Transport and Sustainable Development Goals

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Editorial Statement

The *Transport and Communications Bulletin for Asia and the Pacific* is a peer-reviewed journal published once a year by the Transport Division (TD) of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). The main objectives of the Bulletin are to provide a medium for the sharing of knowledge, experience, ideas, policy options and information on the development of transport infrastructure and services in the Asia-Pacific region; to stimulate policy-oriented research; and to increase awareness of transport policy issues and responses. It is hoped that the Bulletin will help to widen and deepen debate on issues of interest and concern in the transport sector.

Transport plays a critical role in economic and social development by providing access to economic and social opportunities. Transport facilitates the movement of people, goods, labour, resources, products and ideas across the region, creating market opportunities for both consumers and producers. Different transport modes and services, and the state of domestic and international connectivity can greatly influence the well-being of the people and their environment. At the same time, the transport sector is a major contributor to climate change, one of the top consumers of fossil fuels and generates a variety of emissions. Increasing levels of motorization in the Asia and the Pacific has also resulted in an increase in traffic fatalities and injuries.

Managing the transport sector can make a direct and indirect contribution towards the achievements of the SDGs if the three pillars of sustainable development – economic, social and environmental – are integrated into transport policies, planning and operation. More specifically transport policies, initiatives and projects can contribute towards achievement of following aspects of the SDGs:

a) Ending poverty, hunger and achieving food security (Goals 1 and 2);
b) Improving road safety (Goal 3);
c) Improving energy efficiency in the transport sector (Goal 7);
d) Development of quality, reliable, sustainable and resilient transport infrastructure (Goal 9);
e) Improvement of urban public transportation system (Goal 11);
f) Climate impacts on transport and mitigation and adaptation measures (Goal 13);
g) Collaboration and partnership to develop sustainable transport system (Goal17).

The current issue focuses on the theme of “Transport and the Sustainable Development Goals (SDGs)”. Each of the five papers considers different interesting aspects of the subject.

The first article by Bakker, Major, Mejia and Banomyong, analyze the cooperation on sustainable transport within ASEAN. Particularly in the transportation policy, since most of the ASEAN member states are developing countries, which are experiencing high economic growth. With the increase of the middle-income family, also reflect on the increasing number of private vehicles. While the individuals are able to benefit the rise of motorcycles and automobiles, yet this accompany with rising CO2 emissions and congestion in urban areas. The needs for ASEAN to reach sustainable development are inevitable. The authors proposed a series of five options to enforce the cooperation of ASEAN, first, promote the relevance of sustainable transportation and economy, second, improve the collaboration of transport institutions between ASEAN member states, third, standardize the sustainable indicators in the monitoring instruments under AEC and ASCC framework, fourth, harmonize the transport policies, i.e. urban transport route design, within ASEAN member states, lastly, ASEAN member States need persistence funding for implementing policies and action plans.

The second article by Pande presents the process streamlining the SDGs to Nepal national policies. The author details the specific transport policies changes in Nepal to incorporate SDGs. The priority of the government is to strengthen the mobility and connectivity to the rural area, while there has been much progress in road transport connectivity in southern belt. East-West connection, Kathmandu-Terai fast track, and North-South border connections are some of the key initiatives. The author identifies 9 SDGs that are directly impacted by transportation, also providing evidence and examples to show the important linkage between transport and SDGs. A better rural transportation will improve the connectivity and mobility of the rural population and persistent investment on the road will significantly improve the rural population opportunities to escape poverty.
The third article by Gudmundsson and Regmi provides details of developing an index, Sustainable Urban Transport Index (SUTI) to assess the sustainability of urban transport systems in Asian-Pacific cities. Here, the authors detail the process of creating SUTI in three steps. First, they explain the conceptual framework of development indicators based on past literature combine with SDGs. Second, the process of selection of key urban transport indicators is explained through related literature and insights from expert group meetings. Third, the construction of the index is elaborated, which needs statistical adjustment on the weights of each indicator. However, they also show that Asian member States and cities need to fortify the collaboration of transport institutions and awareness of sustainable development in order to collect more data to utilize the true potential of SUTI. The authors hope that SUTI would be a useful tool to evaluate and assess state of urban transportation systems in Asian cities and would provide useful insights for policy suggestions and actions required for improving urban transport system and services.

The fourth article by Puri presents an intermodal transport approach to sustainable development. The author points out that transportation plays a crucial role in alleviating poverty in developing countries, but transportation itself also brings adversity to the environment, i.e. Transportation methods that are heavily dependent on fossil fuels create enormous greenhouse emissions and it also puts pressure on already scarce fossil energy. The author shows that there are three different channels are affect by the linkage between SDGs and transport. First, in the economics dimension shows that increasing connectivity will have a positive impact on reducing poverty in rural area. Second, in the social dimension shows that beside the positive effect in relieving poverty and increasing education enrollment rate. Yet, the negative externality from transport needs to be considered as well, i.e. casualties in transport accidents, which is oftentimes neglected. Third, in the environmental dimension shows the consumption of oil from 1973 – 2013 increase 65.6 per cent, while transportation accounts for 45.8 per cent to 64.3 per cent of the consumption. In order to decrease the effect of pollution from transport, the governments need to incorporate specific SDGs to reach adequate provision of transport infrastructures and policy. Also, different transportation methods have various advantages and disadvantages, which there is a way to find an optimal intermodal mix of transportation.

Finally, the fifth article by Ahmed, Alam and Warda presents Bangladesh’s sustainable urban transport initiatives to improve public transport in Dhaka where private motorization in growing. The authors show a details explanation on the new Bus Rapid Transit (BRT) that is designated to the route Gazipur to Shahjalal International Airport, also how BRT routes, stations, and vehicles are designed to decrease ongoing traffic congestion, emission, and road accidents. Ultimately, they show how implementing a good BRT policy will able to achieve some of the SDGs.

These studies and analyses have directly or indirectly contributed towards understanding the means in which transport can help to achieve one or more SDGs in a meaningful manner by informing us in both theoretical and practical ways how this can be possible. This Bulletin have attained further insight into the topic and received interesting conclusions and recommendations. It is expected that the current issue of the Bulletin “Transportation and Sustainable Development Goals” would generate further debate and provide a point of reference for discussion among policy makers and researchers.

The Bulletin welcomes analytical articles on topics that are currently at the forefront, of transport development in the region as well as policy analysis and best practices. Articles should be based on original research and should have analytical depth. Empirically based, articles should emphasize policy implications emerging from the analysis. Book reviews are also welcome. See the inside back cover for guidelines on contributing articles.

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ASEAN COOPERATION ON SUSTAINABLE TRANSPORT: PROGRESS AND OPTIONS

Stefan Bakker\(^1\), Mark Major\(^2\), Alvin Mejia\(^3\) and Ruth Banomyong\(^4\)

ABSTRACT

The member states of the Association of Southeast-Asian Nations (ASEAN) have been cooperating in the area of transport and connectivity since the early 1990s, contributing to economic and social goals in the context of ASEAN integration. However, in the area of transport and environment, actions included in the various strategies and action plans have been rather limited. Given rapid motorization and the accompanying increase in congestion, fuel consumption and associated CO\(_2\) emissions and air pollution, the need for changing transport on to a more sustainable pathway is imminent. The ASEAN Transport Strategic Plan 2016-2025 (KLTSP) places more emphasis on sustainable transport than its predecessor, including a dedicated chapter with goals and actions. This paper reviews the KLTSP in the light of sustainable transport, in particular SDG 7 (energy efficiency), 11 (urbanization), and 13 (climate change), and suggests options for regional international cooperation that have the potential to create significant impact on energy use and emissions of CO\(_2\) and air pollution, and sustainable development in general. It draws on regional environmental governance theory and practice in ASEAN, options for international cooperation in transport from literature and the experience in the EU and the existing ASEAN policy framework for sustainable development, e.g. the ASEAN Charter.

Keywords: International cooperation, transport policy, sustainable transport, ASEAN, regional governance

INTRODUCTION

Sustainable development is a key objective of the Association of Southeast Asian Nations (ASEAN), emphasised in e.g. the ASEAN Charter (ASEAN, 2007) and the ASEAN Community Vision 2025 (ASEAN, 2015a). Transport of people and goods is a key enabler of social and economic development; however, the sector needs to become more sustainable to address a range of negative environmental, economic and social impacts. Indeed, it has been accepted that sustainable transport is a prerequisite for the achievement of the eight of 17 Sustainable Development Goals (United Nations, 2016) and climate change objectives. In the context of economic cooperation in ASEAN, improving connectivity by better transport infrastructure has been a key area of focus since the 1980s (ERIA, 2010).

The transport sector in ASEAN consumes approximately one-quarter of final energy consumption and related CO\(_2\) emissions and is over 90 per cent dependent on oil (IEA/ERIA, 2015). Without action, emissions may almost triple to 870 million tonnes in 2050 (ITPS & Clean Air Asia, 2014), while air quality, energy security, city livability, social equity, traffic safety and economic competitiveness may worsen as well. ASEAN’s main role is to address issues at the regional level, such as facilitating trade and establishing a single market, yet it also has the mandate to promote coordination national policies of its Member States through regional cooperation or ‘soft law’ (Elliott, 2012).

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For the transport sector, this coordination is recognised in regional transportation plans and by the ASEAN Transport Ministers. It is acknowledged that climate change and sustainable transport are important and that regional and national actions need to be taken (e.g. ASEAN, 2016a). At the national level, ASEAN countries are developing a range of transport plans in which local and national sustainable development concerns play a role (Bakker et al., 2017). In the Nationally Determined Contributions (NDCs), ASEAN countries are committing to contributing to climate change mitigation, e.g. by stabilising (Singapore) or reducing up to 25 per cent (Vietnam) or 70 per cent (the Philippines) of economy-wide emissions compared to business-as-usual by 2030, conditional upon the international support. Although there are no transport-specific emission reduction targets in the NDCs, ASEAN countries consider transport a key sector for mitigation and are proposing a wide range of measures that save emissions, including on public transport, non-motorised transport, transport demand management, fuel economy, electricity and hybrid vehicles, vehicle maintenance, green freight, and biofuels (GIZ, 2016).

This paper aims to address the following research questions: 1) How did (sustainable) transport cooperation in ASEAN look in the past decades? 2) how can effective regional cooperation in the transport sector to promote sustainable development be designed?

