan, and motorcycle rickshaws have a particular importance for rural women. With the rapid adoption, by men, of motorcycles, the rural transport market is declining. Women may be given lifts on motorcycles by male relatives, but they do not benefit from them to the same extent as men. Women tend not to travel on the early 'commuter' buses, unless they are in urban employment. They cannot generally rely on male relatives to transport them on routine multi-purpose journeys in the daytime and wait for them to finish (e.g. to schools, clinics and shops in the nearby town). For these reasons, non-affluent rural women depend on motorcycle rickshaws for rural transport. There are no other affordable options (richer women can hire carry-vans or rent-a-cars). Results from this research have provided evidence of the huge gender issue that is one of the most important features of motorcycle rickshaws. With the increasing adoption (and use by men) of motorcycles, motorcycle rickshaw services are at risk. In addition to falling demand, the motorcycle rickshaws might also face a clamp-down due to the lack of legal recognition of motorcycle rickshaws made by the informal sector. The gender issue for public transport in rural areas is so important that if there were a prohibition of existing rural motorcycle rickshaws it would be necessary to ensure that appropriate alternative transport services were available. If prohibition had serious negative consequences for women, such action could be considered discriminatory against women. It could even be susceptible to legal challenges on the basis of rural women's rights. Therefore, all polices and strategies relating to motorcycle rickshaws, including enforcement of standards or promotion of alternatives, should ensure that there are no consequences (intended or unintended) that marginalise rural women by reducing their mobility, and their access to markets, services and employment opportunities.

7.4 Need for realistic perspectives on road safety, compliance and enforcement

The number of vehicle crashes in Pakistan is high, with most crashes attributable to poor driver behaviour (Pakistan, 2018b). This affects all forms of transport, with motorcyclists being particularly vulnerable. The government has ambitious plans to make significant improvements in road safety and so reduce annual road crash fatalities (for all vehicles) by 6,000 by 2030 (Pakistan, 2018b). While motorcycle rickshaws are classified as vulnerable vehicles, they are not intrinsically dangerous if driven well. What needs to be improved is driver behaviour for all types of transport. This will require a prolonged campaign of education and awareness raising throughout society.

In previous sections of this report, examples have been given of road safety regulations, and their lack of enforcement. For example, crash helmet use for motorcyclists and the number of people on a motorcycle are relatively easy to enforce, because of the clear visibility of the offences that can be seen by all, without any specialist equipment. Yet despite clear regulations dating from the 1960s, rural compliance and enforcement are minimal, and urban enforcement has only been partial. It has been noted that Pakistani migrant workers comply with road safety regulations in countries where they are fully enforced. However, in Pakistan, it appears that vehicle drivers do not feel obliged to comply with all road safety regulations. If the police do intervene, there is a strong chance that this will result in '*bhatta*' negotiations rather than serious consequences. While there appears to be evidence that motorway police are now serious about enforcement, in rural areas, it seems the small number of local police officers benefit from driver's non-compliance, as they can improve their living standards through '*bhatta*'.

The authors of this report do not condone non-compliance or '*bhatta*' but accept that this appears to be the current status quo. They would welcome the changes throughout Pakistan society that would improve current attitudes and practices, so that road safety compliance and enforcement would become the norm. However, until that time comes, it appears unrealistic to believe that enforcement can be easily and rapidly achieved, unless something significant changes or is proposed. At the stakeholder workshop, one group felt that enforcement of motorcycle rickshaw safety regulations and compliance was realistically possible within one to three years. The authors maintain that while this is desirable, it is not realistic, unless circumstances change significantly. It seems more realistic to believe that compliance will be gradually improved though better education and publicity, improved regulatory and enforcement processes, and possibly also through community-based initiatives that encourage compliance and cooperation.

The authors are recommending some new driving tests and vehicle tests. They are aware that currently in Pakistan such tests could offer numerous opportunities for '*bhatta*' negotiations. The authors understand that this could seriously undermine the effectiveness and value of the tests, but it will still be a step in the right direction.

It must also be remembered that enforcement of current regulations may have some unforeseen consequences. Improving vehicle specifications and reducing overloading are likely to increase costs and/or reduce operators' revenues and would probably lead to higher fares. Higher fares might increase the adoption and use of motorcycles: vehicles that are particularly dangerous and have gender implications. Whatever options are recommended, sudden clampdowns on existing vehicles would be unhelpful and potentially damaging. Manufacturers and operators should be nudged towards improved vehicles (and behaviours) with adequate warnings, and the general phasing-in of enforcement, starting in city centres and gradually moving to the suburbs and market towns, and finally to rural areas. This is entirely compatible to the aims and approaches of the National Transport Policy and the National Road Safety Strategy (Pakistan, 2018a and 2018b).

7.5 Need to understand that vehicle designs are a compromise between features

All vehicle designs involve compromises, and no vehicles are perfect in all aspects (size, cost, capacity, function, performance, durability, safety, style, versatility, user-friendliness, etc).While manufacturers often claim that safety is their number one priority, this is incorrect, as not all the safety features found in the high-end models, are available in the cheaper models.

Motorcycle rickshaws have evolved as a compromise, with low cost being one of the main marketing points. They can be improved in various ways, but generally ones that involve added costs.

Auto-rickshaws and motorcycle rickshaws have been developed for different niches. This is not just true of Pakistan, as comparable three-wheelers are used in many emerging and industrialising countries in Asia, Africa and Latin America. As noted already, there are two main types of three-wheelers. The 2/3-seater auto-rickshaws are widely used as urban, point-to-point taxi services carrying passengers that know each other. The motorcycle rickshaws generally have a capacity of six seats (or more) and are mainly used as route-base services (like tiny buses), particularly in rural areas. They provide transport services for a variety of different passengers along their routes, who may be strangers. Route-based services with higher capacity vehicles, allow cheaper fares, per passenger-km. Both vehicle types compromise in different ways to make them suitable for their particular markets. In Pakistan, there are some auto-rickshaw designs (that are not widely available and are not legal for registration purposes in Punjab) that are suitable for route-based operations, having two or three rows of seats or sideways facing seats (that are popular as small school buses).

There are arguments for and against three-wheelers being enclosed. Women prefer to be enclosed if they are travelling with their families or friends. Women do not want to be very enclosed on public transport, when close to strangers. The flexible doors on auto-rickshaws are appreciated by women for preserving their privacy (and by the operators for hiding the overloading of the vehicle). They also keep out poor weather. Motorcycle rickshaws provide more fresh air and a sense of space. They could be enclosed. For example, there are 'school buses', based on loader rickshaws with sideways facing seats. These bring the multiple passengers close together, which women do not like, if there are strangers. There are also

compromises when choosing between enclosure and easy access. Golf-buggies and the rear seats of motorcycle rickshaws have easy access, but they are not enclosed. Increasing enclosure, through doors or gates, improves privacy or safety at the cost of convenient access. Point-to-point services favour enclosure, while route-based public transport vehicles tend to prioritise easy access.

Agreeing specifications for motorcycle rickshaws (or their replacements) will involve compromises, with possible unintended consequences for other design features, including cost and convenience.

