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Sustainable Urban Transport Index for Asian Cities

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Sustainable Urban Transport Index for Asian Cities

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Abstract

The growth and concentration of motor vehicles in Asian cities has led to increased demand for urban mobility. Renewed commitments of Asian cities are required in order to achieve the SDG target 11.2 on urban mobility as well as to enhance overall sustainability of urban transport systems and services. Cities and countries need to track the progress in improving urban mobility. With a view to support evidence based decision, the paper introduces the Sustainable Urban Transport Index (SUTI), a comprehensive assessment tool developed by UNESCAP to help summarize, track and compare the state of urban mobility in Asian cities. It also presents the results of pilot application of SUTI in four Asian cities: Greater Jakarta; Kathmandu; Hanoi; and Colombo completed in 2017. The four pilot cities were able to collect data, analyzed and assess the state of urban mobility in their city using SUTI. The assessment result supported policy makers to identify policy gaps, prioritize additional measures and investment strategies required to improve urban transport systems and services in each city. The visual output display in spider diagram was very useful to comprehend state of all 10 key indicators in a glace. The pilot study demonstrated the usefulness of SUTI tool and the pilot cities were already using the results of SUTI analysis. In Kathmandu additional efforts are required to improve pedestrian infrastructure and facilities, Colombo needed to improve quality and reliability of public transport system, while Hanoi and Greater Jakarta need to put additional efforts to increase mode share of public transport system. More Asian cities have shown interest in application of SUTI. A workshop held in Colombo confirmed the relevance and significance of SUTI tool to evaluate and assess state of urban transport systems and services in Asian cities and as well as to make comparison among peer cities.

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1.   Introduction

Asia has witnessed rapid population growth and urbanization. In 2016, 48.7% of the region's 4.3 billion population lived in urban areas. According to recent projections, more than half of the region's population will be urban residents by 2018 (UNESCAP, UNDP and ADB, 2017), and by 2050 the total regional urban population will reach 3.2 billion (UNESCAP, 2016a). The fleet of motor vehicles is also growing steadily in the region's cities. The growth and concentration of motor vehicles in urban areas has led to increased demand for urban mobility. This rapid growth and increased urbanization will continue to stress urban transport systems and infrastructure leading to congestion, accidents and more consumption of fossil fuels, and correspondingly will raise greenhouse gas (GHG) emissions. Quality of life issues such as loss of productivity and health will also suffer as a follow-on impact.

Provision of sustainable urban transport is becoming a major issue due rapid urban development worldwide, including the Asia-Pacific region. The adoption of the 2030 Agenda for Sustainable Development with the 17 Sustainable Development Goals provides a new impetus to address global development challenges in the world including for transport in urban areas. Further, Sustainable Development Goals (SDG) target 11.2 focuses on improving accessibility for all with emphasis on public transport. Other recent and emerging global and regional commitments such as the Habitat III summit and its outcome the New Urban Agenda and the Ministerial Declaration on Sustainable Transport Connectivity in Asia and the Pacific further emphasize the urgent need to tackle urban transport challenges.

In order to improve urban mobility, achieve the SDG target 11.2 as well as to enhance overall sustainability of urban transport systems and services renewed commitments from Asian countries and cities would be required.

In absence of comprehensive standard frameworks and tools to measure state of urban transport systems in Asian context, UNESCAP has developed the Sustainable Urban Transport Index (SUTI) with 10 key urban transport indicators (UNESCAP, 2016b). SUTI is based on ten key urban transport indicators representing transport system, environmental, social and economic dimension of sustainability. The result of assessment can support city policy makers to make evidence based policies and measures to improve urban mobility

In this context, this paper briefly presents current state of urban transport systems and services in Asia, introduces SUTI and presents the results of its pilot application in four Asian cities and draws some conclusions and policy implications.

Following this introduction, section 2 outlines current state of urban public transport system in Asia. Section 3 presents assessment of urban transport systems in four Asian pilot cities, outlining SUTI, data collection approach and results. Finally, section 4 includes conclusions and discussions and policy implications for enhancing sustainability of urban mobility in Asia.

2.   State of urban public transport in Asia

2.1 urbanization and motorization

Rapid urbanization has transformed cities in the Asia-Pacific region into production and economic centres, and has contributed to economic and social well-being. Cities account for about 80 % of the region's economic output (UNESCAP, ADB and UNDP, 2017).

The Asia-Pacific region has witnessed rapid motorization. Most countries showed growth in motorization rate (vehicles/1,000 inhabitants) from 2014 to 2015.[1] The motorization rate in highly motorized countries, such as Australia, Japan, New Zealand and the Republic of Korea increased from 402-796 in 2014 to 417-819 in 2015, and the rate in less motorized countries, such as India, Pakistan, the Philippines and Viet Nam increased from 20-36 in 2014 to 22-38 in 2015.[2].

This rising vehicle ownership led to traffic congestion which caused many negative externalities in urban areas, such as economic losses, increase in energy consumptions and air pollutions. In 2016, Asian cities, experienced severe traffic congestions ranging from 30 to 50 per cent (increase in overall travel times when compared to a free flow situation), with Bangkok (61 per cent), Jakarta (58 per cent) and Chongqing (52 per cent) had the worst traffic jams.[3]

In addition to the growing number of private vehicles, other characteristic of cities in South Asia and South-East Asia is that powered-two wheelers constitute a major share of vehicle population. For example, India, Indonesia, Thailand and Viet Nam have very high numbers of motorcycles. Due to growing numbers of private vehicles and lack of reliable public transport systems, regional cities and member States are finding it difficult to attract more commuters to the public transport as well keep its mode share.

Road fatalities among vulnerable road users that include motorcyclists, cyclists and pedestrians and urban road safety are a cause of concern in the region. The road traffic deaths among vulnerable road users account for 55 per cent of total road traffic fatalities.

Cities account for more than two-thirds of energy use and GHG emissions. Time losses and transport costs from road congestion imposes an economic cost of 2 to 5 per cent of gross domestic product in the region every year.[4] Another important problem facing Asian cities is the prospect of an ageing population, which in turn adds challenges to urban and transport planning and demands for more urban space, barrier-free public transport and pedestrian facilities. New concepts of planning and designing livable cities are emerging that encourage sustainable and active mobility and accessibility, and which provide more vibrant public spaces.

The increasing trend of urban growth as a result of rural-urban migration in the search for economic opportunities, together with the accompanying motor vehicle fleet growth in cities, is posing challenges to urban planning and provision of urban mobility. The demand for urban

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[1]   www.oica.net/category/vehicles-in-use/.

[2]   Ibid.