Sustainable transport should contribute to environmental, social and economic objectives. This paper focuses mainly on the environmental aspects and is thereby related to SDG 7 on energy, SDG 11 on cities and SDG on climate change. It is indirectly connected to SDG 17 on partnerships and considers social (SDG 3 on health) and economic aspects (SDG 9 on industry and infrastructure).

In the literature, there is limited coverage of transport cooperation in ASEAN (e.g. Tongzon, 2016; Preece, 2016), and none focusing on sustainable transport has been found. In regional environmental governance, the literature on ASEAN mainly focuses on regional air pollution (haze) (Aggarwal and Chow, 2009; Heilmann, 2015), climate change (Koh & Bhullar, 2011), and biodiversity, forests and protection of flora and fauna (Elliott, 2012; Kheng-Lian et al., 2016). Kheng-Lian et al. (2016) also provides a review of and further options for collaboration in the areas of wildlife crimes, the ASEAN transnational water action plan, and environmentally sustainable cities. In other areas, such as trade, energy, and food security, more analysis is available.

This paper uses the following methodology and data sources. The literature on regional cooperation and governance literature, particularly on environmental issues, will provide the starting point. Then we look at the governance system and practice in ASEAN, in both economic and environmental sectors, as well as the broader policy drivers for sustainable transport in the region. As for cooperation in the transport sector, we draw on existing literature on policy options as well as experience in the European Union. Section 5 will provide a review of cooperation on sustainable transport since the 1990s, based on public literature and documentation of ASEAN transport working group meetings. Section 6 will use the results and insights from the previous sections to consider which options for cooperation in the future may be worthwhile and feasible. Section 7 briefly concludes the paper.

REGIONAL INTERNATIONAL COOPERATION

International cooperation between states at the regional level may take different forms. A basic distinction, although not a purely binary one, is that between hard and soft law, with the former defined as “legally binding obligations that are precise (or can be made precise through adjudication or the issuance of detailed regulations) and that delegate authority for interpreting and implementing the law” (Abbott & Snidal, 2000; p.421). Transaction costs, related implementation, enforcement, the risk of free-riding or opportunistic behaviour, can be lower compared to other forms of legalisation; however, contracting cost of hard law (information collection, drafting, negotiation, ratification) can be significant. It is used particularly by states when “forming ‘clubs’ of sincerely committed states, like the European Union and NATO” (p. 429), and “when the benefits of cooperation are great but the potential for opportunism and its costs are high” (p. 429). In soft law, legal arrangements are weakened along the dimensions of obligation, precision, and delegation, which reduces ‘sovereignty cost’ compared to hard law. It also reduces contracting costs, provides more opportunities to come to an agreement and enables parties to learn about the consequences of the agreement (Abbot & Snidal, 2000). In this paper, we consider soft law as a broad range of regional cooperation.
arrangements that are different from hard law and distinguish the following types of cooperation (see Table 1).

**Technology cooperation:** governments pool resources for research and development of cleaner technologies and/or agree to accelerate policies to deploy these. De Coninck (2007) considers several types of international technology-oriented agreements: knowledge sharing and coordination of research activities; research, development and deployment, e.g. in the form of cooperation programmes and based on joint funding; technology transfer, particularly benefiting developing countries; and internationally agreed technology mandates, performance standards or incentives.

**Policy cooperation:** Stead (2016) looks at new, ‘soft’, modes of governance concerned with intergovernmental coordination and ‘networked arrangements and multi-level approach’ for sustainable urban transport. He lists five key instruments: policy indicators and targets to measure progress, benchmarking against current or aspirational peers, policy transfer and best practices, policy experimentation, and the use of visioning exercises. In addition, policy cooperation may include discussion fora or expert groups that develop ideas and standards and guidelines, as well as certification schemes or promotion of low-carbon finance; in addition, high-level political dialogues that help developing a common vision and building mutual trust can support all above-listed categories of cooperation (Stavins et al., 2014).

**Cross-border infrastructure:** infrastructure development is another area of cooperation between states in proximity, in sectors such as energy (connection of grids), communications, and transport (pipelines, roads, railways, and waterways). This also includes software like common standards to use roads, rail, power. Such cooperation can reduce transaction costs significantly (Kuroda et al., 2007)

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REGIONAL GOVERNANCE AND COOPERATION IN ASEAN AND THE EU

The Association of Southeast Asian Nations was formed in 1967, and currently includes ten member states: Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand, Singapore and Vietnam. The total population is 629 million and GDP US$ 2,432 billion. ASEAN norms and practice of decision making can be characterized by the so-called ‘ASEAN Way’, which emphasizes principles of cooperation, consultation, non-interference in internal matters, informality, non-confrontational and ‘soft’ diplomacy, pragmatism, flexibility, and network structures (Elliot, 2012; Severino, 2007; Nesadurai, 2008; Jetschke & Ruland, 2009). Jayasuriya (2009, p. 337) notes that ASEAN works with “forms of regional regulation [that] rely more on the active participation of national agencies in the practices of regulation than on formal international treaties”. According to Elliot (2012), non-hierarchical forms of multi-level governance complement intergovernmental relations, partially because states have limited capability of dealing with environmental challenges. Networks also provide ‘fluidity to the policy-making process’, supporting consultation, learning and exchange among senior officials, experts and stakeholders (p. 49-50). There is also a certain level of technical and financial dependency on national and international organizations.

Since the late 1980s, environmental issues have become more important in the agenda of ASEAN cooperation, as a response to major international (UN) conferences and growing conscience with donor agencies (Elliot, 2012). The “regionalization of environmental governance proceeded from declarations and principles with minimal standards, to functional approaches and project-based cooperation, through to efforts to establish and implement regional policy initiatives through increasingly complex regulatory structures”, including development of minimum regional standards for air and water quality (Elliot, 2012, p. 56). In the forestry domain, AMS have instituted a formal peer-consultation process to review the forestry policies and practices of individual countries, with such processes aiming to be non-adversarial and based on mutual trust.

Especially since the adoption of the ASEAN Charter in 2007, “numerous new treaties and protocols often with detailed obligations and dispute settlement procedures” were adopted, predominantly pertaining to economic cooperation (Ewing-Chow & Hsien-Li, 2013, p.1). Other examples of binding agreements within ASEAN are the ASEAN Petroleum Security Agreement (Nicolas, 2009) and the transboundary air pollution (“haze”) agreement. The latter is arguably the most important environmental cooperation instrument to-date. Heilmann (2015) argues “the agreement refers to these norms as binding (the parties “shall”), but the provisions are written in a way that gives discretion to the member states concerning their actions and the types of activities that they carry out to mitigate haze pollution”, and no coercive steps can be taken, so it is “ultimately a soft law instrument” (p. 105) or a framework for cooperation. Key instruments in the agreement are a coordinating centre and a fund (USD 240,000 in 2014).

ASEAN strategies make use of various cooperation instruments related to policy and technology (see Table 1 in Section 2), which we briefly illustrate here. The Peatland Management Strategy (ASEAN, 2014) include, inter alia, the following actions: Harmonize definitions and classification of peatlands; Status updates in national inventories; Develop a methodology and prepare guideline for monitoring of peatland areas; Undertake research on appropriate techniques and practices; Strengthen regional sharing of experience and networking through use of mechanisms such as the ASEAN Haze Action Online and the SEAPeat Network; Designate specific institutions responsible for peatland management and establish National Peatland Working Groups; Formulate or update national policies and strategies based on the thrust and objectives of the regional strategy; Establish pilot project(s) in each country to test new sustainable management. Other examples, such as on ASEAN Energy Market Integration and a Regional Policy Roadmap for Harmonization of Energy Performance Standards for Air Conditioners, show how roadmaps aim at regional harmonization or at least closer alignment of national approaches in terms of technical matters including definitions, standards and monitoring.

To provide further illustration of how international cooperation could work, we briefly review the governance system of the European Union (EU). We do not intend to carry out a comparative analysis, nor are we implying ASEAN wants to or should follow a similar path, a topic of considerable debate (Jetschke & Ruland, 2009).

5 Enshrined in the ASEAN Charter (2008)
After two devastating World Wars, both of which originated in Europe, the six founding Member States (MS) sought to prevent conflicts by placing strategic resources in the hands of a “High Authority”. These lead to the creation of the European Coal and Steel Community (Treaty of Paris, 1951), the first “supranational” international organization. In 2017 the EU has 28 Member States, and implements policy in a wide range of policy areas on behalf of its MS, when it can be demonstrated that problems can be best solved at the “Union level”. There is a single market, free movement of people good and capital, customs union, common competition policy and a single currency, the Euro, shared by 19 MS. The 28 countries are economically, geographically, culturally, climatically and linguistically diverse – but they share commitments to fundamental principles such as the rule of law, democracy and market based economies. In areas of EU “exclusive competence” such as trade policy the EU acts exclusively on behalf of all the MS. So, for example individual Member States are not allowed to conduct trade negotiations. Many policy areas are “shared competence”, where the EU and MS share powers. EU policies are implemented through EU wide laws and funding programs; the EU budget is approximately 1 per cent of GDP. The EU is governed and administered by a number of institutions and agencies including a European Parliament and Council of Ministers (who together agreeing laws and policy), the European Commission (proposing and implementing laws and programs) as well as a European court and auditor. MS that do not meet their legal obligations can be taken before the European Court of Justice and ultimately face heavy fines – which are paid into the EU budget.

ASEAN POLICY FRAMEWORK FOR SUSTAINABLE TRANSPORT COOPERATION

In this section, we look at how sustainable transport fits in the policy context of ASEAN, i.e. wider than the transport sector. This is relevant as sustainable transport cooperation is not merely about the transport sector per se, but rather involves area such as environment and climate change, energy, economy and research and innovation. Here we look at the frameworks for these issues as well as sustainable development, ASEAN Economic Community, and Socio-Cultural Community.

As stated in the ASEAN Charter, one of ASEAN’s purposes is to ‘promote sustainable development’, which includes protection of the region’s environment and ensuring ‘high quality of life’ (ASEAN, 2007, p.4). The ASEAN Vision 2025 highlights the ‘complementarity’ of the UN Agenda on sustainable development (ASEAN 2015a, p. 13). The importance of sustainable development and the sustainable development goals have been reiterated since in various declarations. For example, ASEAN encourages cooperation on financing and research on climate-friendly technologies and integration of “sustainable consumption and production (SCP) patterns into our national policies”.