7.6 Evidence of potential for improvements

The survey of 300 people in rural Punjab showed that there was a certain willingness to pay for less crowded vehicles and improved safety features. Women were even more willing than men to pay for these. The majority of people seemed willing to pay 40% more, but this tailed off and few were willing to pay double the current fares. The appraisal models developed, involved various assumptions that would lead to motorcycle rickshaws with fewer passengers and/or higher safety standards. These scenarios showed such changes are unlikely to be financially and economically sound, with the changes resulting in higher costs, which would price some people off transport. Nevertheless, the willingness to pay responses suggest that it might be feasible to implement reforms without too much disruption, particularly if the market could be stimulated and increased though improved services, such as running to informal timetables. Therefore, recommendations are made to promote and gradually enforce improvements, in collaboration with operator associations. In advance of this, it appears to be clear that a programme of training for drivers and operators, to improve the reliability, user friendliness and safety of motorcycle rickshaw services, would produce significant benefits. Indeed, based upon the analysis contained herein, this is the only option, of those considered, that represents good value for money.

7.7 Vehicle designs and power sources

The issue of design compromises has already been raised. The current motorcycle rickshaw designs have optimised low cost operations. Current PSQCA and Punjab Transport Department standards are providing a greater focus on safety issues. The current steel ‘gate’ designs appear to have been developed in an office without attention to their practical use. A large person cannot really access the front seats if there are gates in place. The heavy rear gates are inconvenient to use and would be very unforgiving in the case of a crash. Despite such gates being official standards for ten years, the only examples of these seen were the inspection and demonstration models in the factories. None were seen in use. There is a need to consult the operators and users, and more clearly define their design purpose and the objectives of installing such gates. It might be more appropriate to introduce seatbelts, softer, flexible gates or other restraining mechanisms. This and other design issues should be reviewed in consultation with the users, operators and the formal and informal manufacturers.

As has been noted, CNG is not a suitable alternative power source in Punjab Province, but battery powered vehicles are likely to be widely used within a generation. The Ministry of Science and Technology has been advocating electric rickshaws and suggested (on Twitter) that petrol rickshaws might be banned within six months. Although electricity supplies in Punjab are not very reliable and are not ‘green’, the future is likely to be with battery-powered vehicles. The private sector should be encouraged to start to test and market these, building on the experiences of other countries, including China, Bangladesh and Nepal. As noted, Zar motors has been working on battery-powered auto-rickshaws for several years. These do not yet have the performance of conventional auto-rickshaws, and Zar has yet to break into the mainstream market.

Replacing motorcycle rickshaws with electric vehicles may take longer than replacing auto-rickshaws. This is because route-based vehicles in rural areas require greater robustness and higher loading capacity than electric auto-rickshaws. Charging issues will also be more difficult to overcome in rural areas. However, in the medium-to-long term (7-15 years), electric vehicles are likely to replace motorcycle rickshaws and manufacturers should be encouraged to start testing models and components, which will probably be imported from China, in the first instance.

The issue of four-wheeled replacements for auto-rickshaws and motorcycle rickshaws was discussed during the stakeholder workshop. In particular, the use of vehicles derived from golf buggies. Such vehicles are

used worldwide (including in Pakistan) in golf-clubs, high-end resorts, tourist locations and international airports, all environments with relatively flat and uniform driving surfaces. These vehicles have the advantage of relatively easy access and they are generally open, with well-separated seats. Interestingly, traditional golf buggies and many derivatives used in hotels, tourist sites and airports have two rear-facing seats (as do motorcycle rickshaws) but they are not supplied with rear 'safety gates' that are now required on motorcycle rickshaws in Pakistan. Due to the generous dimensions of such vehicles, relative to their official passenger loading, small-scale private operators in Pakistan are likely to be tempted to overload them. The authors have no evidence of such electric four-wheelers being widely used for rural transport services in other countries. However, the suggestion is worth following up with a trial to assess the economics and technical feasibility of such vehicles.

7.8 How changes to motorcycle rickshaws could benefit operators and society

The cost-benefit analysis undertaken reinforced the view that motorcycle rickshaws are providing a valuable service to the community and are helping to optimise rural public transport, despite a range of regulatory issues. Unfortunately, the CBA suggested that trying to enforce passenger limits or improve the quality of the vehicles may be difficult from the economic perspective. Of the scenarios investigated, the one with the greatest economic benefits to society was training operators and encouraging them to run to timetables. This should lead to more frequent services, encouraging more people to use them, and so stimulating a growth in the market. This CBA finding provides support for one of the report's recommendations on improving self-regulation and operational frequency through operator associations.

The CBA compared the present situation (designated scenario 1) with four alternative scenarios, each with different potential changes. In the economic analyses, scenario 2 (maximum of six passengers), scenario 3 (maximum of four passengers) and scenario 5 (more expensive vehicles due to higher safety standards) all had negative NPVs. This means they might not represent good value for money to society. The potentially negative effects of scenarios 2, 3 and 5 relate to possible secondary consequences, including more use of motorcycles, pickups and carry vans. The increase in vehicle numbers (notably of motorcycles) could have adverse road safety implications and a negative environmental impact. However, improving motorcycle rickshaw frequency through training and timetables, should lead to growth in the public transport market. This scenario 4 has a positive NPV of about PKR 3 billion and an EIRR of 29.2%. This scenario stands out as a viable alternative and represents an investment with good value for money. It should be noted that one reason why this scenario is positive is because it did not alter passenger numbers per vehicle from their high current levels. However, in the recommendation relating to training and timetables, the operator associations will be trained in various aspects of safe operations, including appropriate loading levels. The surveys provided evidence there was some willingness to pay motorcycle rickshaw operators extra for lower passenger numbers, with women being more willing than men.

All the alternative scenarios were potentially viable to the operators from a financial perspective, partly because the capital costs of motorcycle rickshaws (discounted over ten years) are low. Even in scenario 5, with the improved safety features, it was assumed to increase capital costs by only 20%. The current incomes of motorcycle rickshaw drivers are low, and the financial models suggest they could remain low. Many existing operators said they would prefer different work if it were available, but it was not. Nevertheless, it is to be hoped that working to timetables with more trips per day and in close cooperation with association colleagues might increase the job satisfaction of the work which could become an additional benefit.

8 Recommendations

8.1 Promote road safety and better driver behaviour in the road transport sector

The federal government and the government of Punjab should promote good, empathetic driving behaviour and awareness raising for drivers and road users of all types of vehicles in the road transport sector. This should involve school education, social media and all appropriate forms of publicity. Drivers and passengers of all forms of road transport should benefit from this, including the operators and users of motorcycle rickshaws. It is likely that the major beneficiaries of positive behavioural changes will be motorcyclists and their passengers.

8.2 Accept current situation with motorcycle rickshaws, but nudge towards improvements

Motorcycle rickshaws are currently extremely important for rural people, particularly women. They play a key role in rural transport in Punjab. They are 'optimising' rural transport services, by providing low-cost, services throughout the day on roads where other transport services are financially unviable. While there is much room for improvement in vehicles and operations, the valuable transport niche they fill should be recognised and appreciated. In the short-to-medium term, they should not be prohibited or prevented from providing their valuable services. They should be encouraged in various ways, to improve their services. When alternative, appropriate and affordable vehicles become available, they can be phased out gradually. Until then they should be appreciated, and their operators nudged towards compliance and higher quality transport provision (through licensing, testing, capacity building and training, as included in Section 8.3 and 8.4).

Policies and strategies should be designed to improve the situation in appropriate ways with realistic mechanisms and timetables. The policies and strategies should be based on understanding, not only the intended consequences of their implementation, but also the possible unintended consequences. A hard clampdown on informal sector motorcycle rickshaw workshops would be damaging and unnecessary. Similarly, attempting to rapidly remove informal sector motorcycle rickshaws from the road would be damaging. The recommendations here will provide mechanisms for gradually regularising the workshops and the vehicles, without disrupting transport services and livelihoods.