[3]   Tomtom Traffic Index, (accessed on 1 August 2018)
https://www.tomtom.com/en_gb/trafficindex/list?citySize=LARGE&continent=AS&country=ALL.

[4]   ADB, 2010. *Sustainable Transport Initiative Operational Plan.* Publication Stock No. RPT102228. Manila, Philippines.

public transport is increasing; urban roads are becoming more congested, leading to slower vehicle speeds as well as increased fossil fuel consumption and vehicle emissions.
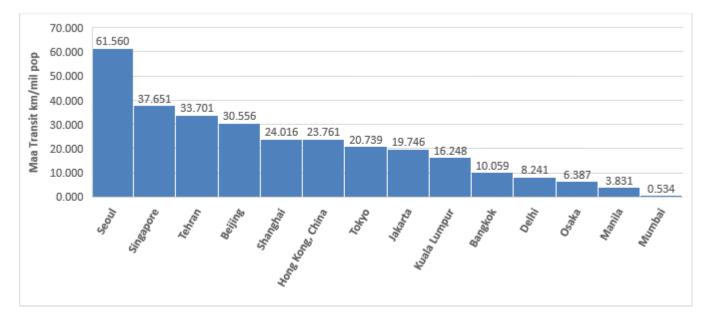
2.2 State of urban mobility

Popular forms of urban public transport modes prevalent in the region's cities include buses, Bus Rapid Transit (BRT), elevated rail, Light Rail Transit (LRT), Mass Rapid Transit (MRT), paratransit, urban railways, taxis, and trams. Boats and ferries are also common modes of transport along inland waterways.

BRT is a popular form of public transport systems in the world, and it continues to be a favored system of mass transit in Asia, for their relative ease and low-cost of installation. Currently, 43 Asian cities operate 1,593 kilometres of BRT carrying about 9.3 million passengers per day.[5] Tehran BRT has the highest capacity of 2 million passengers per day, while the Jakarta BRT system is the longest in the world with 207 kilometres.

The region also has many rail-based public transport systems, such as LRT and MRT. Cities such as Beijing, Guangzhou, Moscow, Tokyo, Seoul and Shanghai have more than 300 kilometres of rail-based urban transport networks. New constructions of rail-based urban mass transit systems are progressing in many Chinese and Indian cities, selected Iranian cities (Ahvaz, Karai, Kermanshah and Qom), as well as in Bangkok, Dhaka, Hanoi, Ho Chi Minh, Jakarta, and Lahore.

Figure 1 presents the total length of mass transit systems (rail-based and BRT) per million head of population in major cities. Seoul and Singapore have the greatest length per population, while Bangkok, Delhi, Manila and Mumbai still need to expand the coverage of their mass public transport systems

**Figure 1. Mass transit system in selected cities (*Source:* De Gruyter and others*.)*

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[5]   See http://www.brtdata.org/ (accessed on 1 August 2018).

In general, the quality of urban public transport is gauged by public perception, ridership and modal share. The mode share of public transport is high in some Asian cities like Manila (59 per cent), Colombo (53 per cent), Hong Kong, China (52 per cent), Mumbai (45 per cent), and Singapore (44 per cent). While Kathmandu (28 per cent) and Jakarta (27 per cent) have moderate public transport mode share, other major cities such as Ho Chi Minh (2 per cent), Hanoi (7 per cent), Kuala Lumpur (7 per cent) and Tehran (13 per cent) have a lower public transport mode share.[6,7]

Inner city paratransit systems are often found in this region that provide flexible and affordable public transport services. Paratransit comes in various forms, including vans, mini-vans, tempos, electric-three wheelers, motorcycle taxis, minibuses and customized public pick-ups (e.g. Ankots in Indonesia, Tempos in Nepal, Songtao in Thailand and Jeepneys in Philippines).

Non-motorized transport, such as walking and cycling, is also gaining popularity in this region. Member States and city authorities are developing infrastructure for non-motorized transport and promoting car-free days as part of their comprehensive mobility plan. Bicycling has been growing and various forms of public bicycle sharing schemes are emerging in China, Japan, India, the Philippines, the Republic of Korea, Singapore and Thailand.

Another common problem in Asian cities is street parking and encroachment of footpaths by local vendors. Even though these activities are commonly restricted by traffic and local laws, however lack of strict enforcement reduces the capacity of roads and footpaths and induces congestion for movement vehicles and pedestrians.

In order to reduce dependency on private transport modes, policies to increase the share of public transport modes and discourage use of private vehicles can be employed. Popular push policies include parking restrictions and pricing, congestion charging, area licensing schemes, electronic road pricing, car sharing, designation of car-free areas and car-free days, and designation of high-occupancy lanes. Pull policies include improvement of the quality and extent of public transportation services. Hong Kong, China as well as Japan, the Republic of Korea and Singapore have developed well-functioning integrated urban transportation systems that are based on attractive public transport and restricted use of private vehicles. As a result of a vehicle quota system being implemented in Singapore, total vehicle population decreased from 974,170 in 2013 to 965,430 in 2016 (LTA, 2016).

Many of the region's megacities have attracted much attention from national Governments and city authorities as well as development partners in addressing urban mobility problems. Cities such as Hong Kong, China as well as Seoul, Shanghai, Singapore and Tokyo have already developed urban public transportation systems while Bangkok, Delhi, Dhaka, and Mumbai are at various stages in the development of urban public transportation systems. Emerging secondary and medium-sized cities offer opportunities to plan and develop integrated sustainable urban public transport systems as land and space to plan such systems can easily be acquired. Many large Asian cities are located on, or close to coastal areas and are vulnerable to the impacts of climate change (ADB, 2011). These cities also pose additional challenges to develop resilient urban transport systems.

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[6]   Chris De Gruyter, Graham Currie and Geoff Rose, Sustainability Measures of Urban Public Transport in Cities: A World Review and Focus on the Asia/Middle East Region. Sustainability 2017. MDPI, Basel, Switzerland 2017.

[7]   SUTI city reports, available at: https://www.unescap.org/events/capacity-building-workshop-sustainable-urban-transport-index-suti.

In order to enhance the energy efficiency of transport sector in the region, regulations that support the usage of hybrid and electric passenger vehicles are also gaining popularity. Recent examples include the popular electric rickshaws (a new form of paratransit) in Nepal, and a fleet of electric buses operating in the central core of Hanoi and Ho Chi Minh city. The energy white paper of the Government of Nepal envisages policies to promote use of electric vehicles, development of charging stations and infrastructure. It aims to increase the import share of electric vehicles to 50 per cent in 5 years (by 2023) and the Energy Minister is currently using an electric vehicle.[8.]