In the 2025 vision for the ASEAN Economic Community, the vision for transport cooperation (in the context of ‘promoting connectivity’) is “towards greater connectivity, efficiency, integration, safety, and sustainability of ASEAN transport to strengthen ASEAN’s competitiveness and foster regional inclusive growth and development”. In transport cooperation, it aims “to embrace sustainable transport as a new key sectoral focus as it has a vital role to play in the sustainable development of the ASEAN region” (ASEAN, 2015b, p.21). Biofuels are considered in connection with sustainable economic development and can be promoted by free trade and investment in research and development for third-generation biofuels. The blueprint for the ASEAN Socio-Cultural Community (ASEAN, 2016b) refers to ‘green lifestyle’ and ‘people-oriented’, and, in the context of Environmentally Sustainable Cities, includes a measure “to enhance participatory and integrated approaches in urban planning and management for sustainable urbanisation towards a clean and green ASEAN” (p. 12).

ASEAN’s commitment to the climate change agenda and the UNFCCC is stated in multiple declarations. The ASEAN Action Plan on Joint Responses to Climate Change (2012) includes actions related to GHG mitigation such as sharing best practices on energy production and use and policy towards low carbon development and green economy, establishing alliances to promote technology transfer, promoting common understanding on climate instruments and monitoring (MRV), promoting common understanding on access to climate finance and facilitating capacity building.

The Regional Action Plan on Healthy ASEAN Lifestyles (2012) includes in its programme work on road safety and physical activity: "to incorporate healthy lifestyle issues into public planning
systems, especially with regard to transport and land use, safe transportation, provision for pedestrian and non-motorized traffic, considerations about noise, green space for physical activity”.

In the context of energy, ASEAN has adopted an aspirational goal of reducing energy intensity by 20 per cent by 2020 as a medium-term target and 30 per cent by 2025 as a long-term target based on the 2005 levels. The transport sector has not played a significant role to date in energy cooperation. The ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025 only includes ‘The conduct of a feasibility study on energy efficiency in the Transport Sector would be considered during this period’ (2016-2020). Energy security is considered a key issue in ASEAN, and the basis for cooperation is laid down in the (binding) ASEAN Petroleum Security Agreement, and refers to energy efficiency and conservation, fuel switching and energy diversification as medium and long-term strategies, without referring to the transport sector explicitly. Tongsopit (2016) shows that energy security in the ASEAN region has declined in 2010 compared to 2005.

No explicit references to the Sustainable Development Goals, the Paris Agreement on Climate Change and the New Urban Agenda have been found. This may be due to the fact that these were adopted relatively recently.

It should also be noted that in contrast to the adopted declarations and cooperation goals, ratification and implementation of agreements often falls behind (Jetschke, 2009; Olsen et al., 2015).

ASEAN cooperation on sustainable transport: a review

Since the 1980s, the transport sector has been an important area of cooperation in ASEAN. The main aims were to create an efficient and integrated transport system that supports the ASEAN Free Trade Area, an integrated production area and to narrow the development gap between the member states (ERIA, 2010). To date, transport cooperation has been a key part of ASEAN efforts to promote connectivity (ASEAN, 2016c) and essential in realising the ASEAN Economic Community (ASEAN, 2015b). Most of the efforts are related to cross-border infrastructure and measures to facilitate trade, such as reducing non-tariff barriers.

Institutional structure and governance framework

The biannual ASEAN Senior Transport Officials Meetings (STOM), with participation by all AMS usually at the level of permanent secretary have the responsibility to supervise, coordinate and implement the transport action plans and strategies. It is supported by four working groups (land transport, aviation, maritime, and transport facilitation) and one Special Working Group on the Singapore – Kunming Rail Link. These working groups, facilitated by the ASEAN Secretariat, meet once or twice annually and are represented by mid to high-level staff from the ministries of transport of the 10 AMS. The STOM reports to the ASEAN Transport Ministers meeting, which has taken place annually since 1996. Transport cooperation is part of the economic pillar of ASEAN, and progress is reported through the AEC scorecard and indicators in the Master Plan on ASEAN Connectivity (MPAC). There are no institutionalized cooperation or coordination efforts with other sectoral economic bodies such as energy, automotive products, trade, research/technology, or with the socio-cultural pillar of which environmental working groups are a part. However, in some cases, representatives from other working groups are invited to transport working group meetings (ERIA, 2010). Dialogue Partners, mainly development organisations, may be invited to participate in (parts of) the STOM and working group meetings. Some Dialogue Partners, such as Japan, China, and the Republic of Korea, convene dedicated meetings with STOM and ASEAN Transport Ministers. Other actors, such as civil society and business associations, may play an indirect or informal role, and in some cases, participate in official transport meetings as observers.

Sustainable transport in ASEAN policies and action plans

Environmental considerations first appeared in 1996, and the plan (ASEAN, 1997) noted cooperation on transport can focus on “where externalities such as safety and pollution as well as competition have acquired regional dimension to warrant cooperative action.” As early as 1998, specific measures were also included in action plans, e.g. to “adopt harmonised standards and regulations with regard to vehicle specifications (e.g. width, length, height and weight), axle load
limits, maximum weights, and pollution or emission standards. In transport cooperation plans until 2010, promoting environmentally sustainable transport was emphasised; however as ERIA (2010) notes “limited efforts were made in selected [AMS]” and sharing of experiences and capacity building appeared to be limited to exchange in working group meetings and some workshops. The ASEAN Strategic Transport Plan 2011-2015 included more actions related to energy efficiency, GHG emissions, and “environmental-friendly transport system, vehicles and fuels” and “green public transport system” in the capital cities.

With the Kuala Lumpur Transport Strategic Plan (ASEAN, 2016a), sustainable transport was covered in a dedicated chapter for the first time. The chapter includes ten actions and 31 milestones (see Appendix I), and widens the scope of topics compared to earlier plans, by including non-motorised transport, fuel economy, green freight and logistics, economic instruments, development of a monitoring framework and integration with land-use planning. In addition, other chapters of the plan cover rail infrastructure, inland and maritime transport, intelligent transport systems and road safety. However, the plan does not refer to global agendas on sustainable development, climate change or urban development, which all AMS have agreed to.

In energy cooperation plans, transport has played a limited role to date. Cooperation on science and technology included an action on fuel cell research and biofuel life-cycle methodology harmonisation.

**Instruments and implementation**

The instruments used in actions and milestones on sustainable transport in the KLTSP are mainly the exchange of experience and knowledge, capacity building, workshops and carrying out studies (see Appendix I). ASEAN plans also ‘encourage’ member states to adopt and implement suggestions and results from studies. A few notable examples of milestones are i) to “develop ‘Avoid’, ‘Shift’ and ‘Improve’ (ASI) strategies at the regional and Member States level”, ii) development of databases on sustainable transport and green freight, iii) convening of expert groups, iv) formulation of a regional fuel economy roadmap, v) creation of a ‘checklist guide’ on green logistics, vi) development of a monitoring framework and harmonised approach for indicators, vii) compilation of data, viii) development of guidelines (on green logistics and transport - land-use integration), ix) creation of a platform for information exchange, and x) carrying out training. The road safety strategy (ASEAN, 2016d) includes, inter alia, ‘harmonisation of standards, road rules and legislation’ and ‘monitoring and reporting progress’. Implementation of the actions and milestones mainly depends on projects and funding from Dialogue Partners such as Japan, Germany, and the Asian Development Bank. As the KLTSP (adopted November 2015) is in its early stage of implementation at the time of writing (July 2017), it is not possible to evaluate the implementation of the plan.

** Drivers, agenda setting**

The overall vision for post-2015 transport cooperation, adopted by the transport ministers, includes a reference to ‘sustainability’: “Towards greater connectivity, efficiency, integration, safety, and sustainability of ASEAN transport to strengthen ASEAN’s competitiveness and foster regional inclusive growth and development” (ASEAN, 2016d; p. 4). The Strategic Goal for Sustainable Transport is to “Formulate a regional policy framework to support sustainable transport which includes low carbon modes of transport, energy efficiency and user-friendly transport initiatives, integration of transport and land use planning (p. 17).” Further explicit references to air quality, the UNFCCC agreements, and sustainable development have not been found in official ASEAN transport strategies. Earlier, ERIA (2010), the study used as a basis for the 2011-2015 plan, does refer to the millennium development goals, including environment and climate change. In addition, we note that the AEC Blueprint (ASEAN, 2016a), which includes a chapter on transport and connectivity, does not refer to the ASEAN socio-cultural blueprint, its environmental goals, and scorecard. In short, the environment may not be a strong driver for transport cooperation hitherto.

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7 Ha Noi Plan of Action, which supports the ASEAN 2020 vision. There is no evidence however, that action has been taken on pollution or emission standards between 1998 and 2015.
The MPAC (ASEAN, 2016c) indirectly supports sustainable transport, particularly modal shift strategies, through the development of multi-modal transport including rail and maritime / in-land transport. Energy cooperation seems to focus on electricity production. Energy-efficiency in consumption such as buildings are of lower priority and appear more driven by international organisations. In petroleum security, energy efficiency is mentioned but the key actions in the agreement are related to securing supply in emergency situations. In general, ASEAN regional cooperation is driven by its member states, with a key role for the chair of the respective working groups, and a topic can be pursued if countries benefit from cooperation. Looking at the country perspective, there is limited evidence of drivers for regional cooperation or cases where one or multiple AMS are pushing an agenda (other than cross-border infrastructure or trade facilitation). Thailand has organised an ASEAN workshop to discuss of car taxation based on CO$_2$. The Singapore Land Transport Academy regularly organised workshops and training on transport where ASEAN countries are invited to, including on urban transport. Malaysia was driving the green freight and logistics topic, together with Japan. In reviewing national transport strategies and plans, we found that for multiple AMS, ASEAN and its strategies are being referred to in the context of the AEC, connectivity and free trade – predominantly in sections on improving infrastructure -, and in some cases road safety. We did not find evidence of other sustainable transport aspects of ASEAN plans playing a role in national strategies yet.