For on-road enforcement, there should be a realistic, phased approach. Warnings should be given (to allow compliance) and the timing and location of enforcement should be publicised and phased in over time and space. Enforcement should start in the cities, and gradually move out to market towns and rural roads. This is pragmatic as worldwide experience suggests enforcement is easier in cities and most difficult in rural areas where there are few enforcement personnel. Successful enforcement in city centres will become widely known, so that it will be easier to subsequently enforce in rural areas (in the Punjab surveys, motorcycle rickshaw compliance was greatest in Kasur, which was believed to be due to enforcement in Lahore).

Should adopted standards eventually prevent the sale of new motorcycle rickshaws (which is not proposed here), it is recommended that the simplest alternative would be to encourage the switch to auto-rickshaws with two rows of seats. These are already available in Pakistan and they have been proven as viable on some route services in Punjab. They have higher specifications and safety standards than motorcycle rickshaws, although they are more 170% more expensive.

When it comes to the adoption of electric vehicles (which is likely to start within a few years in Pakistan's cities), again a phased approach will be required, with initial emphasis on electric rickshaws in the cities. The logistics of supplying, charging and maintaining electric vehicles in cities are easier than rural areas. The pollution benefits are much more apparent in cities, and the road infrastructure is generally more appropriate. Similarly, if non-electric vehicles are to be banned or discouraged, this is simpler to enforce in cities. Following successful operations and enforcement in cities, the emphasis can move to peri-urban areas and towns, and finally to the rural areas. This gradual approach is pragmatic and appropriate.

8.3 Reinstate registration and introduce training, testing and licensing

Punjab Province should:

- Immediately resume licensing all new motorcycle rickshaws and auto-rickshaws made by the formal sector. These conform to existing standards and there is no reason to continue to block their registration.
- Immediately resume licensing of informal-sector motorcycle rickshaws, while giving warning of changes to come. In the short term, while procedures are being developed, informal sector motorcycle rickshaws could continue to be registered as 'motorcycles' although this practice should be phased out, as new vehicle tests are phased in, and informal operators are assisted to comply with relevant safety standards.
- Authorise the registration of auto-rickshaws with two rows of seats, suitable for route-based operations, as a potential, higher quality replacement of motorcycle rickshaws.
- Develop and adopt a training curriculum for motorcyclists and the drivers of three wheelers. There are plenty of resources available worldwide to build upon (eg, Transaid, 2015a, 2015b), so there is no need to start from scratch.
- Develop driving tests for motorcyclists and drivers of auto-rickshaws and motorcycle rickshaws. These should include not only good driving practices, but also knowledge of traffic rules and regulations and for the three-wheeler operator test, an understanding the responsibilities of public transport operators.
- Introduce a new driving licence category for operators of small-scale transport services. This will require the passing of the three-wheeler operator driving test.
- Introduce a new motorcycle driving licence, with photo identification, with the requirement to pass the motorcycle drivers test which will include knowledge of traffic rules and regulations.
- Phase in the new motorcycle licence and provide notice that over a period of time (several years) all motorcycle drivers (including those already using motorcycles) will be required to carry the new style of licences when they travel on their motorcycles. They will have to pass a test to be entitled to the new licences.

Punjab Province should work with VICS to develop appropriate vehicle tests for new (in the first instance) and existing (gradually phased in) motorcycle rickshaws. The tests and registration processes should be carried out at district level (also a phased approach). In the first instance, the test should concentrate on road worthiness and safety issues and not conformity to PSQCA/Punjab technical standards. Thus, informal sector vehicles can pass the test provided they are safe and road worthy, even if certain dimensions differ from the 'letter of the law' specifications. Warnings can be given to vehicles not conforming to standards, but several years should be allowed before any programme to deregister non-conforming vehicles.

Punjab Province and should also work with PSQCA and in consultation and collaboration with formal sector manufacturers, informal sector manufacturers and researchers able to interact with users, operators and operator associations, to review current design standards. The aim would be to have motorcycle rickshaw standards that are convenient to use (the gate design is a notable issue) and can be reasonably implemented by both formal and informal sector workshops.

Punjab Province should develop a capacity building and training programme for informal sector workshops building motorcycle rickshaws. The informal workshops would be assisted to ensure their procedures and outputs match current (or revised) PSQCA standards. They would also be trained and assisted to modify existing operational motorcycle rickshaws that had been warned following non-compliance in the new VICS tests. This programme could be implemented in collaboration with formal sector factories, who would provide expertise but also gain from the closer relationship that exists between informal producers and their supply chains. The formal sector would benefit from gathering greater understanding of the needs and preferences of users and operators. Punjab Province should consider how to assist the upgrading of informal sector workshops making motorcycle rickshaws, and give sympathetic consideration to providing

soft finance, and generous tax breaks, before the informal sector workshops are gradually integrated into the taxation system.

8.4 Improve self-regulation and operational frequency through associations

NTRC and Punjab Province should develop a pilot project to facilitate non-governmental organisations and/or universities to promote motorcycle rickshaw user associations. This would be a pilot project, operating in several different locations, with a strong research element, that would collect data on the changing situation including financial, socio-economic and operational issues arising. Informal user associations already exist in most of the villages visited, and they would be willing to cooperate with a project that was clearly seeking their best long-term interests. The project should try to work in close collaboration with the local authorities and any relevant local NGOs to encourage long-term, sustainable continuity, following the initial subsidised phase(s).

The aim of the project would be to improve operational standards through higher frequency services and greater compliance with standards. Operator associations themselves would be expected to enforce (over time) various safety and comfort criteria. These might include loading levels (four adult passengers per motorcycle rickshaw), operators wearing reflective tabards with the association's name and the operator's number, the requirement to have working handbrakes, lights and indicators, and other technical and safety features. They would also be encouraged and facilitated to develop appropriate informal timetables and keep to these to reduce waiting times and encourage more customers. The pilot project would clearly need funding, appropriate to the scale of the project, to allow there to be inducements, in terms of vehicle upgrades and fuel use in the initial stages of the transition to timetabled services. In the transport industry, timetabled services often comprise a mixture of profitable and unprofitable journeys, justified by the overall profitable outcome. However, motorcycle rickshaw operators have very modest incomes and cash flows and cannot tolerate any losses or make large investments.

The project members (researchers and operator associations) should be invited to join the consultations recommended for updating the Punjab Province and PSQCA standards.

Subject to the conclusions of the first project phase, the project should be expanded, bringing in other NGO actors in different districts, and facilitate even greater expansion. Selected operators from the first successful associations should be used as trainers and facilitators to assist adoption in new areas.

8.5 Test electric options with manufacturers, benefitting from international experience

Electric vehicles will be increasingly important throughout the world and may become the norm in Pakistan within a generation. There is already much technology, experience and expertise in other countries, that can be adapted for the needs of Pakistan. Experience suggests that competing private sector companies are particularly well suited to adapting existing technologies for the market. Existing manufacturers or start-up companies are in a good position to acquire technologies and components (probably from China) to test and assess the products and start to enter the market. While China itself is not using large numbers of electric three-wheelers for passengers, it is supplying components, for example for the 'tom-tom' electric rickshaws used in Bangladesh. The 'tom-tom' electric rickshaws are similar to auto-rickshaws in configuration, with two seats opposite two more 'parcel-shelf' seats. For route-based operations, at least four seats (preferably two rows of seats) are required.