There is much agreement and consensus in urban transport experts and policy makers on how to plan, develop and operate urban transport systems and services including the use of emerging technologies. Planning and design guidelines (UN-HABITAT, 2013), technical standards, case studies and sourcebooks (ITDP, SUTP, ELTIS, 2017) that focus on a particular aspect of urban transport and mobility are readily available. Countries and cities of the region could focus attention on utilizing these resources for actual application and implementation. A broad coalition of development partners to support regional cities in implementing sustainable urban transport master plans would be a step in the right direction. An example of this approach is the Transformative Urban Mobility Initiative of the German Federal Ministry for Economic Cooperation and Development (BMZ), the objective of which is to enable leaders to plan and implement sustainable mobility concepts (TUMI, 2017). A project on Transforming Urban Transport: The Role of Political Leadership aims to advance knowledge about where political leadership has successfully implemented ground-breaking transportation policies in major cities (TUT-POL, 2017).

Some of the policies being taken by member States and cities are improving quality and extent of mass urban public transport systems, integration of various urban transport modes, prioritizing non-motorized transport, construction of intermodal transfer stations, using integrated ticketing and smart card systems, and restriction on the use of private vehicles.

The following describes few innovative examples of some policy measures and projects to improve urban mobility being implemented by countries and cities.

(a) Suroboyo Bus: It is an awareness campaign for public transport and waste management in Surabaya. A fleet of eight large red low-floor public buses operates between Purabaya Terminal and Rajawali Street covering 44 stations. This bus fleet operates with a 5-minute headway and 67-passenger capacity per a bus. The buses are designed with assigned seats for women and priority citizens. To exchange for a single-ride sticker for this bus route, passengers need to bring empty plastic bottles, either six small bottles or three large bottles. Bus stops are equipped with facilities to collect recyclable plastics bottles and ride stickers. This awareness campaign for recycling plastic waste and promoting bus service is gaining popularity; as a result, the city authority is planning to add 10 more similar buses to the existing fleet by the end of 2018 and extending the service to other routes.

(b) Purabaya Intercity Bus Terminal: Surabaya has developed a state of the art intercity bus terminal at Purabaya for smooth transfer of passengers from intercity and suburban buses to urban buses. In 2016, the terminal handled 16,151,715 arrivals and 16,071,055 departure passengers, in 577,820 arrivals and 575,794 departure buses. The well-designed terminal features bus information, ticketing booths, passenger waiting areas, kiosks, restaurants, two level departure halls with overpass leading to 25 intercity and suburban bus bays and 10

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[8]   Government white paper on energy, water resources and irrigation issued on 8 May 2018.

central city bus bays. The terminal is well managed and operated as the largest bus terminal in South East Asia and one of the busiest.

(c) Surat Sitilink public transport system: Surat has a public transport system featuring 102 kilometres of BRT network with 156 stations, 279 kilometres of regular city bus network, and 12 kilometres of high mobility corridor. The ridership raised from 25,000 to 210,000 passengers per day over 18 months after the opening of the system.[9] The three systems are operated by a single private operator, Sitilink, with a common fare structure and transferable ticketing system. Surat city authority is planning a new bus depot, a smart ticketing card system, and new infrastructure for walking and cycling.[10]

(d) India's Smart City Mission: The provision of efficient urban mobility and public transport is a strategic element of Smart City Mission launched by India in 2015. Key elements include: traffic and transport management; universal design and barrier-free public transport facilities; strategies to increase walking and cycling mode-shares, and urban planning strategies to reduce long distance trips of private passenger vehicle, lower air and noise pollution. Rail-based public transport is also a key component of this Smart City Mission, which completed 77 kilometres of new metro network in the last three years and approved five new metro projects. Currently, there are 14 metro projects under construction in 12 Indian Smart Cities.[11]

3. Assessment of urban transport systems and services

Provision of sustainable urban transport is becoming a major issue because of rapid urbanization worldwide, including the Asia-Pacific region. The adoption of 2030 Agenda for Sustainable Development[12] with 17 Sustainable Development Goals provides a new impetus to address global development challenges in the world, including urban transport. Sustainable Development Goal target 11.2 focuses on improving accessibility for all with emphasis on public transport.

Countries and cities need to periodically assess their urban transport systems and services, and identify policy, planning and implementation shortcomings, and pledge to continuously improve the urban transport system and increase their ridership. City authorities need comprehensive set of information on the state of urban transport including potential areas for improvement to support their evidence based decision making.

Measurement of the state of urban transport, evaluation of urban transport policies and their implementation can support the assessment of urban transport contribution to sustainable development. A set of key urban transport indicators and indices, easily populated with data, can be very useful tools for the assessment of urban transport systems and services, as well as reflecting the state of urban transport performance among cities. Indicators and indices are increasingly being used as tools for this purpose. There is, however, no established system of indicators and indices to measure, monitor and report on sustainable transport for cites in the Asia-Pacific region.

A collaborative research study was undertaken in 2016 to identify key urban transport indicators that could constitute an index to measure sustainability of urban transport systems and policies in the Asia-Pacific context.

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[9]   Surat Smart City, Information Brochure 2018, Surat Municipal Corporation, India
[10]   Information collected during the mission to Surat, 25-27 July 2018
[11]   http://mohua.gov.in/eBook_2017/mobile/index.html#p=13.
[12]   A/RES/70/1

The concept of sustainable urban transport index that includes indicators and index was presented at the Expert Group Meeting on Planning and Assessment of Urban Transportation Systems[13] held in Kathmandu on 16 and 17 September 2016. The meeting supported the concept and provided feedback to identify indicators and develop an index. The Regional Meeting on Sustainable Urban Transport Index[14], held in Jakarta on 2 and 3 March 2017, finalized the index and recommended for its endorsement by the UNESCAP Committee on Transport for its application in Asian cities.

3.1 Sustainable urban transport index

The sustainable urban transport index is a framework of 10 indicators for the assessment of urban transport systems and services as well as the state of urban transport performance in cities. Table 1 lists the 10 indicators, measurement units and normalization range.

Table 1: Indicators for sustainable urban transport index

No.	Indicators	Measurement units	Weights	Range	
				Min.	Max.
1.	The extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes	0 - 16 scale	0.1	0	16
2.	Modal share of active and public transport in commuting	Trips/mode share	0.1	10	90
3.	Convenient access to public transport service	Percentage of population	0.1	20	100
4.	Public transport quality and reliability	Percentage satisfied	0.1	30	95
5.	Traffic fatalities per 100.000 inhabitants	Number of fatalities	0.1	0	35
6.	Affordability – travel costs as part of income	Percent of income	0.1	35	3.5
7.	Operational costs of the public transport system	Cost recovery ratio	0.1	22	175
8.	Investment in public transport systems	Percentage of total investment	0.1	0	50
9.	Air quality (PM 10)	µg/m3	0.1	150	10
10.	Greenhouse gas emissions from transport	CO_2 Eq. tons/capita/year	0.1	2.75	0
	Total		1.00		

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[13] https://www.unescap.org/events/expert-group-meeting-planning-and-assessment-urban-transportation-systems.