Summary

This brief review shows ASEAN cooperation on sustainable transport is growing since the 1990s, both increasing in breadth and depth. Yet it can be said sustainable transport is still of lower importance compared to the connectivity agenda and has limited ambition. In terms of activities, cooperation predominantly focuses on to carrying out studies, sharing experience and discussions in expert groups. Work on developing standards and tools for policies and transport indicators and monitoring has started or is being planned. Many of the activities are dependent on international organisations to be developed and funded. Cooperation with other relevant ASEAN bodies such as energy, environment, and industry is rather limited as well. In general, the absence of a strong ASEAN mandate and few country-level drivers limit the current ambition.

**Box 1: Transport policy in the European Union**

Transport has been a shared competence of the European co-operation since 1957, the aim has been to develop facilitate transport of passengers and freight between and across the EU Member States through a common transport policy. A vision and ten quantified goals for EU action on transport is set out in the European Commission’s (2011) White Paper “Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system”, although since 2014 there has been an adjustment of policy priorities. Important drivers of action on the environmental impacts of transport have been EU environment and single market policy – not transport policy. For example, EU laws on climate and air quality drive action on transport in cities, aviation and reduce emissions from new vehicles.

**OPTIONS FOR REGIONAL COOPERATION ON SUSTAINABLE TRANSPORT**

Based on the preceding evaluation, the cooperation typology and instruments (Section 2) and the discussion on regional governance in ASEAN in Section 3, we explore options (instruments) for strengthening ASEAN sustainable transport cooperation, some of which may be relevant to other sectors as well.

**Common vision and strategy:** a vision on sustainable transport in ASEAN endorsed and adopted by all ten-member states can provide a point of reference for regional and national policymaking. If politically feasible this vision could include quantitative, long-term targets for objectives such as energy, climate change mitigation, and air pollution. A strategy can elaborate

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9 There is a precedent for quantitative targets: ASEAN already has adopted a target to halve road crash fatalities by 2020.
necessary steps to realise the vision. The EU White Paper (EC, 2011) includes such a vision, targets and actions.

**Knowledge sharing, policy transfer:** the current actions promoting knowledge sharing and policy transfer can be strengthened and expanded to make them more effective. In addition to learning from countries and cities outside the region, there is a large and untapped potential to learn from intra-ASEAN experience, as AMS are developing and experimenting with new policies and programmes (Bakker et al., 2017). Key innovative policies include jeepney modernisation in the Philippines, fuel efficiency standards for new vehicles in Vietnam and Brunei Darussalam, CO2-based vehicle taxation in Thailand, vehicle quota and electronic road pricing in Singapore, bus reform in Myanmar, a green technology finance scheme in Malaysia, and public transport systems (see Box 2). To further facilitate knowledge sharing, development of knowledge platforms, such as a dedicated website where data and information on country policies are gathered and maintained, and dissemination are required.

**Studies, knowledge development:** carry out, publish and disseminate high-quality research into sustainable transport solutions that can be applied in the region, while considering the different national and local circumstances and transferability of policies.

**Institutions:** sustainable transport policy development is a multi-sectoral undertaking and currently the topic is missing a ‘home’. The institutional setup can be improved by strengthening the transport working group meetings and the interaction with other relevant ASEAN bodies such as energy and environment. Regional expert groups on dedicated topics can improve the link between national and regional policies. In addition, data collection and knowledge development and management could be enhanced by a dedicated institution, e.g. following the example of the ASEAN Centre for Energy, and annual conferences. Setting up a facility to support public-private partnerships may provide assistance in developing viable projects.

**Data, indicators, monitoring:** a common and harmonised approach for monitoring sustainable transport indicators within ASEAN at the national level provides benefits for monitoring progress towards common goals related to transport and climate change, avoids duplicating research work for developing monitoring systems, enables benchmarking and cross-country learning as to effectiveness of policies, and can inform the public about emerging issues and trends. In addition, output and outcome indicators, linked to the SDGs, could be added to the AEC and ASCC Scorecards, which are the key monitoring tools at the regional level. In the EU, the publication of comparable data, indicators, and monitoring have been a key “soft” mechanism to drive action and progress.

**Awards:** recognition of countries, cities or individuals that show remarkable achievements in the field of sustainable transport policy by awards or other means provides an additional incentive and is a means to highlight best practices. The current practice of the ASEAN Environmentally Sustainable Cities awards can be built upon.
Box 2. Integrated mass transit systems: potential for best practice sharing

High-quality public transport systems, well-integrated with other modes, are key to sustainable transport, yet may be complex to develop. High-capacity systems such as metro, light rail and bus rapid transit need first and last mile connectivity with non-motorized modes and paratransit, and be facilitated by integrated ticketing, land-use policies such as transit-oriented development, transport demand management and institutional development (Morichi & Acharya, 2013). ASEAN countries and cities are making significant progress in this area. Singapore’s extensive network of rail and bus lines can be used by a single smart card, and its programme ‘Walk Cycle Ride SG’ aims at better access by walking and cycling. Cities such as Kuala Lumpur, Bangkok, Hanoi, Jakarta, Phnom Penh and Manila are developing and expanding urban rail systems and can learn from Singapore’s experience. Jakarta’s BRT has been in operation since 2004, and is now the world’s longest with 13 main corridors (totaling 230 km), which are integrated with many feeder routes and other bus lines. Such experience can be valuable for Yangon, Kuala Lumpur, Vientiane, Phnom Penh, Cebu, Ho Chi Minh City, and Brunei Darussalam, which are developing their own BRT systems. Institutional development such as transport authorities covering metropolitan urban regions, such as the Land Public Transport Commission in Peninsular Malaysia, can further help to integrate public transport systems. Best practice sharing on such issues would support KLTSP actions 1.2, 2.2 and 2.5, and is also taking place through the country updates in the UNCRD Asia Regional Environmentally Sustainable Transport Forums. It should be noted however that due to each country’s circumstances and preferences, realizing policy transfer through knowledge sharing programmes remains challenging (Gray et al., 2017).

Technical and performance standards, common definitions, guidelines, tools: examples could be a fuel economy standard or label 10; guidelines for national policies (such as included in the ASEAN ITS Roadmap (ASEAN, 2015c)) and indicators/monitoring, and greenhouse gas impact assessment tool for policies or specific options such as alternative fuels.

Research and technology cooperation: to date, under the ASEAN Science and Technology Network, activities on related to the transport sector have been limited to biofuels and fuel cells (funded by the ASEAN Science Fund). The 2016-2025 ASEAN Plan of Action on Science, Technology, and Innovation emphasises the role of green and low-carbon technology, ‘transformation to low-carbon society’, energy security and energy efficiency, however, transport is not addressed explicitly. Developing partnerships between scientists, universities and other stakeholders can be enhanced, pooling of resources for research and development in key transport technologies, joint policy research on transport and land-use planning (e.g. in urban areas) are actions that may be considered.

To show how such instruments can be to promote the different strategies in sustainable transport, Table 2 summarises these options based on the “Access + Avoid–Shift–Improve” approach (Bakker et al., 2014). This sustainable transport policy framework emphasises that in addition to improving access to opportunities, transport policy should aim to avoid the need to travel, e.g., by improved urban planning, travel demand management or road pricing, and e-communication options; shift transport to cleaner or more efficient modes, e.g., rail freight or public transport; and (c) improve the environmental performance of modes by making vehicles more energy efficient and fuels less carbon-intensive. In addition to policy instruments, there are cross-cutting and supporting actions. Possible drivers and rationales for developing such cooperation instruments are also highlighted (see Section 4), as well as possible key actors involved in implementation.

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10 This does not necessarily mean that all member states adopted the same standards at the same time; a convergence approach could be appropriate as well.
Table 2. Cooperation options and drivers: Illustrative examples

<table>
<thead>
<tr>
<th></th>
<th>Access / connectivity</th>
<th>Avoid / shift</th>
<th>Improve</th>
<th>Cross-cutting / supportive instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical measures</td>
<td>Infrastructure, reduction of trade barriers</td>
<td>Rail, water infrastructure (inter-urban); Public transport, NMT, planning, logistic centres, etc (urban)</td>
<td>Fuel efficiency, alternative fuels, clean fuels</td>
<td>Monitoring system; institutional development; knowledge development</td>
</tr>
<tr>
<td>Regional cooperation instruments</td>
<td>Joint action plans for infrastructure development and national policy changes (current practice);</td>
<td>Joint action plans (current practice); policy transfer; networks, expert groups; studies; guidelines; awards; benchmarking; PPP facility</td>
<td>Fuel economy and technology roadmap; standards; mutual recognition schemes; expert groups; technology cooperation; studies/best practice; green freight labelling scheme; policy dialogues; policy tools; capacity building; benchmarking</td>
<td>Joint vision / strategy; capacity building; joint indicator system; knowledge sharing; knowledge centre and website; curricula development; academic cooperation; conferences / Mobility Week</td>
</tr>
<tr>
<td>Drivers</td>
<td>Economic / social development</td>
<td>Accessibility, urban liveability, environment, (sustainable development)</td>
<td>Environment, trade / economic integration, single market, energy security, R&amp;D policy</td>
<td>Supports various goals stated in ASEAN strategies</td>
</tr>
<tr>
<td>Actors</td>
<td>Ministries of transport, trade/industry; MDBs</td>
<td>Ministries of transport, urban development; local governments; civil society; MDBs, technical cooperation</td>
<td>Ministries of transport, energy, environment, trade/industry, business sector; research / science community; civil society; IOs</td>
<td>Ministries of transport; academics; civil society; IOs</td>
</tr>
</tbody>
</table>

IO: international organization; MDB: multilateral development bank; PPP: public-private partnership

**CONCLUSION**

Sustainable transport is a relatively new topic in ASEAN transport cooperation, which focuses mostly on facilitating trade and connectivity as part of the ASEAN Economic Community agenda. Sustainable transport covers social, economic and environmental dimensions, and is essential in achieving multiple SDGs, notably on poverty reduction, road safety, energy efficiency and climate change, while ASEAN transport cooperation itself could be seen as contributing to SDG 17 on partnerships.