The role of government should be to encourage, facilitate and regulate. Encouragement can include tax incentives and subsidies to all private companies that have eligible products. Currently, the formal sector workshops making motorcycle rickshaws and auto-rickshaws are dubious about electric vehicles, because of the comparative advantages (at present) of petrol-powered vehicles. The suggestion by the Ministry of Science and Technology (MOST) that petrol rickshaws might be banned within six months is not taken seriously.

Given the poor state of the electricity supply, encouragement seems more appropriate than threats. One option could be a government-funded competition so that many companies submit electric rickshaw models. Another option would be to facilitate a tradeshow, inviting potential suppliers of products and

components to exhibit in Pakistan. The process could be initiated after some fact-finding visits by a team from NTRC (Ministry of Communications), MOST, Punjab Transport Department and relevant academic departments.

It was suggested by two groups in the stakeholder workshop that small, four-wheel, electric vehicles not dissimilar to golf-buggies, could become replacements to rickshaws for both rural and urban transport. Such vehicles are well-proven in environments with smooth infrastructure, and a variety of designs with different seating capacities are available from China. Similar vehicles are already used in Pakistan, in elite hotels and tourist sites in Lahore and elsewhere. While similar vehicles have been used to a limited extent for urban transport in China, the authors are not aware of any widespread use for rural transport services. Therefore, the authors cannot endorse them as replacements for motorcycle rickshaws, at this stage. However, the authors agree that this option should be followed up through a small research study, preferably in collaboration with one, or more, of the formal sector manufacturers. In the first instance, one vehicle could be tested in an urban or rural environment to determine operational performance and costs, and what design modifications would be needed for public transport operations. The results of this study should be shared with all rickshaw manufacturers, and if very positive, encourage them to develop the ideas, perhaps though a competition.

The recommendation is that the government should encourage and facilitate the current rickshaw manufacturers, and other interested companies, to develop their own electric rickshaws and possibly four-wheeler models. Initiatives could be preceded by a study tour and a small research study on the appropriateness of ‘golf-buggy’ type vehicles as potential transport services.

9 References

3wheelers (2019). Butler Petrol Cycle. www.3wheelers.com/butler.html. Accessed 10 March 2019.

Arif, R. M. (ed) (2018). Manual of motor vehicles laws including Provincial Motor Vehicles Ordinances 1965 and 1969. Revised edition. Civil and Criminal Law Publications, Lahore, Pakistan.

Arshad, N (2019). Electric Vehicles in Pakistan: Policy Recommendations Lahore University of Management Sciences (LUMS) Energy Institute and US-Pakistan Center for Advanced Studies in Energy (USPCAS-E). Available at: http://web.lums.edu.pk/~eig/pdf/evReport.pdf

Batool, Z. (2012). Attitudes towards road safety and aberrant behaviour of drivers in Pakistan. University of Leeds. Available at http://etheses.whiterose.ac.uk/6765/1/589055.pdf.

BBC (2019). India turns to electric vehicles to beat pollution. BBC world service. Published 24 June 2019. Accessed 28 October 2019. https://www.bbc.co.uk/news/world-asia-india-48961525

Bishop T., Barber C., Chaman, S. and Porter, G. (2018). Enhancing understanding on safe motorcycle and three-wheeler use for rural transport: literature review. AfCAP Project RAF2114A. Amend and Transaid for Africa Community Access Partnership (AfCAP), London. 44p

Express Tribune (2015). With CNG scarce, electronic rickshaws offer a ride out for Pakistan's commuters. Published 14 May 2015. Accessed 29 October 2019. https://tribune.com.pk/story/886463/with-gas-scarce-electronic-rickshaws-offer-a-ride-out-for-pakistans-commuters/

Express Tribune (2019). Pakistan's 30% vehicles to go electric by 2030. Express Tribune. Published 17 May 2019. Accessed 29 October 2019. https://tribune.com.pk/story/1975380/8-pm-directs-ministry-finalise-electric-vehicle-policy-two-weeks/

Haider, M. and Badami, M.G. (2004). Public transit for the urban poor in Pakistan: Balancing efficiency and equity. Paper presented at the Forum on Sustainable Infrastructure and Service Delivery for the Urban Poor, New Delhi, organized by the Woodrow Wilson International Center for Scholars (WWICS), June 24–25. Available from: http://www.wilsoncenter.org/index.cfm?topic_id=1410&fuseaction=topics.documents&group_id=61692.

Hasan A. and Raza M. (2015). Responding to the transport crisis in Karachi. Urban Resource Centre, Karachi and International Institute for Environment and Development, London. 54p. Available at: http://pubs.iied.org/10733IIED/

Haworth S and Starkey P, (2017). Greening Fiji's Bus Fleet, with bus renewal and scrappage plan. ADB for the Government of Fiji. Asia Development Bank (ADB), Manila, Philippines 38p.

Hisam Z. (2006). Road Transport Workers in Pakistan. Karachi. Pakistan Institute of Labour Education and Research (PILER). 24p. Available at: https://zeenathisam2004.files.wordpress.com/2013/07/road-transport-workers-in-pakistan.pdf

IMF (2019). Pakistan World Economic Outlook 2017-2024.

JICA (2012). The Project for Lahore Urban Transport Master Plan in the Islamic Republic of Pakistan – Final Report: Volume I of II: Chapter 7 – Master Plan 2030. Available at: http://open_jicareport.jica.go.jp/pdf/12068110_06.pdf

Kadiyali L. R. 1992. Road User Cost Study. Update of the 1982 Road User Cost Study of Central Road Research Institute, India.

Kazmi, J. Zubair, S. (2014). Estimation of vehicle damage cost involved in Road Traffic Accidents in Karachi, Pakistan: A Geospatial Perspective. Fourth International Symposium on Infrastructure Engineering in Developing Countries, IEDC 2013.

Khatana, K. J. (2015). Role of the three wheeler auto vehicle in promoting sustainable urban transport in Pakistan. Presentation at Pakistan Urban Forum held Lahore, 4-8 Dec 2015. Institute of Road Safety Traffic Environment Pakistan.

Klair, A.A., Arfan, M., (2016). Trends, Patterns and Causes of Road Accidents on N-5, North-3 Pakistan: A Decade Study (2006 – 2015). National Highways and Motorway Police, Beat-10, North-3, N-5, Pakistan.

Metameta (2017). Gender Mainstreaming in Rural Road Construction and Usage in Ethiopia: impact and implications. Final Report. ETH2044E. London: ReCAP for DFID. 65p. Available at: http://www.research4cap.org/Library/MetaMeta-2017-GenderMainstreamingEthiopia-FinalReport-ReCAP-ETH2044E-20171004.pdf

Muhammad, M., Minhas, MS., Effendi, J., Jahanzeb, S., Mughal, A., Qadir, A. (2017). Qing-Qi Rickshaw: A Boon or Bane for Public Transportation? A Study of Road Traffic Injury Patterns Involving Qing-Qi Rickshaws in Karachi Pakistan. J AYub Med Coll Abbottabad. 2017 Apr-Jun; 29(2): 289-292.

Murty, M., Dhavala, K. Ghosh, M., and Singh, R. (2006). Social Cost-Benefit Analysis of Delhi Metro. Institute of Economic Growth. Available at: http://www.iegindia.org/upload/publication/Workpap/wp273.pdf

MVR (1969). The Motor Vehicles Rules, 1969. Government of the Punjab. Available at: http://nasirlawsite.com/laws/mvr.htm

Pakistan (2018a). National Transport Policy of Pakistan 2018. Islamabad. Government of Pakistan.