[14] More information available from: http://www.unescap.org/events/regional-meeting-sustainable-urban-transport-index.

The composition of indicators indicates that the index is a comprehensive assessment tool that incorporates urban transport system, social, economic and environmental dimensions of sustainable urban transport systems and services.

The indicators on urban transport plan and modal share of active and public transport represent the urban transport system dimension. It will enable cities to evaluate how comprehensive is their urban transport master plan and whether the plan includes facilities for intermodal transfer, pedestrians and cyclists as well polies to increase public transport modal share.

The indicators on accessibility, road safety, quality and reliability of public transport and affordability represent social dimension of urban transport system and service. Their assessment will enable cities to initiate policies to improve on those indicators.

The indicators on operational cost and investment in public transport system represent economic dimension. Their assessment will enable cities to evaluate the state of investment made in public transport and how the public transport service is generating revenue. Their assessment result would enable city authority to initiate policies to increase investment in public transport and possible fare review.
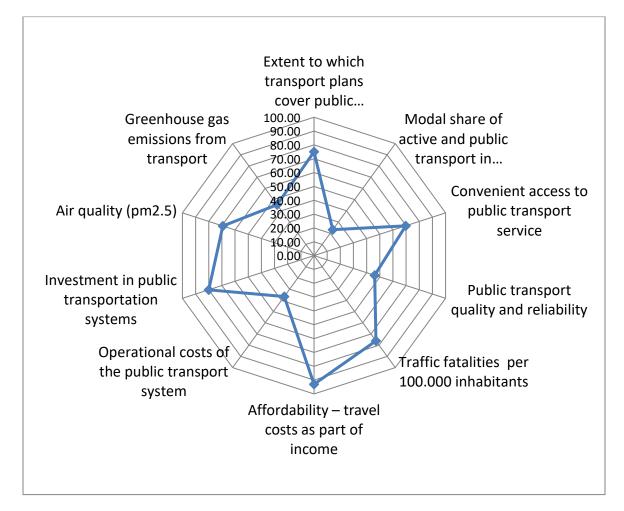Finally, the indicators on air quality and greenhouse gas emissions represent environmental dimension. Their assessment will enable cities to evaluate state of air quality and greenhouse gas emissions. Policies on fuel quality, use of alternate energy, emissions standards, and vehicle maintenance would help improve air quality and greenhouse gas emissions.

Indicators on different scales need to be normalized before comparison and aggregation are possible. The linear rescaling method that is applied for sustainable urban transport index, is a common approach in composite index design. This allows for a simple transformation to a linear scale 1-100 for each indicator. The minimum and maximum ranges are defined as lowest and highest value found or expected for each indicator based on real performance, information in literature and considering Asian context. The index is derived by geometric aggregation of the 10 indicators and equal weightage is applied for all 10 indicators.

The most important factor in the application of the index is the availability of suitable, consistent and reliable urban transport data. Without data, even the most sophisticated index is useless. The data need to be collected using similar data collection method and regularly updated. Therefore, additional efforts of city authorities are needed to collect and compile data for the ten indicators.

One of the important user-friendly outputs of the analysis is the display of result in a spider diagram. The visual display of the state of each indicator in a city easily allows policy makers to comprehend the system and focus attention on the indicators, which have low values (near the center of circle).

The figure 2 shows an example of a spider diagram generated by SUTI analysis, the state of each indicator can be observed. A high value (near the outer circle of the diagram) indicates good result, whereas the opposite is the case for a low value. Based on this result, the city could consider if there were areas where it would like to focus more attention, or areas where additional data should be required and examined more closely. Repeating the exercise at a regular interval will allow a city to track improvements in performance and results of its efforts to improve urban transport system over time. Analyzing SUTI for several cities will allow comparison and ranking of performance across cities in a standardized way. It is important that

each city follows the same procedure and guideline to collect data for the indicators to be able to compare results across cities.

Figure 2: Result display in spider diagram

Application of the index among similar cities based on standardized data collection approach and methodology and comparisons of results would enable cities to benchmark their performance against individual indicators as well as the index to assess overall sustainability of urban transport systems and services.

Sustainable urban transport index has the potential to serve as a quantitative tool for countries and cities of the region to assess urban transport systems and services. It can help identify policy gaps, prioritize additional measures and investment strategies required to improve urban transport systems and services. It is expected that more cities and countries would gradually adopt the standardized data collection methods and apply the indictors and index. The index can also serve as a tool to monitor progress towards the achievement of Sustainable Development Goal target 11.2.

3.2 Pilot application of SUTI

The pilot applications of the index were undertaken and completed in four cities in 2017: Colombo; Greater Jakarta; Hanoi; and Kathmandu. Table 2 shows basic characteristics of four pilot cities.

Table 1 Basic characteristics of the four pilot cities

	Greater Jakarta	**Hanoi**	**Kathmandu**	**Colombo**
Area	Greater Jakarta	Hanoi city	Kathmandu Valley	Western Region
Size	6,767 km2	3,325 km2	722 km2	3,684 km2
Population	30.1 mill.	7.7 mill.	2.8 mill.	5.8 mill
Average density	4,448 inh./km2	2,306 inh./km2	3,878 inh./km2	1,774 inh./km2

For sustainability assessment of public transport systems and services in four selected cities, the methodology outlined in the Assessment of Urban Transport Systems (UNESCAP, 2016b and Gudmundsson and Regmi, 2017) is used. The methodology is much inspired by the sustainable urban transport evaluation being used in the Republic of Korea (KOTI, 2015) and sustainable mobility (WBCSD, 2016). It involved collection of urban transport data for ten key indicators, discussion with city officials for validation of data and evaluation of urban transport master plans and analyze the data for each cities using SUTI excel sheet.

3.2.1 Data

The data collection work was carried out during June-October 2017. UNESCAP supported each pilot city on data collection, provided advisory services and organized a consultation meeting with key urban transport stakeholders in each city to discuss the data collection approach for 10 indicators, analysis and preparation of report. The visits to the four pilot countries and cities took place during July-September 2017.