With the adoption of the ASEAN Transport Strategic Plan 2016-2025, sustainable transport has gained importance due to a dedicated chapter on the topic, with actions mainly related to energy and environmental topics. However, there are no references to the Paris Agreement or the Sustainable Development Goals, nor to the ASEAN Socio-Cultural Community and its (environmental) goals. This shows that transport development strategy in ASEAN is not linked with global environmental and sustainability agenda. Alignment is also lacking with the other pillars of the ASEAN Community.
The instruments used are predominantly focusing on policy cooperation, e.g. by best practice and knowledge sharing, capacity building, information platforms and development of a harmonised monitoring approach. This approach is common in ASEAN cooperation frameworks, with its strong preference for consultation and networking, dialogue, non-interference, soft diplomacy, and weak institutions, and our findings are line with the literature on networked regionalism. The private sector and civil society are involved to a limited extent, and implementation of actions partially depends on funding from international Dialogue Partners. In general, there is a gap between what is happening and what was discussed or has been agreed upon by AMS.

With climate change, air quality, energy security, liveability becoming more important as policy drivers, as well as the strong basis in various ASEAN declarations and strategies, to advance sustainable transport, there may be potential to raise the ambition. This would require 1) increased awareness of the importance of sustainable transport for economic development, 2) institutional development, in particular, collaboration between transport and environment institutions at the regional and national level, 3) integration of sustainable transport indicators in the monitoring mechanisms of the AEC and ASCC, 4) more intensive cooperation to exchange best practices, enhance capacity and develop harmonised approaches in action areas such as fuel economy policies, green freight, and urban transport, and 5) continued funding for implementation of action plans, by AMS, international organisations and the private sector.
ACKNOWLEDGEMENTS

We wish to thank the ASEAN Expert Group on Sustainable Land Transport and the ASEAN Secretariat, and the project team “Energy Efficiency and Climate Change Mitigation in the Land Transport Sector in the ASEAN Region”, funded by the German Federal Ministry of Economic Development and Cooperation, in particular Tali Trigg, Aditya Mahalana and Friedel Sehlieier.

REFERENCES


### Appendix I. Cooperation instruments in the KLTSP Sustainable Transport Chapter

<table>
<thead>
<tr>
<th>Goals</th>
<th>Elements of the KLTSP</th>
<th>Hard</th>
<th>Low</th>
<th>Soft measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Intensify regional cooperation in the development of sustainable transport-related policies and strategies</td>
<td>1.1 Institute coordinated approach to further promote non-motorised and public transport in the regional and Member State level</td>
<td></td>
<td></td>
<td>Infrastructure Cooperation, Policy Cooperation, Regional Cooperation</td>
</tr>
<tr>
<td></td>
<td>1.2 Enhance sharing and adoption of experiences, projects and knowledge related to sustainable transport</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>1.3 Institute and support to the development and implementation of fuel economy policies and standard as well as policies towards cleaner fuels and vehicles and vessels</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.4 Develop a regional framework towards green and efficient freight and logistics in order to support ASEAN Member States in implementing respective policies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Identify and implement the key measures on sustainable transport</td>
<td>2.1 Ensure government support and commitment for the implementation of sustainable transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2 Diffuse best PPP practices for developing transport infrastructure needed for sustainable transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3 Develop monitoring framework and harmonised approach for indicators on energy and GHG emissions in the transport sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.4 Promote the integration of transport and land use planning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Enhance human resource activities and institutions for</td>
<td>3.1 Strengthen sustainable transport education and training through greater networking with transport education centres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.2 Carry out trainings in the field of sustainable transport for representatives of transport related agencies and ministries</td>
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<td></td>
</tr>
</tbody>
</table>

**Notes:**
- The typology of instruments is based on Table 1 and instruments commonly used in ASEAN cooperation.
- The table focuses on the KLTSP elements on land transportation, and excludes those related to maritime transport.
- Mutual recognition agreements pertaining to the automotive sector are relevant to the environmental sustainability of road transportation.
MAINSTREAMING SDGs IN NATIONAL POLICIES: 
THE CASE OF TRANSPORT SECTOR IN NEPAL

Kamal Pande

ABSTRACT

Nepal is committed to developing a robust transport network to achieve the SDGs by 2030. Poverty reduction, the main target of the SDGs, has primarily been the thrust of the road program. The poverty rate for Nepal is 25 per cent, which increases to 46 per cent in the less connected Mid-Western and Far-Western regions. About 30 per cent of Nepalese lives under US$ 14 per month. In addition to reducing poverty, an efficient transport system contributes significantly towards meeting the SDGs as it establishes basic mobility through road connectivity, which helps to bring down incidences of death by increasing access to basic health services and reducing road accident fatalities and injuries. In addition, increased connectivity increases access to education services, markets and income generating opportunities, in turn supporting economic growth as well as encouraging gender equality in the country. Moreover, Nepal is also moving towards introducing and scaling up clean transport services to efficiently manage rapid urbanization and increase energy security to meet targets set in SDGs 7, 9 and 11.

The process of internalizing SDGs into national programs began in the Fiscal Year 2014/15. Preliminary targets have been set and budget allocation to support these programs have already started. The current need is to develop a strong monitoring mechanism at the policy level (National Planning Commission/concerned development ministries) and at implementation level (implementing agencies) to monitor the progress as well as identify and mitigate issues that impede the process/programs. A strong nexus that exists between the transport sector and SDGs must be further explored and strengthened to achieve SDGs within 2030.

Keywords: Transport sector, National policies, Nepal, SDGs, National development priorities

INTRODUCTION

A Nepal has a diverse topography consisting of Terai (plains), Mountainous (hilly) and Himalaya regions. Within a short horizontal distance of 145 to 241 km, the ground altitude changes from 50 m (Terai) to 8,488 m at the peak of Mount Everest (Himalaya). Such a sharp vertical landscape is one of the major challenges in developing transport infrastructure in the country.

About 80 per cent of Nepalese live in rural areas and most of them depend on subsistence farming for their livelihoods. Poverty in rural Nepal is a massive problem. About 23.8 per cent of the Nepali population lives on less than US$ 1.25 per day (NPC, 2015a). The current per capita income of Nepal stands at US$ 762 (as of 2016). It was remarkable that even at the height of the conflict, during 1996-2006, a steady growth in Nepal’s economy was observed.

Although population living below poverty line has declined in the last decade, the disparity between rich and poor remains high. The Gini Coefficient, based on consumption expenditure, reached 0.353 in the urban area, 0.311 in the local area, and 0.328 in Nepal overall (CBS, 2014). In addition to poverty reduction, Nepal has achieved gender parity in education and reductions in infant and maternal mortality. According to the WHO report, the maternal mortality rate of 548 deaths per 100,000 populations in 2000 was reduced considerably to 258 deaths per 100,000 populations in 2015 (WHO et al, n.d).

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11 The paper is based on the background paper entitled “Improving Rural Connectivity and its impact on Sustainable Development Goals (SDGs) – Case of Nepal” presented to 10th EST Forum in Vientiane.

12 Transport Infrastructure Specialist, Nepal.
Transport Sector Assessment

The transport sector has been playing a key role in the social and economic development of the country. Nepal’s transport infrastructure mainly consists of roads and civil aviation. It is dominated by the road subsector, which provides for the movement of approximately 90 per cent of all passengers and freight within the country. Since air service is limited and expensive to the locals, it only contributes to passenger movements in commercial and tourist destinations. The basic objective of the transport sector development is aimed at strengthening regional interconnectivity and reducing socio-economic imbalances by enhancing people’s reach to basic facilities such as health services, market centers and education.

Road infrastructure in Nepal is made up of the Strategic Road Network (SRN) comprising of National Highways and Feeder Roads, along with the Local Road Network (LRN) comprising of District, Urban and Village Roads (see Figure 1.). The road network has grown from merely 276 km in 1956 to around 72,000 km in 2015/16. LRN constitutes a significant proportion (82 per cent) of the Nepal’s Road System. A summary of the Nepal Road System is given in Table 1.

<table>
<thead>
<tr>
<th>Road Class</th>
<th>Km (2015)</th>
<th>Description</th>
<th>Respective Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Highways (NH)</td>
<td>12,894</td>
<td>The Main Arterial Route</td>
<td>DOR</td>
</tr>
<tr>
<td>Feeder Roads (FR)</td>
<td></td>
<td>Important Roads with a more Localized Nature</td>
<td></td>
</tr>
<tr>
<td>District Road Core Network (DRCN)</td>
<td>25,728</td>
<td>Roads Connecting Village HQ (economic centers)</td>
<td>DDC</td>
</tr>
<tr>
<td>Urban Roads</td>
<td>3,000</td>
<td>Roads Within a Municipal Boundary</td>
<td>Municipality</td>
</tr>
<tr>
<td>Villages Roads</td>
<td>&gt;31,903</td>
<td>Non-through roads linking single villages to roads of a higher class</td>
<td>VDC</td>
</tr>
</tbody>
</table>
Network and Connectivity

In terms of transport sector development, the early 1990s marks an important milestone for rural road connectivity. With the “Build Your Own Village” campaign initiated by the Government in 1994, provision of a lump-sum grants of USD 3,000 to each Village Development Committee was instrumental in raising people’s aspiration towards building rural access. To pursue the Agricultural Perspective Plan and stimulate rural growth, the government established Department of Local Infrastructure Development and Agricultural Roads (DoLIDAR).

The Green Road concept in rural road construction was introduced in 1990. Two significant pilot projects, “Rampur – Aryabhanjyang Road” in Western Region and “Kathmandu – Sitapaila - Bhimdhunga Road” in Central Region, were launched with this same concept. The results obtained from these pilot projects were later used to develop specification and design standards for both feeder and rural roads.

Nepal's road system has been developed in stages. The first stage begins with track opening, which is followed by upgrading activities such as gravelling, construction of drainage structures along with, river crossing structures and finally bituminous pavement. According to Statistics of the Strategic Road Network (SRN), there is a total of 12,898 km of the SRN linking east to west and north to south of the country (as of 2013). However, half of the SRN is still unpaved and 35 per cent of it is still in an earthen condition. The total road assets in Nepal stands over USD 3.5 billion which is around 15.9 per cent of the current GDP. Effective maintenance of gravel surface pavement has remained a challenge due to extreme weather events: excessive rain during monsoon and complete dry spells afterward. Generally, after three to four years of the operation, the gravel surface is found to have reverted back to the earthen stage, owing to the excessive loss of gravel.