Pakistan (2018b). National Road Safety Strategy 2018-2030. Islamabad. Ministry of Communications, Government of Pakistan.
Pakistan Today News Desk, (2017). Motorcycle crashes are more dangerous than car accidents. Pakistan Today. Available at: https://www.pakistantoday.com.pk/2017/11/23/motorcycle-crashes-are-more-dangerous-than-car-accidents/
PAMA (2019). Pakistan Automotive Manufacturers Association. http://www.pama.org.pk/statistical-information/historical-information/annual-sales-production (accessed 24 July 2019).
PBS (2016). Pakistan Statistical Year Book 2016. Pakistan Bureau of Statistics (PBS), Islamabad, Pakistan. 514p
PMVO (1965). Provincial Motor Vehicles Ordinances 1965. Government of Punjab. Available at: http://punjablaws.gov.pk/laws/189.html
Politicpk (2019). Punjab Province Map District Wise. https://www.politicpk.com/wp-content/uploads/2017/02/Punjab-Province-Map-District-Wise.jpg available at: https://www.politicpk.com/punjab-province-list-tehsils-districts-divisions-
PSQCA (2018). Pakistan standard specification for three wheeler auto vehicles. PSS: 4708-2018 (R). Pakistan Standards and Quality Control Authority, Karachi, Pakistan. 69p. Available at: https://www.psqca.com.pk/cs/AUTOMOBILE - 03/PS - 04708-2018 (R).pdf
PTD (2009). Technical specifications of 4-stroke CNG engine motor cab rickshaw and 4-stroke engine motorcycle rickshaw. Pakistan Transport Department, Lahore, Pakistan.
PTD (2018). Notification of specification of 4-stroke motor cab loader rickshaw and motorcycle load rickshaw. Pakistan Transport Department, Lahore, Pakistan.
Schmidt, M. (2016). Adverse Incorporation of Informal Transport Workers in Pakistan: A Case Study of Auto-rickshaw and Qingqi Drivers in Lahore. (MS Thesis). London School of Economics and Political Science.
SIAM (2019a). Automobile Domestic Sales Trends, Society of Indian Automobile Manufactures (SIAM). http://www.siamindia.com/statistics.aspx?mpgid=8&pgidtrail=14. Accessed 1 March 2019
SIAM (2019b). Automobile Domestic Sales Trends, Society of Indian Automobile Manufactures (SIAM). http://www.siamindia.com/statistics.aspx?mpgid=8&pgidtrail=15. Accessed 1 March 2019
Starkey, P. (2007). The rapid assessment of rural transport services. SSATP Working Paper No. 87A. Sub-Saharan Africa Transport Policy Program (SSATP). Washington D.C.: World Bank. 80p. Available from: www4.worldbank.org/afr/ssatp/Open.aspx?id=814
Starkey, P. (2009). Transportation services. Chapter 7 in: National Road Network Master Plan, Volume 1 of Final Report Preparing the Road Network Development Project (TA 7100). Cardno Acil in association with KWK Consulting for Asia Development Bank and Department of Infrastructure, Timor-Leste
Starkey, P. (2013). Mission report: rural transport services specialist. Yunnan Pu'er Regional Integrated Road Network Development Project (TA-8149 PRC), Asia Development Bank (ADB). Manila, Philippines. 46p.
Starkey P. (2016a). The benefits and challenges of increasing motorcycle use for rural access. Proceedings of International Conference on Transport and Road Research (iTRARR) held Mombasa, March 2016. 17p. Available at: http://transportconferencekenya.org/Proceedings/Starkey-Motorcycle-Issues-KRBMombasa2016-160223.pdf
Starkey, P. (2016b). Provision of rural transport services: user needs, practical constraints and policy issues. Transport and Communications Bulletin for Asia and the Pacific: 86: 6-22.
Starkey, P. and Cartier van Dissel, S. (2016). Myanmar transport sector policy note: rural roads and access. Asia Development Bank, Mandaluyong City, Philippines. 61p. Available at: https://www.adb.org/publications/myanmar-transport-sector-policy-note-rural-roads-access
Starkey, P., Batool, Z. and Younis, M. W. (2019a). Investigation into the use of Qingqis as a mode of public transport in Punjab Province: Inception Report PAK2156A. IMC Worldwide. London: ReCAP for DFID.
Starkey, P., Batool, Z. and Younis, M. W. (2019b). The expansion of three-wheeler transport services: the case of Qingqis in Pakistan. Paper prepared for the 26 World Road Congress, held Abu Dhabi, 6-10 October 2019.
Starkey P., Batool Z., Younis M. W. and Reeves, J. (2019c). Investigation into the use of Qingqis as a mode of public transport in Punjab Province: Progress Report. ReCAP PAK2156A. London: ReCAP for DFID
Starkey P., Batool Z., Younis M. W., Humpish J, Rehman A. U. and Ali S. (2019d). Investigation into the use of Qingqis as a mode of public transport in Punjab Province: Draft Final Report. ReCAP PAK2156A. London: ReCAP for DFID.
Starkey P., Batool Z., Younis M. W., Umer, S, Rehman A. U. and Ali S. (2019e). Investigation into the use of Qingqis as a mode of public transport in Punjab Province: Report of workshop held 5 September 2019, NTRC, Islamabad. ReCAP PAK2156A. London: ReCAP for DFID.
Starkey, P., Njenga P., Kemtsop G., Willilo S., Hine J., Odero K., Mbathi M. and Opiyo R. (2013a). Rural transport services indicators: guidelines to the methodology, September 2013. African Community Access Programme (AFCAP) Project GEN/060. International Forum for Rural Transport and Development (IFRTD), London, UK for Crown Agents, Sutton, UK. 176p.

Starkey, P., Njenga. P., Kemtsop, G., Willilo, S., Opiyo, R. and Hine, J. (2013b). Rural transport services indicators: Final Report, August 2013. International Forum for Rural Transport and Development (IFRTD), London, UK for Crown Agents, Sutton, UK. 158p.

Starkey P, Tumbahangfe A and Sharma S, (2013). External review of the District Roads Support Programme (DRSP) Final Report. Swiss Agency for Development and Cooperation, Kathmandu, Nepal. 82p. http://drsp.squarespace.com/storage/DRSP-Review-FinalReport.pdf

Starkey, P., Workman, R. and Hine, J. (2019). Interactions between improved rural access infrastructure and transport services provision: Phase 2-3 Brief Progress Statement. ReCAP GEN2136A. London: ReCAP for DFID.