The countries and pilot cities designated a focal point to coordinate data collection, collect data and prepare an SUTI analysis report. In order to support cities to take a standardized approach in data collection and analysis, a monograph series on assessment of urban transport system (UNESCAP, 2016b), a sustainable urban transport index data collection guideline (UNESCAP, 2017a) and a SUTI Excel calculation sheet (UNESCAP, 2017b) were developed and provided to the focal points in given cities and countries. The focal points found these to be very useful. The countries and cities officials and experts were provided technical support and advice.

Despite the short period, all four pilot cities were able to collect data for the 10 indicators and produced analysis reports (Chung, 2017; Khokhali, 2017; Nanang, 2017; and De Silva, 2017). The data for ten indicators was presented in prescribed Excel format.

During the pilot phase, UNESCAP has collaborated with the cities authorities for collection of data and analysis. The secretariat collaborated with the Center of Excellence in Urban Transport in India, Greater Jakarta Transport Authority, Kathmandu Valley Development Authority, Transport Development and Strategy Institute in Viet Nam, and Moratuwa University

in Sri Lanka. To expand the index application in major, secondary and emerging cities of the region, new partnerships with related stakeholders are essential.

3.2.2 Greater Jakarta

SUTI analysis covers the Greater Jakarta area (JABODETABEK). This includes six cities and three regencies, Jakarta, Bogor, Depok, Tangerang, Bekasi, Tangerang Selatan, Bekasi regency, Tangerang regency and Bogor Regency. The population is more than 30 million.

According to the report, Jakarta has struggled with traffic and transportation problems in the last 20 years. The share of private vehicles has increased significantly, while the shares of public transport tends to decrease. In the 2000 the use of public transport was 58% while it significantly decreased in 2010 to 28%. The city experiences significant congestion due to motorization.

Data were collected for all 10 SUTI indicators and the results are shown in figure 3. Jakarta aggregate SUTI value is 52.5. Greater Jakarta scores highest in indicator 8 'Investments in public transport systems'. The city also scores fairly well in Indicator 5 'Traffic fatalities', indicator 1 on 'Transport plans' and indicator 10 'Greenhouse gas emissions'. Indicators 2 'mode share of public transport", 3 'accessibility' and 4 'quality and reliability' have low score. The lowest score is in indicator 7 'Operational costs of the public transport system'.

Greater Jakarta performed well compared to other pilot cities. Greater Jakarta has been investing for two mass transit systems and have developed an integrated urban transport plan. The road safety indicator showed good road safety situation. Based on the analysis, the Greater Jakarta city authorities have identified that additional efforts are required to: (i) extend public transport accessibility which is currently at 49 per cent, (ii) increase mode share of public transport which is currently at 27 per cent, (iii) improve quality and reliability of public transport services and (iv) improve air quality including strategies to reduce pollutant particles PM10, which stood at 82 ug/m3 annual mean value and exceeded the WHO guidelines (20 ug/m3) and has been ranked one of the highest in the region[15].

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[15]   For details please refer to individual SUTI city report available at:
https://www.unescap.org/events/capacity-building-workshop-sustainable-urban-transport-index-suti.
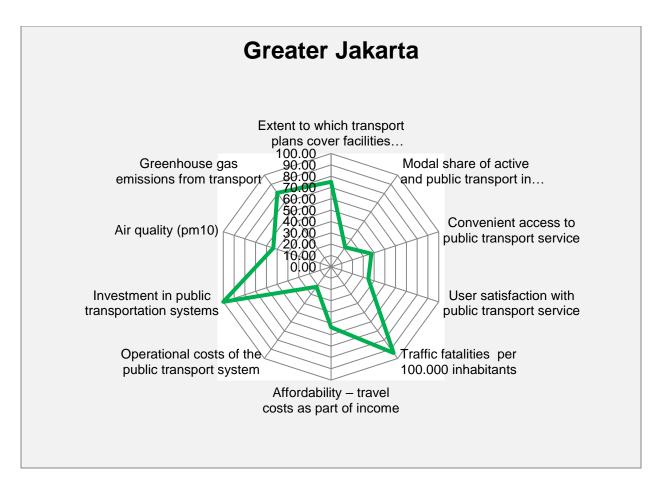
Figure 3: SUTI spider diagram for Greater Jakarta

3.2.3 Kathmandu

Kathmandu is the Capital of Nepal, located in the Kathmandu valley and the Bagmati zone of central development. The report covers the Kathmandu Valley which has an area of 721.87 sq.km including Kathmandu, parts of Lalitpur district, and Bhaktapur district. The valley is 47% cultivated land.

The economy of the valley has been rapidly growing. Road is by far the dominant mode of transport. There is no rail based mass transit systems, although several feasibility studies have been conducted. The share of motorcycles has increased at an alarming rate.

The Kathmandu Sustainable Urban Transport Project (KSUTP) is an initiative of the Ministry of Physical Infrastructure and Transport, with support of the Asian Development Bank the Global Environment Facility aims is to improve public transport condition and the walking environment in Kathmandu valley area.

Data were collected for all 10 SUTI indicators and the results are shown in figure 4. Kathmandu aggregate SUTI value is 47.80. Kathmandu scores highest in indicator10 'Greenhouse gas emissions from transport'. It also scores well in indictors 2, 3, 5 and 6. The city scores lowest in indicator 4 'Public transport quality and reliability'.

Kathmandu does not have an approved urban transport master plan yet despite having undertaken many studies. The analysis highlighted that Kathmandu had an improved road safety record and a relative high mode share of public transport, despite a low level of user's satisfaction. The city should work on developing its comprehensive urban transport master plan incorporating walking and cycling infrastructure. Based on the analysis, Kathmandu city authorities have identified the need to: (i) Improve pedestrian facilities to address the high mode share of walking (40.6 per cent); (ii) Improve quality and reliability of public transport systems (28 per cent public transport mode-share), (iii) Increase investment in the development of mass public transport system, and (iv) Improve air quality, which regularly exceeds the Nepal's National Ambient Air Quality Standards (120 ug/m3 for PM10).
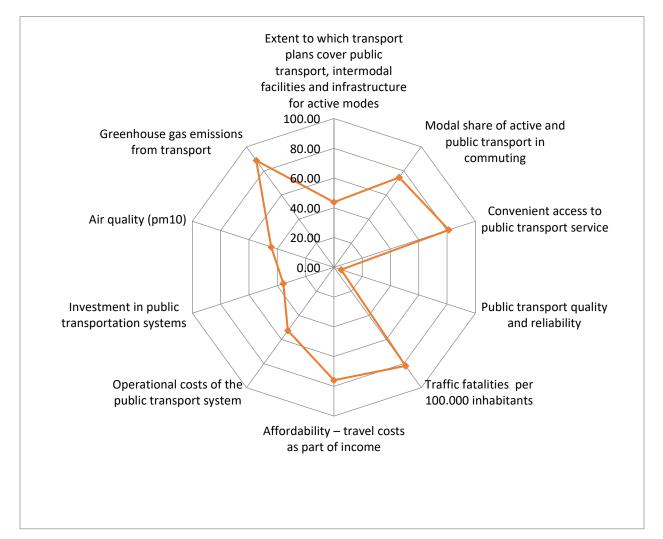

Figure 4: SUTI spider diagram for Kathmandu

3.2.4 Colombo

The area included in the Colombo report is the Western Region of Sri Lanka, which is the main economic hub of the country. It includes three administrative districts; Colombo, Gampaha and Kalutara and 33 divisional secretariat divisions. The total land area of the Western Region is 3.684 sq. km.