Figure 1 presents the road network distribution in each province of Nepal, based on terrain conditions. The hills constitute a significant proportion of road network (58) in the all the provinces, except Province 2. Only 10 per cent of roads are in mountains and 31 per cent in Terai region. In mountains, the roads exist mostly in the form of track and are operational only during winter season. Based on terrain condition, 33 per cent of SRN is in Terai region with 55 per cent in hills. Only 22 per cent of SRN is in the mountainous region.

The SRN, which connects to international borders and district headquarters is critical. It helps to maintain administrative, political and social linkages with the districts. Figure 3 shows the status of SRN in terms of its pavement condition. As of 2011, 97 per cent people in Terai and 77 per cent in hills/mountains have access to SRN within two and four hours of walk respectively (see Figure 2).

13 Source: Estimated
14 The gravel loss (estimated to 22 – 25 mm/year) of the graveled paved road is also substantially high due to 9 months’ complete dryness of the surface, which causes a loss in the gravel moisture, and 3 months’ excessive rains during monsoon.
The total road length in the country, including SRN, reached 70,400 km in 2016. 33 per cent of the total network has been identified as all-weather road and the rest are fair-weather which is seasonal and only operational during the dry season. 68 per cent of LRN is fair-weather out of which more than 50 per cent roads need major investment to bring the network into vehicle passable condition. Local village roads mostly fall into this category due to their poor design and lack of engineering input during construction. Figure 3 shows the distribution of all-weather and fair-weather roads (SRN and LRN) in different provinces. Compared to other provinces, province 1, 3 and 4 have a significantly higher share of fair-weather roads.

**Road Accessibility and Density**

Road density of the paved roads, which is normally an all-weather road, has currently reached 16 km per 100 sq. km. Although Nepal’s total (paved & unpaved) road density (49km/100km²) is higher than other mountainous countries such as Bhutan (20km/100km²) and Pakistan (32km/100 km²), the transport services are limited to only around 50 per cent of the
network. The Government of Nepal’s major focus is on constructing new roads in the rural areas, which puts provisions of adequate attention to upgrading earthen track to all-weather vehicle passable condition on the back seat. The terrain-wise road density is given in Table 2. Because of varied topography and settlement patterns, the distribution of roads in all the Development Regions and physiographic zones of the country is not even. The Central Development Region (CDR) has the highest road network, followed by Eastern (EDR), Western (WDR), Midwestern (MWDR) and Far Western Development Regions (FWDR). Similarly, the Terai has the highest road network followed by hills and mountains.

<table>
<thead>
<tr>
<th>Table 2: Road Density km/sq km</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Road density Km/100 sq.km</td>
</tr>
<tr>
<td>Mountains</td>
<td>0.03</td>
</tr>
<tr>
<td>Hills</td>
<td>0.12</td>
</tr>
<tr>
<td>Terai</td>
<td>0.13</td>
</tr>
<tr>
<td>Kathmandu Valley</td>
<td>2.61</td>
</tr>
<tr>
<td>Kathmandu District</td>
<td>2.78</td>
</tr>
<tr>
<td>Nepal</td>
<td>0.49</td>
</tr>
</tbody>
</table>

As stated, the characteristics of the road transport system in Nepal is mainly guided to lessen walking time to reach nearby motorable road head in rural areas. Road development in Nepal is based on political classifications rather than functional classifications. Partly because of that, roads built with significant investment are found to be underutilized. Underutilization and unserviceability of roads combined with disruptions of local movement during rainy season call into question the efficacy of Nepal’s road system planning and threatens return on the investment made to date on local roads. Fiscal Budget Allocation and Expenditures (Transport Sector).

The annual budget of Nepal is targeted towards achieving economic growth, poverty reduction, employment generation and establishing foundations for overall socio-economic development. Over the last four years, the average annual fiscal budget increased in the tune of around 20.4 per cent (MoF, 2016a). However, due to various constraints, only around 80 per cent of the allocation is spent annually. Table 3 gives annual budget allocation and expenditures between 2012 and 2016.

Two implementing agencies: Department of Roads (DoR) and Department of Local Infrastructure Development and Agricultural Roads (DoLIDAR) are involved in implementing road projects. Despite DoR’s mandate to restrict its programs to implementation of SRN, it is still involved in rural road construction. For the fiscal year 2016/17, the total combined budget for these two agencies for managing and developing road connectivity is estimated to be 9.35 per cent of the total national budget (NPC, 2016a). In FY 2015/16, the total budget spending on transport infrastructure was approx. 8.5 per cent of the fiscal expenditures (NPC, 2016b).

The major aim of improving transport connectivity is to support poverty reduction program by focusing on creating additional employment opportunities and supporting the rural environment in creating additional income-generating activities to raise the living standards of the locals. The Government of Nepal is putting significant effort to bridge the connectivity gap between rural districts, national road network, and major tourist destinations. Different policies, programmes, and development projects have been launched by the government with the help of international organizations and development banks such as Rural Action Program (RAP), Strengthening National Rural Transport Programme (SNRTP), Model Villages Programme, Decentralized Rural Infrastructure and Livelihood Programme (DRILP), among others.

55 Low spent allocation is contributed
### Table 3. Budget Allocation and Expenditures (in USD billion)

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>2013/14</th>
<th>2014/15</th>
<th>2015/16</th>
<th>2016/17</th>
</tr>
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<tbody>
<tr>
<td>Annual Budget Allocation</td>
<td>5.17</td>
<td>6.18</td>
<td>7.01</td>
<td>10.48</td>
</tr>
<tr>
<td>Annual Expenditure</td>
<td>4.1</td>
<td>5.31</td>
<td>5.85</td>
<td></td>
</tr>
<tr>
<td>Per cent Expenditures against Fiscal Allocation (Total Budget)</td>
<td>79.30</td>
<td>85.92</td>
<td>83.45</td>
<td></td>
</tr>
<tr>
<td>Annual Allocation of Transport Sector</td>
<td>0.476</td>
<td>0.438</td>
<td>0.580</td>
<td></td>
</tr>
<tr>
<td>Annual Expenditures Transport sector</td>
<td>0.368</td>
<td>0.438</td>
<td>0.580</td>
<td></td>
</tr>
<tr>
<td>Per cent Expenditures against Fiscal Allocation (Transport Sector)</td>
<td>92.0</td>
<td>94.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Allocation for Rural Transport</td>
<td>0.158</td>
<td>0.214</td>
<td>0.356</td>
<td></td>
</tr>
<tr>
<td>Annual Expenditures for Rural Transport</td>
<td>0.152</td>
<td>0.116</td>
<td>0.196</td>
<td></td>
</tr>
<tr>
<td>Per cent Expenditures against Fiscal Allocation (Rural Transport)</td>
<td>73.4</td>
<td>91.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### SDGs and National Development Priorities

Through adoption of the Sustainable Development Goals (SDG) agenda, member countries have acknowledged the importance of the transport infrastructure and services in achieving the SDGs. Sustainable transport particularly rural-urban connectivity and rural access closely linked to achieving the Sustainable Development Goals (SDGs).

Following the adoption of agenda on SDGs, Nepal Planning Commission carried out a review on the status of SDGs (NPC, 2015b). The review extensively covered the achievements of MDGs as well as progress related to SDGs 1, 2, 3, 5, 9 and 17.

The review also pointed out the issues and challenges that might be faced in implementing SDGs agenda in Nepal. A major challenge for a least developed country like Nepal, where there are limited resources, skills, and access to technology, is mainstreaming the SDGs agenda into the provincial and local level planning and budgeting as these new government levels are in the process of being formed. Making existing data generation system robust and databases in line with SDGs requirement and data disaggregation have also been a serious challenge in regularly tracking progress of SDGs. Other challenges include job creation and tackling nutrition deficiency and natural disasters and strengthening governance at all levels.

The review has also highlighted further need of a) Aligning and disaggregating (at sub-national level, by sex, age, social groups and disability) the targets and indicators of sectoral plans, long-term strategies and perspective plans with the SDGs; b) Shifting alignment of national M&E systems from MDG to SDG targets and indicators; c) Integrating SDGs into the current fourteenth periodic plan and other plans; and d) Aligning provincial and local government periodic plans, annual programmes and budgets with the SDGs.

The National Report on SDGs provides a preliminary assessment of current SDGs status and the preliminary set of targets to be achieved by 2030 (NPC, 2015b). This report has been further revised and updated in June 2017 to draft Baseline Report published by the NPC Secretariat (NPC, 2017).

The Baseline Report also highlights the agenda and the challenges in aligning sectoral outcomes impacting SDGs. The major challenges that have been identified in the Baseline Report includes: a) creating environment for mobilizing domestic and foreign investment to accelerate growth by strengthening microeconomic policy; b) further disaggregating the SDGs to match the development environment and its capacity to deliver in a structured time line; c) building medium and long-term sectoral plan to match SDGs; e) strengthening monitoring, evaluation and reporting mechanism for applying corrective measures in a timely manner to ensure SDGs outcome; f) establishing apex
monitoring and evaluation mechanism at center to guide and coordinate sectoral outcomes with SDGs. In carrying out these activities, good governance practices need to prevail.

**Annual Budget and SDGs**

Nepal is one of the few countries which achieved substantial progress in aligning the annual budget with the SDGs. Considering the activities and the programs targeted in each SDGs, for FY 2015/16, resource allocation ranges from 0.18 per cent (Partnerships for the Goals: Goal 17) to 28.61 per cent (Sustainable Cities and Communities: Goal 11). In terms of the budget allocation, Goal 9 and Goal 11 receive highest percentage resources. A massive program has been launched to address the rapid urbanization in the country. Industry, Innovation, and Infrastructure (SDG 9) receives 27.59 per cent of the allocated resources targeted to support 94 development programs. Around 50 per cent of these resources are aimed at strengthening the overall rural connectivity. Figure 4 provides details of the consecutive two fiscal year budget allocation aligned to SDGs. The allocation for FY 2016/17 is almost in the same proportion as of FY 2015/16 except for Goal 16 (Peace, Justice and Strong Institutions), primarily due to the government’s commitment to hold all three level (Local, Provincial and Federal) elections within this FY 2016/17 as part of the constitutional provisions in the new constitution.