Stiebert, S. (2016). Pakistan Low Carbon Scenario Analysis: GHG Reference Case Projection. Report of International Institute for Sustainable Development (IISD) and Energy Research Centre (ECN) with support of Centre for Climate Research and Development (CCRD) and PITCO, Pakistan. Available at: https://cdkn.org/wp-content/uploads/2016/11/Pakistan-GHG-Emissions-Reference-Case-Report-Oct-27.pdf

Supreme Court (2015). Civil Petitions No.423-K & 472-K of 2015. Association for the Welfare of Owner & Staff of Qingqi Rickshaw, Sindh and All Karachi Qingqi Rickshaw Welfare Association *versus* Province of Sindh through Secretary Transport, Government of Sindh, Karachi & others. Supreme Court of Pakistan, Islamabad. 13p. Available at: http://www.supremecourt.gov.pk/web/page.asp?id=2636

Tahir, N., Haworth, N., King, M., Washington, S., and A.H. Akbar (2018). Underage driving among motorcycle rickshaw drivers in Pakistan. Injury Prevention, 24 (2). Available at: http://dx.doi.org/10.1136/injuryprevention-2018-safety.132

Transaid (2015a). Tanzania motorcycle taxi rider training: assessment and development of appropriate training curriculum. Final Report. AfCAP Project TAN2015E. Africa Community Access Partnership (AfCAP), Thame, UK. 22p. http://www.research4cap.org/Library/BarberCRettieN-TRANSAID-2015-MotorcycleTaxi-Training-FinalReport-ICTRR2016Paper-v20160229.pdf

Transaid (2015b). Tanzania motorcycle taxi rider training: assessment and development of appropriate training curriculum. Annex A: Competency-based curriculum for training motorcycle and tricycle riders. AfCAP Project TAN2015E. Africa Community Access Partnership (AfCAP), Thame, UK. 33p. Available at: http://www.research4cap.org/Library/TRANSAID-2015-MotorcycleTaxi-Training-FinRept-AFCAP-TAN2015E-AnnexA-Curriculum-v150616.pdf

Zhuang, J., Linag, Z., Lin, T., De Guzman, F. (2007). Theory and Practice in the Choice of Social Discount Rate for Cost-Benefit Analysis: A Survey. Available at: https://www.adb.org/sites/default/files/publication/28360/wp094.pdf

Annex 1: Traffic count statistics

In order to investigate the use of motorcycle rickshaws both in themselves and relative to other traffic, thorough traffic counts were conducted across the three villages of interest, with eight roads in total. Each road was subject to 24 hours of observation (two 12-hour counts). The dates and traffic volume counts for each site were as follows.

Table 42: Sample size by road and date

Roads	Dates	Sample Size
PD Khan		
Sodi Gujjaran to PD Khan	19/04/2019	1,826
Sodi Gujjaran to PD Khan	20/04/2019	1,369
Kasur		
Satuki to Mustfabad	18/04/2019	1,152
Satuki to Mustfabad	19/04/2019	1,141
Satuki to Raokhan	18/04/2019	794
Satuki to Raokhan	19/04/2019	910
Mir MHD to Kasur Road	18/04/2019	1,267
Mir MHD to Kasur Road	19/04/2019	1,321
Mir MHD to LHE RWD Road	18/04/2019	1,467
Mir MHD to LHE RWD Road	19/04/2019	1,191
Mir MHD to Raja Jang	18/04/2019	1,414
Mir MHD to Raja Jang	19/04/2019	1,084
Lodhran		
377/WB, 384/WB to Basti Malook	26/04/2019	1,135
377/WB, 384/WB to Basti Malook	27/04/2019	1,229
Highway: Dunyur Pur to Basti Malook	26/04/2019	3,310
Highway: Dunyur Pur to Basti Malook	27/04/2019	3,743
Total		**24,353**

On a site by site, the sample sizes are as follows:

Table 43: Sample size by road

Roads	Sample Size
PD Khan	
Sodi Gujjaran to PD Khan	3,195
Kasur	
Satuki to Mustfabad	2,293
Satuki to Raokhan	1,704
Mir MHD to Kasur Road	2,588
Mir MHD to LHE RWD Road	2,658
Mir MHD to Raja Jang	2,498
Lodhran	
377/WB, 384/WB to Basti Malook	2,364
Highway: Dunyur Pur to Basti Malook	7,053
Total	**24,353**

With each site being subject to the same time of observation, it is clear that Bridge to Basti Malook has a larger volume of traffic than the other sites (more than twice as large as the second highest volume site).

The passenger count can be disaggregated according to the roads under observation. Because pedestrians are observed, these are segmented into groups of pedestrians (e.g. if a group of people together, these people are grouped as they would otherwise be travelling together).

Table 44: Passenger count by vehicle and project road

Passenger / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Freight Vehicle	Passenger Qingqi	Freight Qingqi	Auto-rickshaw	Hiace / Coach / Bus	Total
377/WB, 384/WB to Basti Malook	2,909	445	196	119	61	679	556	324	721	183	37	12	**6,242**
Highway: Dunyur Pur to Basti Malook	7,418	246	191	273	417	3,346	1,946	294	4,233	1,236	159	12	**19,771**
Mir MHD to Kasur Road	3,748	238	44	135	119	172	388	172	294	103	85	70	**5,568**
Mir MHD to LHE RWD Road	3,462	198	66	234	193	103	178	208	172	76	38	133	**5,061**
Mir MHD to Raja Jang	2,626	1,214	182	352	30	79	182	58	1,444	120	116	21	**6,424**
PD Khan	4,442	512	117	57	1,554	343	401	307	3,786	41	-	425	**11,985**
Satuki to Mustfabad	2,758	273	30	133	120	147	161	48	452	58	119	67	**4,366**
Satuki to Raokhan	2,162	256	44	264	72	44	34	39	344	143	-	-	**3,402**
Total	**29,525**	**3,382**	**870**	**1,567**	**2,566**	**4,913**	**3,846**	**1,450**	**11,446**	**1,960**	**554**	**740**	**62,819**

Table 45: Passenger count by vehicle and project road (%)

Passenger / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Freight Vehicle	Passenger Qingqi	Freight Qingqi	Auto-rickshaw	Hiace / Coach / Bus	Total
377/WB, 384/WB to Basti Malook	46.6%	7.1%	3.1%	1.9%	1.0%	10.9%	8.9%	5.2%	11.6%	2.9%	0.6%	0.2%	**9.9%**
Highway: Dunyur Pur to Basti Malook	37.5%	1.2%	1.0%	1.4%	2.1%	16.9%	9.8%	1.5%	21.4%	6.3%	0.8%	0.1%	**31.5%**
Mir MHD to Kasur Road	67.3%	4.3%	0.8%	2.4%	2.1%	3.1%	7.0%	3.1%	5.3%	1.8%	1.5%	1.3%	**8.9%**
Mir MHD to LHE RWD Road	68.4%	3.9%	1.3%	4.6%	3.8%	2.0%	3.5%	4.1%	3.4%	1.5%	0.8%	2.6%	**8.1%**
Mir MHD to Raja Jang	40.9%	18.9%	2.8%	5.5%	0.5%	1.2%	2.8%	0.9%	22.5%	1.9%	1.8%	0.3%	**10.2%**
PD Khan	37.1%	4.3%	1.0%	0.5%	13.0%	2.9%	3.3%	2.6%	31.6%	0.3%	0.0%	3.5%	**19.1%**
Satuki to Mustfabad	63.2%	6.3%	0.7%	3.0%	2.7%	3.4%	3.7%	1.1%	10.4%	1.3%	2.7%	1.5%	**7.0%**
Satuki to Raokhan	63.6%	7.5%	1.3%	7.8%	2.1%	1.3%	1.0%	1.1%	10.1%	4.2%	0.0%	0.0%	**5.4%**
Total	**47.0%**	**5.4%**	**1.4%**	**2.5%**	**4.1%**	**7.8%**	**6.1%**	**2.3%**	**18.2%**	**3.1%**	**0.9%**	**1.2%**	**100.0%**