Main sources for the report include the Western Region Megapolis Transport Master Plan 2016 and the Urban Transport Survey Project (CoMTrans), conducted in 2012 to 2014. Data were collected for all 10 SUTI indicators and the results are shown in figure 5. Colombo aggregate SUTI value is 32.70.

Colombo scores highest in indicator 2 'Modal share of active and public transport in commuting'. It also scores fairly well in indicator 9 'Air Quality and 10 "Greenhouse gas emissions". The city scores lowest in indicator 4 'Public transport quality and reliability'.

Colombo has a good urban transport master plan, public transport network, good air quality, low greenhouse gas emissions and affordable public transport fare. Based on the analysis, Colombo has identified areas for further improvement, such as increasing mode share, accessibility of public transport which is currently at 44 %., quality and reliability of its public transport services, which already enjoys a high mode share of 44 per cent. Colombo is also planning to develop an elevated light rail transit system.
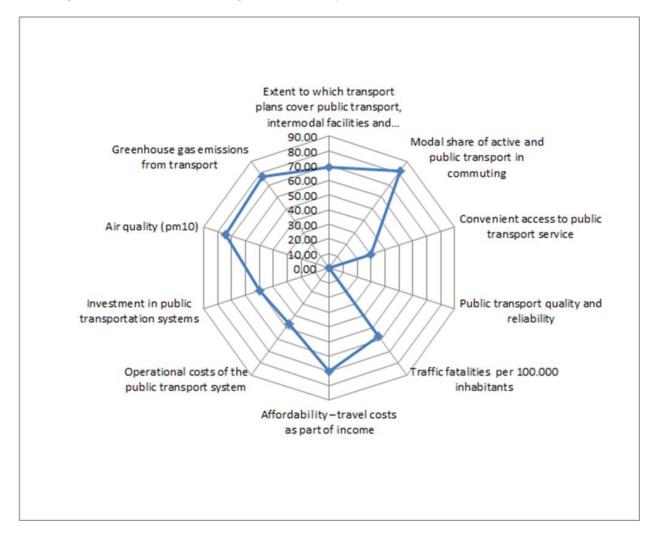

Figure 5: SUTI spider diagram for Colombo

3.2.5 Hanoi

Hanoi is the capital of Vietnam, and the cultural and political center of the country. Hanoi City comprises 30 urban/suburban districts, with 584 precincts and towns. It takes up an area of 3,324.5 km2. According to the Hanoi focal point report recent years has seen a strong increase in the use of cars and motorbikes. There are now (2016) more than five million motorbikes in the city. Significant investments in infrastructure have been undertaken in recent years, and two new urban railways systems will come into operation in 2018.

Traffic congestion is a significant concern in Hanoi although congestion in the city has improved in recent years due to the recent investments. It is estimated that traffic jams in Hanoi result in losses of time and increasing of fuel costs of about 22 trillion Vietnamese Dong (near US$ 1 billion) per year. Data were collected for all 10 SUTI indicators and the results are shown in figure 6. Hanoi aggregate SUTI value is 26.77.

Hanoi scores highest in indicator 6 'Affordability'. The city also scores fairly well in indicators 4, 'Public transport quality and reliability', 5 'Traffic fatalities', and 10 'Greenhouse gas emissions'. Hanoi scores lowest in indicators 2 'Modal share of active and public transport' and 8 'Investment in public transport systems'.

In comparison with other pilot cities, Hanoi has low greenhouse gas emissions, high affordability and accessibility (60 per cent) of public transport as well as a relatively good road safety record. It has very low mode share of public transport as many trips are made on personal vehicles including motorcycle. The Hanoi city authorities have identified the need to further increase the mode share of public transport and improve air quality. Based on the analysis, additional infrastructure for walking and cycling, and intermodal transfer facilities could be incorporated in the already approved transport master plan. Hanoi is developing two externally funded mass transit systems. It scored low on investment in public transport as externally funded projects were not included in analysis.
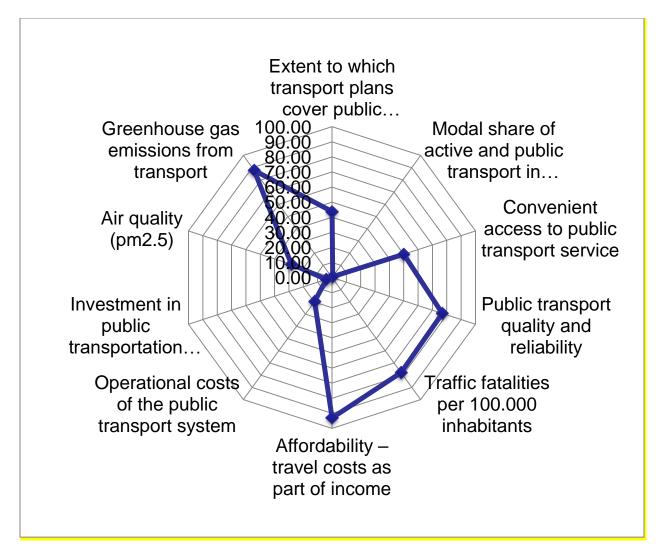
Figure 6 SUTI spider diagram for Hanoi

3.3   Further work on SUTI

UNESCAP collaborated with the Russian Federation and successfully organized the High-Level International Conference on City and Transport: Safety, Efficiency, and Sustainability in Khabarovsk, Russian Federation on 4 and 5 September 2017. The concept of sustainable urban transport index was introduced, and the conference considered that provision of public transport, non-motorized transport, electric and smart mobility and use of intelligent transport systems as essential components of sustainable urban transport systems.

UNESCAP is currently providing capacity building support to six cities in Asia and the Pacific region (Bandung, Dhaka, Ho Chi Minh City, Surabaya, Surat and Suva) for the application of the index for assessment of urban mobility. Advisory missions to five cities were completed during June-July 2018 and technical advice was provided to city focal points and city transport authorities for data collection and analysis.