**INTER-LINKAGES OF TRANSPORT POLICIES AND ACTIVITIES WITH THE SDGs**

**Transport and Sustainable Development Goals**

Majority of the Nepalese population (81.39 per cent in 2015) live in rural areas, and most of these areas are isolated and lack transport connectivity. Sustainable transport infrastructure and services play a major role in the rural economic growth, rural productivity and rural resilience by providing access to basic utilities and services. Therefore, sustainable rural transport is the prerequisite for sustainable development. Provisions of improved rural transport connectivity bring multiple socio-economic benefits to rural communities. Transport acts as a stimulus to promote and accelerate programs that lead to successful achievement of SDGs within the targeted time frame. It encompasses all SDGs in case of Nepal except SDGs 12 and 14. Out of the 17 SDGs, 1, 2, 3, 4, 5, 9, 11, 13 and 17 have been assessed to have a direct relation with the transport infrastructure and services. The target of transport sector has been defined in SDG 9 but its inter-related target for other SDGs is yet to be established and worked out in detail. It connects rural communities with education, healthcare, administrative and welfare facilities, and it opens new opportunities for markets and
employment, both of which have significant implications to poverty eradication, hunger elimination, social integration and improved quality of life.

In case of Nepal, due to lack of functionality of the road system, roads can be commonly described belonging to either urban or rural category. As significant population lives in rural setting, the SDGs is basically focused on the uplift social and economic environment in the rural area. Therefore, there is a pressing need for improvement of rural transport and enhanced rural access in developing countries so that no one will be “left behind”.

Transport connectivity and rural-urban linkage would contribute directly/indirectly to the following SDGs and associated targets.

**Transport contribution towards ending poverty, hunger and achieving food security (Goals 1 and 2)**

Although transport is not directly linked to poverty reduction, many studies show that investment in urban and rural roads stimulate significant socio-economic growth. In the case of Nepal, improved transport connectivity is one of the biggest factors improving economic activities of areas that were earlier limited to porter services. Improving transport mobility and rural-urban connectivity can reduce rural poverty by providing economic opportunities and basic services for all sectors of society (men, women, youth, children, farmers, elderly and physically disables). Studies show that given a sufficiently long period of employment on the road, the poor can accumulate significant capital to invest in alternative livelihood opportunities and thus move away from poverty (ADB, 2002).

According to the national living standards survey conducted in 2010-2011, the overall poverty rate for Nepal is 25 per cent, which increases to 46 per cent in the Mid-Western and Far-Western regions. Over 30 per cent of Nepalese live on less than US$ 14 per person per month. Based on the multidimensional poverty index, Nepal has made significant progress in reducing poverty by 4.1 per cent per year between 1999 and 2008, according to the study released by Oxford Poverty and Human Development Initiative (OPHI). Human Development Report shows that Nepal’s HDI value increased from 0.279 to 0.548 between 1980 and 2014 with the average annual increase of about 2.0 per cent. The percentage of poor people in Nepal dropped from 64.7 per cent to 44.2 per cent between 2006 and 2011.

Improved transport connectivity is one of the biggest factors in reducing the incidences of poverty. If planned and implemented properly, this could aid in achieving the SDG 1 target (i.e., reduction of poverty from 23.5 per cent in 2014 to 5 per cent in 2030). NPC (2015) specifies that eradication of poverty will be possible through an economic growth that is spurred by transfer of technologies and “support for innovation”. This type of economic growth is unimaginable without access to markets that road connectivity provides.

Although transport is not explicitly mentioned in SDG 2: ending hunger and increasing food security, rural transport is vital to achieving this goal. Evidence shows that investment in rural roads leads to greater food security. Improved rural transport infrastructure and services can make food more accessible and affordable for the poor by reducing costs of the agriculture products. Studies reveal that lack of proper transport facility and road linkage results in a considerable proportion of agriculture products getting lost or wasted in rural Nepal. Most of the Nepalese farmers used to spend three to five hours to carry their agriculture produce to the market causing a loss of 20-25 per cent of their agriculture products due to lack of transport services. Another study indicates that annually, Nepalese farmers lose about 25-30 per cent of their food products before reaching the market (New Spotlight, Vol: 06 No.23 May 31, 2013). Similarly, the estimated post-harvest loss of fruit and vegetable in Nepal lies in the range of 20-50 per cent (Gautam and Bhattarai, 2006 Post-Harvest Horticulture). Efficient rural transport systems and better supply chain and logistics connect rural communities with market and farm input suppliers which significantly contribute to ending hunger.

**Transport Support to Access Health Care and Education (Goal 3)**

SDG 3: to ensure healthy lives and promote well-being for all at all ages, is a prominent target for Nepal transport sector as it aims to reduce deaths and injuries from road accidents and increases the accessibility to affordable health services. The current global target is to reduce deaths and injuries from road accidents to half by the end of 2020. Following the UNRSC "Global Plan for the
Decade of Action for road-safety 2011 to 2020”, Nepal has prepared its Road Safety Action Plan 2013-2020 and it is now under implementation. The objective of the Plan is to reduce current deaths and injuries to 35 to 50 per cent by the end of 2020.

Over the years, Nepal has suffered a great deal in road accidents due to limited efforts on educating people and reinforcing road safety measures. Despite several constraints including a) ineffective coordination among stakeholders; b) weak institutional setup c) flaws in existing legislation; and d) low priority to pedestrians (conflict between pedestrians and vehicle is high), efforts are being made to minimize road transport accidents. With these efforts, the fatalities have decreased from 24 deaths per 10,000 vehicles in 2001/02 to below 11 deaths per 10,000 vehicles in 2013/14. However, the negligence by the driver (43.7 per cent) and high speed (18.7 per cent) continue to remain as a major cause of accidents in Nepal. Nepal Road Safety Action Plan (2013-2020) provides the detailed formulation of the road safety strategy as one of the activities of this action plan. The strategy tries to address all the five pillars of the road safety management plan and include: a) Road Safety Management; b) Safer Roads and Mobility; c) Safer Vehicles; d) Safer Road Users; and e) Post Crash Response.

The availability of reliable transportation impacts a person’s ability to access appropriate and well-coordinated healthcare and education. As the significant population lives in rural areas, the need of transportation services dominates the necessity of providing these services for the well-being of these resident's rural population. Access to healthcare services in Nepal is critical for rural residents. Because of poor transport facility, many rural residents suffer as they have to walk to access healthcare services during childbirth, disability, etc. Often children, elderly and physically disabled persons have greater healthcare needs than others, and living in rural areas isolated from healthcare providers causes them additional difficulties. Studies have shown that providing transportation for medical treatment and quality health services to the rural community is cost-effective, and improves the quality of life. However, Nepal's rugged terrain and the lack of transport infrastructure and services make it highly inaccessible, limiting the availability of basic health care for the rural residents.

In terms of access to health facilities, with the advent of road connecting Khimti to the Tamakoshi-Khimti Road, for example, the health post in Khimti can access the facilities provided by the Dhalikkel hospital. Thus, households in VDCs around Ramechhap and Dolakha that previously didn’t have access to health facilities will now be able to travel a shorter distance to acquire quality health services. This shows that the targets set under SDG 3 (i.e., reduce maternal mortality rate to below 70 per 100,000 live births and eliminate prevalence of HIV, TB, malaria, and other water-borne diseases) is achievable through rural transport connections.

**Education and Transport (Goal 4)**

The aim of the SDG 4 is to achieve 100 per cent completion of primary education, 95 per cent enrollment and completion of grades one to eight and 90 per cent enrollment in pre-primary education by 2030. The provision of equal opportunity access to safe and reliable transport can promote equality and equitable educational opportunities for all.

Because of distance-related obstacles and lack of transportation facility, rural children in Nepal face many problems in reaching schools. As a result, school dropout rates are very high in rural areas, compared to that in urban areas. Increase in access to educational institutions through rural road connections not only reduces the travel time for the students but also decreases absenteeism. Rural transport connectivity and rural-urban linkage have significantly improved in the past few decades in Nepal, which has significant positive impact on different dimensions of sustainable development.

**Gender Equality and Transport (Goal 5)**

In Nepal, there is a huge gap between men and women in terms of access to education, healthcare, and participation in decision-making. Infant mortality is much higher for girls than boys, and illiteracy is far more prevalent among women compared to men. Many rural women live in extreme poverty, without any means of improving conditions for themselves and their families. Within households, women often have less to eat than men, and mothers’ insufficient calorie intake has led to chronic malnutrition among infants. At the same time, more women are heading households and
taking on the burden of sustaining the rural economy. Women constitute more than 60 per cent of the agricultural labour force but have little access to land, production technology and training. In recent years, lack of economic opportunities has prompted many girls and women of rural households to migrate from Nepal. Safe, efficient and socially inclusive rural transport system opens new opportunities for women and girls that improve access to education, healthcare, markets, administrative and welfare facilities and employment opportunities.

Although Nepal has formulated Gender and Social Inclusion (GESI) approaches, challenges remain in the national and local implementation to achieve genuine social inclusions. In this regard, through the District Development Committees (DDCs), Village Development Committees (VDCs) and the Municipalities, the Government of Nepal has given considerable emphasis for implementing GESI approaches and ensured participation of women and disadvantaged groups (DAGs) in the decision-making process.

Improving energy efficiency in the transport sector (Goal 7)

Nepal's potential to produce clean fuel is a well-acknowledged fact. GoN is strongly contemplating upscale of clean energy and subsequently reduce dependencies on imported fossils fuel to meet SDG 7. This will help to improve energy efficiency in the transport sector, utilize clean fuel to run mass transit system as well as railways. A feasibility study for projects such as the East-West Railway and prospects of monorail in Kathmandu are few such examples of the Government’s efforts to introduce clean and efficient transport systems in the country.

Since the rate of vehicle ownership has been increasing on an average by 13 per cent every year, the need to switch to cleaner fuels to decrease the GHG emissions in the country is inherent. In addition, promoting clean energy-based alternate transport, converting public utility vehicles to LPG and renewable energy, promoting non-motorized transport especially the dedicated bicycle lanes and walkway facilities and conducting public awareness activities are some measures that can be taken to reduce the increasing stress (GHG emissions and air pollution) to the environment.