Table 46: Vehicle count by vehicle and project road

Vehicle / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Freight Vehicle	Passenger Qingqi	Freight Qingqi	Auto-rickshaw	Hiace / Coach / Bus	Total
377/WB, 384/WB to Basti Malook	1,385	117	132	68	33	82	149	123	106	105	9	4	**2,313**
Highway: Dunyur Pur to Basti Malook	3,654	103	140	143	49	343	613	293	705	621	19	2	**6,685**
Mir MHD to Kasur Road	1,873	141	34	108	43	36	109	85	67	62	16	6	**2,580**
Mir MHD to LHE RWD Road	1,970	130	60	172	47	22	56	84	51	41	12	9	**2,654**
Mir MHD to Raja Jang	1,295	352	130	190	16	29	72	25	270	68	31	4	**2,482**
PD Khan	1,882	164	76	39	96	47	86	163	567	21	-	23	**3,164**
Satuki to Mustfabad	1,738	170	24	99	29	23	45	15	86	30	28	3	**2,290**
Satuki to Raokhan	1,163	199	41	163	9	4	13	17	61	30	-	-	**1,700**
Total	**14,960**	**1,376**	**637**	**982**	**322**	**586**	**1,143**	**805**	**1,913**	**978**	**115**	**51**	**23,868**

Table 47: Vehicle count by vehicle and project road

Vehicle / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Freight Vehicle	Passenger Qingqi	Freight Qingqi	Auto-rickshaw	Hiace / Coach / Bus	Total
377/WB, 384/WB to Basti Malook	59.9%	5.1%	5.7%	2.9%	1.4%	3.5%	6.4%	5.3%	4.6%	4.5%	0.4%	0.2%	**3.7%**
Highway: Dunyur Pur to Basti Malook	54.7%	1.5%	2.1%	2.1%	0.7%	5.1%	9.2%	4.4%	10.5%	9.3%	0.3%	0.0%	**10.6%**
Mir MHD to Kasur Road	72.6%	5.5%	1.3%	4.2%	1.7%	1.4%	4.2%	3.3%	2.6%	2.4%	0.6%	0.2%	**4.1%**
Mir MHD to LHE RWD Road	74.2%	4.9%	2.3%	6.5%	1.8%	0.8%	2.1%	3.2%	1.9%	1.5%	0.5%	0.3%	**4.2%**
Mir MHD to Raja Jang	52.2%	14.2%	5.2%	7.7%	0.6%	1.2%	2.9%	1.0%	10.9%	2.7%	1.2%	0.2%	**4.0%**
PD Khan	59.5%	5.2%	2.4%	1.2%	3.0%	1.5%	2.7%	5.2%	17.9%	0.7%	0.0%	0.7%	**5.0%**
Satuki to Mustfabad	75.9%	7.4%	1.0%	4.3%	1.3%	1.0%	2.0%	0.7%	3.8%	1.3%	1.2%	0.1%	**3.6%**
Total	**62.7%**	**5.8%**	**2.7%**	**4.1%**	**1.3%**	**2.5%**	**4.8%**	**3.4%**	**8.0%**	**4.1%**	**0.5%**	**0.2%**	**100.0%**

Table 48: Average passenger count per vehicle by vehicle and project road

Vehicle / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Freight Vehicle	Passenger Qingqi	Freight Qingqi	Auto-rickshaw	Hiace / Coach / Bus	Total
377/WB, 384/WB to Basti Malook	2.1	3.8	1.5	1.8	1.8	8.3	3.7	2.6	6.8	1.7	4.1	3.0	**2.7**
Highway: Dunyur Pur to Basti Malook	2.0	2.4	1.4	1.9	8.5	9.8	3.2	1.0	6.0	2.0	8.4	6.0	**3.0**
Mir MHD to Kasur Road	2.0	1.7	1.3	1.3	2.8	4.8	3.6	2.0	4.4	1.7	5.3	11.7	**2.2**
Mir MHD to LHE RWD Road	1.8	1.5	1.1	1.4	4.1	4.7	3.2	2.5	3.4	1.9	3.2	14.8	**1.9**
Mir MHD to Raja Jang	2.0	3.4	1.4	1.9	1.9	2.7	2.5	2.3	5.3	1.8	3.7	5.3	**2.6**
PD Khan	2.4	3.1	1.5	1.5	16.2	7.3	4.7	1.9	6.7	2.0	0.0	18.5	**3.8**
Satuki to Mustfabad	1.6	1.6	1.3	1.3	4.1	6.4	3.6	3.2	5.3	1.9	4.3	22.3	**1.9**
Satuki to Raokhan	1.9	1.3	1.1	1.6	8.0	11.0	2.6	2.3	5.6	4.8	0.0	0.0	**2.0**
Total	**2.0**	**2.5**	**1.4**	**1.6**	**8.0**	**8.4**	**3.4**	**1.8**	**6.0**	**2.0**	**4.8**	**14.5**	**2.6**

Table 49: Passenger count by vehicle and gender (freight vehicle not included)

Passenger / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Passenger Qingqi	Freight Qingqi	Autorickshaw	Hiace / Coach / Bus	Total
Male	20,227	1,321	597	1,171	1,030	1,887	2,264	4,600	1,289	220	353	**34,959**
Female	5,376	844	58	141	638	1,445	974	4,047	438	169	86	**14,216**
Children	3,922	1,217	215	255	898	1,581	608	2,799	233	165	301	**12,194**
Total	**29,525**	**3,382**	**870**	**1,567**	**2,566**	**4,913**	**3,846**	**11,446**	**1,960**	**554**	**740**	**61,369**

Table 50: Passenger count by vehicle and gender (% by vehicle type) (freight vehicle not included)

Passenger / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Passenger Qingqi	Freight Qingqi	Autorickshaw	Hiace / Coach / Bus	Total
Male	68.5%	39.1%	68.6%	74.7%	40.1%	38.4%	58.9%	40.2%	65.8%	39.7%	47.7%	**57.0%**
Female	18.2%	25.0%	6.7%	9.0%	24.9%	29.4%	25.3%	35.4%	22.3%	30.5%	11.6%	**23.2%**
Children	13.3%	36.0%	24.7%	16.3%	35.0%	32.2%	15.8%	24.5%	11.9%	29.8%	40.7%	**19.9%**
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table 51: Passenger count by vehicle and gender (% by gender) (freight vehicles not included)

Passenger / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Passenger Qingqi	Freight Qingqi	Autorickshaw	Hiace / Coach / Bus		Total
Male	57.9%	3.8%	1.7%	3.3%	2.9%	5.4%	6.5%	13.2%	3.7%	0.6%	1.0%		100.0%
Female	37.8%	5.9%	0.4%	1.0%	4.5%	10.2%	6.9%	28.5%	3.1%	1.2%	0.6%		100.0%
Children	32.2%	10.0%	1.8%	2.1%	7.4%	13.0%	5.0%	23.0%	1.9%	1.4%	2.5%		100.0%
Total	**48.1%**	**5.5%**	**1.4%**	**2.6%**	**4.2%**	**8.0%**	**6.3%**	**18.7%**	**3.2%**	**0.9%**	**1.2%**		**100.0%**

Table 52: Highway: Dunyur Pur to Basti Malook comparison with other sites (vehicle count)