Five cities have completed the draft assessment of urban transport. A Capacity Building Workshop on Urban Mobility and Sustainable Urban Transport Index was held in Dhaka on 12

and 13 September 2018 in collaboration with the Roads and Highways Department, Bangladesh and Dhaka Transport Coordination Authority. The objective of the workshop was to share the experience of cities, as well as to discuss policy measures to improve urban mobility in these cities and other Asian cities. About 70 participants from 9 countries and cities including local stakeholders from major and secondary cities in Bangladesh participated in the workshop. Participants from Bangladesh, Bhutan, India and the Islamic Republic of Iran have appreciated the usefulness of SUTI and showed interest in its application in their cities.

To enhance the dissemination information on the sustainable urban transport index, a brochure was developed and distributed at related events and during missions. The brochure is available in English, Russian and Chinese. An article on the index was published in the Transport and Communications Bulletin for Asia and the Pacific, No. 87[16] with the theme "Transport and Sustainable Development Goals" and a blog[17] on the index was published.

As the data for 10 indicators are readily available in most cities, the cities are encouraged to use the index for assessment of urban transport systems, and its findings to initiate evidence based policies and implement the policies to improve urban transport systems and services. Further, the index includes aspects of planning, accessibility, modal share, quality and reliability of public transport, safety, affordability, investment, and air quality and greenhouse gas emissions. The index has the potential to emerge as a global framework and tool for assessment of urban transport systems and services and track the progress of achievement of Sustainable Development Goal target 11.2. The index was presented at the Asian Development Bank, Manila in November 2017 and at the 9th World Urban Forum[18] held in Kuala Lumpur, 9-13 February 2018 at a plenary session and urban library. Sustainable urban transport index was included in the Sustainable Development Goal 11 Synthesis Report[19] prepared for the High Level Political Forum held United Nations in New York in July 2018.

UNESCAP has explored collaboration and partnership opportunity with the World Business Council for Sustainable Development and UNHABITAT and would explore further opportunity with Cities Alliance, ASEAN Smart City Alliance, Indian Smart Cities Network and other related stakeholders.

As the urban transport is the domain of city authorities, organization of a mayor's conference would be useful for wider dissemination of the sustainable urban transport index tool, data collection and assessment guidelines. Also, to encourage cities for self-assessment of urban transport systems using the index, development of a dedicated web site for the index and train the trainer programme for the stakeholders will be planned.

4.   Conclusions

4.1 Results and discussions

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[16]   https://www.unescap.org/publications/transport-and-communications-bulletin-asia-and-pacific-no-87-transport-and-sustainable.
[17]   https://www.unescap.org/blog/tracking-the-progress-of-urban-mobility-in-asian-cities-using-the-sustainable-urban-transport-index.
[18]   http://wuf9.org/.
[19]   https://unhabitat.org/sdg-11-synthesis-report/.

Table 3 shows normalized values of ten SUTI indicators for four cities. The SUTI analysis and result based on the available compiled and collected data in 2017 for four pilot cities shows the current state of urban transport with respect to the 10 indicators.

Table 3. SUTI indicator results for the four pilot cities (normalized values)

No	Indicator	Greater Jakarta	Hanoi	Kathmandu	Colombo
1	Extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes	75.00	43.75	43.75	68.75
2	Modal share of active and public transport in commuting	35.11	0.81	74.71	81.81
3	Convenient access to public transport service	46.88	50.00	81.25	30.00
4	Public transport quality and reliability	49.25	76.87	5.12	0.15
5	Traffic fatalities per 100,000 inhabitants	94.43	77.87	81.91	57.34
6	Affordability – travel costs as part of income	67.90	92.98	75.87	70.41
7	Operational costs of the public transport system	28.35	19.57	52.55	46.93
8	Investment in public transportation systems	100.00	3.93	35.68	49.60
9	Air quality (pm10)	53.57	28.24	44.29	74.29
10	Greenhouse gas emissions from transport	71.27	88.16	88.73	77.09

Table 4 lists the calculated SUTI values for four cities based on data compiled and available in 2017. A higher SUTI number suggests a higher overall performance.

Table 4. SUTI value for pilot cities

S. No.	Cities	SUTI
1	Greater Jakarta	52.5
2	Kathmandu	47.8
3	Colombo	32.7
4	Hanoi	32.2

The results clearly show that four cities score quite differently overall. Overall Greater Jakarta showed good performance with the highest aggregate SUTI score of 52.5 whereas Hanoi dominated by motorcycle transport has the lowest SUTI score of 32.2. However, all cities have indicators for which they score well on the scale and others where they score low and could likely improve. As could be expected for four cities located in developing countries their aggregate sustainable transport performance is generally placed in the lower half of the 0-100 range, with Greater Jakarta as the exception just above middle performance. None of the cities are thus near the theoretical top-level score of 100 SUTI. Neither are cities near 0 SUTI score.

Greater Jakarta have a good transport master plan, accessibility, road safety record, affordability, have investment well in public transport systems as well as GHG emissions. Kathmandu also scored high due to high mode share of public and active transport, good accessibility, safety record, affordability and GHG emissions. Colombo and Hanoi are assessed as having low SUTI score. Colombo SUTI low score was due to low accessibility, low public perception of quality and reliability of public transport and poor safety record. Hanoi low SUTI score was mainly due to very low mode share of public and active transport, low accessibility, low investment from public sector on public transport despite have two externally funded project which were not evaluated and low air quality.

The aggregate SUTI score only provides a rough approximation of performance. It is more enlightening, especially in the pilot study, to compare at the level of individual indicators. However, directly comparing results across the pilot cities, let alone ranking them, based on the numerical results only, should proceed with caution. Firstly, the pilot cities experience different circumstances, spatial conditions, and economic development. Therefore, they will not be able to deliver the same level of performance. Secondly the practical testing during the pilot phase shows some variations in data sources that cities used to calculate the indicators and the index. Therefore, differences in reported performance are in some cases influenced by data availability and quality.

Looking at individual indicators, the best performance overall is seen for indicator 10 'Greenhouse Gas emissions'. Also for indicators 6 'Affordability' and 5 'Traffic fatalities' performance is relatively good, while further improvements may still be required, or deterioration avoided. For other indicators performance is varied in some cases in the extreme, as is the case of indicators 2 'Modal share', 4, 'Public transport quality and reliability' and 8 'Investment in public transportation systems'. For these indicators in particular, data collection guideline may need to be revised or strengthened. In general scores are lowest for indicator 4 'Public transport quality and reliability' and 7 'Operational costs of the public transport system'. These may be areas that deserve attention in several cities.