Vehicle / Group Count	Motorcycles	Pedestrians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Freight Vehicle	Passenger Qingqi	Freight Qingqi	Autorickshaw	Hiace / Coach / Bus	Total
377/WB, 384/WB to Basti Malook	1,385	117	132	68	33	82	149	123	106	105	9	4	**2,313**
Mir MHD to Kasur Road	1,873	141	34	108	43	36	109	85	67	62	16	6	**2,580**
Mir MHD to LHE RWD Road	1,970	130	60	172	47	22	56	84	51	41	12	9	**2,654**
Mir MHD to Raja Jang	1,295	352	130	190	16	29	72	25	270	68	31	4	**2,482**
PD Khan	1,882	164	76	39	96	47	86	163	567	21	-	23	**3,164**
Satuki to Mustfabad	1,738	170	24	99	29	23	45	15	86	30	28	3	**2,290**
Satuki to Raokhan	1,163	199	41	163	9	4	13	17	61	30	-	-	**1,700**
Total	**11,306**	**1,273**	**497**	**839**	**273**	**243**	**530**	**512**	**1,208**	**357**	**96**	**49**	**17,183**
Highway: Dunyur Pur to Basti Malook	**3,654**	**103**	**140**	**143**	**49**	**343**	**613**	**293**	**705**	**621**	**19**	**2**	**6,685**

Table 53: Bridge to Basti Malook comparison with other sites (vehicle count) (%)

Passenger / Group Count	Motorcycles	Pede strians	Cyclists	Animal Carts	Pickups	Carry Vans	Rent-a-car	Freight Vehicle	Passenger Qingqi	Freight Qingqi	Auto-rickshaw	Hiace / Coach / Bus	Total
377/WB, 384/WB to Basti Malook	59.9%	5.1%	5.7%	2.9%	1.4%	3.5%	6.4%	5.3%	4.6%	4.5%	0.4%	0.2%	100.0%
Mir MHD to Kasur Road	72.6%	5.5%	1.3%	4.2%	1.7%	1.4%	4.2%	3.3%	2.6%	2.4%	0.6%	0.2%	100.0%
Mir MHD to LHE RWD Road	74.2%	4.9%	2.3%	6.5%	1.8%	0.8%	2.1%	3.2%	1.9%	1.5%	0.5%	0.3%	100.0%
Mir MHD to Raja Jang	52.2%	14.2%	5.2%	7.7%	0.6%	1.2%	2.9%	1.0%	10.9%	2.7%	1.2%	0.2%	100.0%
PD Khan	59.5%	5.2%	2.4%	1.2%	3.0%	1.5%	2.7%	5.2%	17.9%	0.7%	0.0%	0.7%	100.0%
Satuki to Mustfabad	75.9%	7.4%	1.0%	4.3%	1.3%	1.0%	2.0%	0.7%	3.8%	1.3%	1.2%	0.1%	100.0%
Satuki to Raokhan	68.4%	11.7%	2.4%	9.6%	0.5%	0.2%	0.8%	1.0%	3.6%	1.8%	0.0%	0.0%	100.0%
Total	65.8%	7.4%	2.9%	4.9%	1.6%	1.4%	3.1%	3.0%	7.0%	2.1%	0.6%	0.3%	100.0%
Highway: Dunyur Pur to Basti Malook	54.7%	1.5%	2.1%	2.1%	0.7%	5.1%	9.2%	4.4%	10.5%	9.3%	0.3%	0.0%	100.0%

While the average number of passengers per vehicle provides insight into which modes of transport move the most number of people, analysing this distribution gives a better sense of how transport service demands will change if restrictions are made and enforced as to the number of passengers permitted per vehicle. These are displayed in - Table 54 and Table 55. The very high figures probably relate to the transport of school children.

Table 54: Motorcycle rickshaw recorded passenger volumes

Observed passengers	Vehicles	Passengers	% Passenger
1	234	234	2%
2	123	246	2%
3	108	324	3%
4	134	536	5%
5	193	965	8%
6	305	1,830	16%
7	272	1,904	17%
8	167	1,336	12%
9	147	1,323	12%
10	85	850	7%
11	43	473	4%
12	29	348	3%
13	29	377	3%
14	10	140	1%
15	6	90	1%
16	19	304	3%
17	3	51	0%
18	1	18	0%
19	4	76	1%
Total	**1,913**	**11,446**	**100%**

Table 55: Motorcycle passenger volumes

Observed passengers	Vehicles	Passengers	% Passenger
1	5,795	5,795	20%
2	5,163	10,326	35%
3	2,823	8,469	29%
4	993	3,972	13%
5	157	785	3%
6	21	126	0%
7	5	35	0%
8	-	-	0%
9	1	9	0%
Total	**14,960**	**29,525**	**100%**

Annex 2: Registered Vehicles in Pakistan and the Punjab

The following tables are derived from the Pakistan Bureau of Statistics Year Book (PBS, 2016) and show the number of registered vehicles, based on data from the Provincial Excise and Taxation Departments. It should be noted that there is no procedure for deregistering motorcycles (so scrapped vehicles will still be included in the statistics). Many motorcycle rickshaws have been registered as motorcycles.

Table 56: Registered vehicles in Pakistan, Provincial Excise and Taxation Departments

Pakistan								
Year	Motor Cars	Motor Cabs	Buses	Trucks	Motorcycles	Motor Rickshaws	Other 3 wheelers	Total
2006	1,372,191	105,373	175,589	189,950	2,757,842	136,394	896,014	**5,633,353**
2007	1,440,801	103,397	184,368	199,447	2,895,734	143,215	940,851	**5,907,813**
2008	1,549,854	104,431	187,367	202,574	3,039,815	156,068	961,646	**6,201,755**
2009	1,657,860	106,463	195,163	210,944	3,215,583	167,910	1,005,441	**6,559,364**
2010	1,726,347	122,882	198,790	216,119	4,305,121	201,827	1,081,916	**7,853,002**
2011	1,881,560	124,651	202,476	225,075	5,781,953	266,390	1,178,890	**9,660,995**
2012	2,094,289	143,859	215,374	240,888	7,500,182	323,189	1,270,788	**11,788,569**
2013	2,281,083	145,234	220,347	247,197	9,129,532	379,879	1,336,470	**13,739,742**
2014	2,436,430	145,424	224,341	252,606	10,944,244	465,258	1,400,812	**15,869,115**
2015	2,577,858	164,045	228,588	259,198	12,476,856	544,792	1,464,091	**17,715,428**

Table 57: Registered vehicles in the Punjab, Provincial Excise and Taxation Departments

Punjab								
Year	Motor Cars	Motor Cabs	Buses	Trucks	Motorcycles	Motor Rickshaws	Other 3 wheelers	Total
2006	613,185	23,694	105,218	66,510	1,843,012	59,577	595,020	**3,306,216**
2007	643,844	23,931	110,479	69,835	1,935,163	62,556	624,795	**3,470,603**
2008	692,567	24,171	112,276	70,930	2,031,449	68,170	638,605	**3,638,168**
2009	740,840	24,641	116,948	73,861	2,148,912	73,343	667,688	**3,846,233**
2010	807,162	24,818	118,366	76,214	3,078,239	98,340	708,058	**4,911,197**
2011	905,240	26,511	121,306	79,656	4,153,262	124,181	767,769	**6,177,925**
2012	1,055,975	45,519	132,270	87,153	5,342,692	153,263	825,608	**7,642,480**
2013	1,180,078	46,894	135,691	89,632	6,608,422	183,645	868,465	**9,112,827**
2014	1,287,407	47,083	139,086	91,924	8,017,794	228,191	916,445	**10,727,930**
2015	1,369,582	65,580	142,882	96,153	9,197,134	272,425	962,105	**12,105,861**