On interesting common feature of the assessment was that the fare structure of public transport was very low in all pilot cities. The fare structure of public transport in Asian cities is relatively affordable. The fare revision is a sensitive issue for cities and national transport authorities. City authorities usually provide subsidies to the operators of the public transport services. Often city authorities or central government provided subsides to the public transport operators except for Kathmandu where the private sector dominates the operation of public transport system.

While results overall seem robust, the full interpretation of individual results and how to respond to them would need to consider several factors including conditions in general for developing cities as well as the spatial and economic context of each city. Such interpretations are primarily within the domain of the individual cities and countries to make.

However, city authorities are already interpreting results of SUTI assessment and drawing implication for urban transport planning. For example, Kathmandu needed to focus on improving pedestrian facilities as the mode share of waling was high; Hanoi has a low mode share of public transport despite having good bus and a BRT system. Greater Jakarta was investing well for improvement of public transport system, Colombo needed to improve quality and reliability of public transport systems.

It is encouraging that all four cities have used SUTI results to discuss their performance and the possible implications for urban transport planning. All cities reflect various challenges with the

provision of "access to safe, affordable, accessible and sustainable transport systems for all," as required by SDG Target 11.2 Most cities observe how they are struggling with various aspects of public transport reflected by indicators. The cities highlight the need for taking various actions to improve this situation. Other areas needing attention include air pollution and measures to support active modes and inter-modality.

A Capacity Building Workshop on Sustainable Urban Transport Index[20] was organized in Colombo in October 2017 in collaboration with the Ministry of Transport and Civil Aviation, Sri Lanka to share the results of pilot study among the pilot cities and other related stakeholders and consider ways to improve urban transport systems in Asian cities. The Workshop appreciated the support extended to the cities and found the data collection guideline and SUTI Excel sheet very useful. The workshop recommended for application of SUTI in additional cities and highlighted the need to collect data using a standardized and uniform guideline and a standard household survey questionnaire for the use by city authorities in order to be able to make comparison among peer cities. In this respect further refined of the guidelines and development uniform questionnaire for data collection would be useful for cities. UNESCAP would consider these learning and recommendations for next phase of SUTI implementation.

Some cities reported difficulty in collecting data for indicators 7 operational cost of public transport as cities would have many operators. Also, the analysis shows that all four cities have fare box ration form 28-51% and this indicates cities are subsidies public transport operations – except for Kathmandu where the private sector dominates the operation. It was observed that the higher range of 175% for the indictor was very high and a revision of this value could be considered.

For indictor 8 investment in public transportation systems, the main objective was to see the commitment of city and government authority towards investing in public transport, therefore the data collection guidelines not to include externally funded project. Thus, despite having two major public transport projects in Hanoi, it scored low. As receiving external fund for public transport also need efforts and commitment of city authorities, the data collection guideline could take this into account for next SUTI exercise.

The data collected for urban road safety indicates good road safety record, however it was observed that it may not include the underreporting. In case of national road safety, the reported data are usually modelled to take account for underreporting. Also as the lower target of 35 for the indicator was set based on national safety records, and a revision of this value could be considered considering the safety situation in Asian cities.

While the SUTI has overall been successfully applied it seems that some city and general results may be particularly influenced by data availability and data selection choices in individual cities. While data availability may depend on general resource, capacity and time constraints, data selection choices may be enhanced by further strengthening of the data collection guideline.

The main purpose of this SUTI pilot application was to validate the usefulness of the indicator set and index and draw policy insights for cities to improve urban mobility. As discussed above, the pilot application and results have demonstrated usefulness and relevance of ten key indicators and the index. However, there is scope for further refinement, development and application of SUTI. Particularly, the development of uniform standardized data collection

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[20] http://www.unescap.org/events/capacity-building-workshop-sustainable-urban-transport-index-suti

guidelines, survey questionnaire, and possible revision of minimum and maximum values of indicators 5 and 7.

4.2 Conclusions and policy implications

Asian City authorities need to consider innovative mobility solution to address the rapid urbanization and motorization in Asia cities. The city leadership need to bring transformation and rigorous action in policy development and implementation, financing and technical innovation (High-Level Advisory Group on Sustainable Transport, 2016).

The four pilot cities were able to collect data and prepare SUTI analysis report in short time. The visual output display in spider diagram was very useful to comprehend state of all 10 key indictors in a glace. The pilot study demonstrated the usefulness of SUTI analysis for planning of future actions required to improve mobility condition. Colombo mentioned especially public transport accessibility, quality and reliability. Kathmandu highlighted needs for investment to improve public transport quality and reliability and to improve infrastructure for active modes. For Greater Jakarta it was emphasized the need to improve public transport mode share, quality and reliability and the operational costs of the public transport system. Hanoi highlighted a need to improve the mode share of active and public transport at the expense of motorcycles, to improve access in the more suburban areas and to improve air quality.

The pilot SUTI assessment has also demonstrated that pilot cities were able to work systematically with measuring their urban transport performance and to use the results for informing the planning of future initiatives. However, officials and related stakeholders in cities are likely to need capacity building support and advisory services for data collection and analysis and apply SUTI in a coordinated and comparable way.

The SUTI results also showed that Asian cities face significant challenges regarding key sustainable urban transport indicators and would need to act to improve their performance in several areas, including public and active transport, and to avoid a further deterioration of the present situation in accessibility and environmental impact.

The results from four cities indicated that cities authorities need to periodically assess their urban transport systems and services, and identify policy, planning and implementation shortcomings, improve quality and extent of services, and pledge to continuously improve the urban transport system through evidence based policy and decision making. SUTI with systemic, economic, environmental and social indicators that include elements of planning, multimodal transport, service quality, user satisfaction, operation, infrastructure, safety, costs, funding, PM10 and GHG has the potential to emerge as a useful objective tool for measuring sustainability of urban mobility in a city. As the data for 10 indicators are readily available, the cities and countries can use SUTI for assessment of urban transport systems and utilize result to initiate and implement policy measures to improve urban transport systems and services.

The pilot study thus confirmed the relevance and usefulness of the SUTI and the data collection guidelines and SUTI Excel sheet in its present form. However, some adjustments to the data collection guideline and calculation methods may be considered for future applications. It would be desirable to extend application of SUTI in secondary and emerging Asian cities and enhance collaboration and partnerships with related stakeholders for SUTI data collection and analysis. It would also be necessary to encourage more city authority to periodically self-assess the urban mobility in order to track the progress and contribution towards SDG 11.

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