Since Nepal is a landlocked country, without local fossil fuel resources to meet its growing fossil fuel demand, it imports 100 per cent of its fossil fuels from neighboring countries. This has a negative impact on the energy security of the country. In response to the unofficial blockade in 2015, the government issued the National Energy Crisis Reduction and Electricity Development Decade Plan (2016) declaring Nepal's targets to realize 10,000 MW hydropower potential in the next 10 years to facilitate all energy-intensive sectors by providing electricity as fuel. This is a step to move towards a more modern fuel source.

The country is slowly transitioning toward cleaner fuels. Numerous policies, including the National Transport Policy (2001) and the Environment Friendly Transport Policy (2015), have emphasized the types of fuel for clean energy transport services, ranging from electricity to hydrogen fuel cells, that should be introduced in the country. For example, the Environment Friendly Transport Policy targets the share of environment-friendly vehicles to increase to 20 per cent of the total vehicle fleet by 2020. In addition, the policy emphasizes establishing charging stations and manufacturing plants to encourage the use of local resources.

Development of quality, reliable, sustainable and resilient transport infrastructure (Goal 9)

The Fourteenth Plan envisages major challenges that the sector is currently facing, which includes a) management of expensive construction works due to existing difficult terrain condition; b) difficulty in managing sufficient resources for road asset management; c) prioritizing resource allocation due to heavy demands; d) extending roads into dispersed villages; e) constructing dependable and safe road operating throughout the year; and f) consideration of natural disaster and climate resiliency (NPC, 2016c).

In the Fourteenth Plan, the transport sector investment requirements have been lumped together with storage and communication. Out of these three areas, it is estimated that the transport sector constitutes around 70 per cent of the projected investments. Compared with this projected investment, the proposed investment of the newly announced “Strategic Plan, 2072” is considered to
be highly ambitious (USD 8.16 billion in the next five year) (MoPIT, 2015). The investment in the transport sector for the next three-year period of Fourteenth Plan is given in the following table 4.

<table>
<thead>
<tr>
<th>Sector</th>
<th>2016/17</th>
<th>2017/18</th>
<th>2018/19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport, Storage and Communication</td>
<td>1.58 (24.7 per cent)</td>
<td>2.08 (26.5 per cent)</td>
<td>2.40 (26.7 per cent)</td>
</tr>
<tr>
<td>Total Investment</td>
<td>6.49 (100 per cent)</td>
<td>7.89 (100 per cent)</td>
<td>9.68 (100 per cent)</td>
</tr>
</tbody>
</table>

Source: NPC

Although efforts are being made to make the transport infrastructure resilient, budgetary gaps in the sector constrain sustainable growth. Various studies carried out by the ADB and World Bank indicate that expenditure in the transport sector needs to be boosted to create adequate infrastructure support for growth. The ADB report suggests that Nepal should annually be spending 1.65 per cent of the GDP in the transport sector for the next 10-year period (2010-2020) (Bajracharya, 2010). The World Bank report suggests upscaling the investment in the transport sector to 3.49 per cent of the GDP in high GDP scenario and 2.65 per cent of GDP in low case scenario (Andres, Biller, and Dappe, 2013).

The Nepal Growth Diagnostic Study (2014) concluded that Nepal’s transportation sector, as a whole, poses many constraints to the overall country’s development as Nepal’s road network is limited. In addition, implementation of border and customs policies also appear problematic. The degree to which any one of these issues contributes to the high cost of transport is not clear. However, given the importance of transporting goods and services from Nepal to regional and global markets, the high cost of transport is a binding constraint to economic growth in Nepal. Therefore, different private and public institutions have realized the importance of developing sustainable infrastructure, according to the SDG 9 target. Quick action in this area will be essential in meeting the targets in time.

**Improvement of urban public transport system (Goal 11)**

The level of urbanization in Nepal remains low but the pace of urbanization has remained faster and is likely to remain so in the future (MoUD, 2017). Only 17.1 per cent of Nepal’s population resided in 58 designated urban areas according to the 2011 census. However, with the addition and creation of 276 of Urban Municipalities, it estimated that the urban population is now around 40 per cent of Nepal’s population. Although the urban growth rate in the intercensal decade was 3.43 per cent, the average annual growth between 1981-2011 has remained at a high rate of 5.3 per cent. The urban rural growth differential in 2011 was 2.4 per cent. Over half of Nepal’s urban population reside in the hills and the rest of the Tarai. Physiographic and connectivity characteristics are important determinants of urbanization which result in wide variation in the regional levels of urbanization. The level of urbanization in the Kathmandu valley (three districts) and Pokhara valley (Kaski district) comes to 96.97 per cent and 79.52 per cent respectively, while it is only 18.28 per cent for the rest of the hills. Similarly, inner Tarai valleys2 have a level of urbanization of 41.97 per cent compared to 38.94 per cent for the rest of the Tarai.

Acknowledging the contributions made by the urban areas and its increasing share in GDP growth, it is imperative that urban transport system is accorded as the priority area for investments. Transport is the growth engine for these urban cities. A bad transport planning not only ruins the general condition of the liability but also continue to create missed opportunities. A study carried out by Nepal Rastra Bank in 2012 finds that Kathmandu Valley contributes 23 per cent to the GDP. In this context, there is a strong case for the level of investment required in urban transport infrastructure and services to increase to match its contributions to the GDP.

Following the Kathmandu Sustainable Transport initiative, an agenda for reform in the public transport is now being actively pursued. Road hierarchy in Kathmandu Valley is being established to accommodate size and capacity of the public transport vehicle. Incentives are being provided to small public transport operators to upgrade their fleet to an environmental friendly higher class of public transport. An alternate mode of transport for mass transit in Kathmandu valley is being explored and
is pursued. Various options including metro, light rail, and urban ropeway system are being examined for its suitability and viability.

**Climate impacts on transport and mitigation and adaptation measures (Goal 13)**

Since Nepal is a country with varying topography, different parts of the country are subjected to different climatic conditions. The mountainous region of Nepal is more prone to landslides, mudflow, debris flow and rock-falls, due to heavy rainfalls, that blocks the flow of traffic and can also cause damage to the road infrastructure. In the Terai region, the increase in temperature escalates the instances of cracks on the roads and heavy precipitation leads to potholes. The poor road conditions resulting from such natural calamities increase chances of accidents and delay transportation of necessities as well as increasing consumption of fuels.

Nepal is significantly affected by temperature increase as it causes the melting of the glaciers and consequently, washout of the roads. High temperature also causes increased fatigue to the bituminous pavement, deterioration of gravel surface, thermal expansion of bridges, buckling of joints of steel structures, etc. When there's a temperature drop, the infrastructure becomes vulnerable to snow conditions. High rainfall and flooding caused significant damage to the road drainage structures, breaching of road embankments, scouring of bridge foundation, washouts, etc. Apart from climate change impacts, there are natural disasters (such as earthquakes and landslides) impacts that have been significantly felt in Nepal. These also cause major road blockages and failures.

**Adaptation measures**

The cost of building and maintaining road infrastructure in Nepal is high compared to other countries in this region. Road building in extreme terrain condition, maintaining it and facing frequent disaster leading to premature failures of the road structures are common issues of the road system in Nepal. To be able to adapt to such adverse conditions and disasters, special consideration is needed while designing transport infrastructures. Infrastructures need to be emphasized to be able to adapt in such a way that operation and maintenance costs are kept to a minimum. A long-term life cycle cost (LCC) principle needs to be adopted while making the investment decision. To make a proper assessment on infrastructure planning, Nepal took several initiatives to prepare the "Climate Resilient Planning – A Tool for Long-term Climate Adaptation" along with the National Adaptation Programme of Action (NAPA) and Local Adaptation Plans for Action (LAPA) in 2011. These documents were prepared to facilitate the preparation of resilient periodic development plans and to aid in making the environment and people adapt to the adverse impacts of climate change. The Climate Change Vulnerability Mapping of Nepal under NAPA has been established as a tool to help identify the areas that are the most vulnerable to different kinds of disasters in Nepal.

In Nepal, bioengineering has been successfully adapted to decrease the occurrence of landslides and its negative impact on roads. However, no design specifications have been formulated to climate-proofing roads. To address these, it is extremely necessary that the country develop a framework to i) identify locations for extreme climate conditions, ii) carry out risk analysis and impact assessment in that location, iii) plan an appropriate response to the risks, iv) calculate the life-cycle costs of building roads, v) design the infrastructure accordingly, vi) implement the plan and vii) carry out continuous monitoring and evaluation. Although this does not prevent extreme climate conditions, it will help in reducing the life cycle costs of the road.

Eight strategies have been identified to reduce the impacts of climate change and disasters on road infrastructure. The consideration of these strategies will be useful while revisiting the much-awaited revision on “National Transport Policy”. The strategies focus on a) building awareness; b) developing project screening guidelines; c) integrating “Avoid – Shift – Improve” strategy in formulating, designing transport mode; d) classifying road system based on vulnerability to climate change impacts and disasters; e) developing design standards; f) operationalization of maintenance practices to minimize secondary impact; g) strengthening environmental and social safeguards; and, h) enhancing institutional capacity.
Collaboration and partnership to develop sustainable transport system (Goal 17)

The current road length has reached around 65,500 km (including SRN and LRN) out of which around 20,000 km is all-weather. A recent study carried out by the DoR concludes that by the end of 2013, over 90 per cent of the population is within the 2 to 4-hour accessibility criteria (i.e., 77 per cent of the Hill population within 4 hours and 97 per cent of the Terai within 2 hours) (DoR, 2015). Two-thirds of the population (17.2 million) is within 1 hour of the SRN and less than 9 per cent is more than 4 hours away. The additional inclusion (32,000 km) to the existing Local Road Network raises the total population served to 99 per cent (based on the 2hr/4hr criteria) – with less than 250,000 people in the remote northern mountain areas more than 4 hours away from a road. Overall, 99 per cent of the Terai population and 77 per cent of the Hill population is located within an hour of access from a road.

The major challenge now lies in consolidating the gains established so far by the construction of the existing road network and progressing to implement other sectoral actions. Tourism, energy, trade, and manufacturing industries all depend on reliability and competitiveness of the transport cost. By bringing the existing road network into a maintainable condition, (by applying a series of activities like upgrading, widening, pavement strengthening, etc.) reliability, dependability, cost-effectiveness and safety will be ensured to the users.

The transport sector consumes a considerable part of the overall infrastructure investment in Nepal. A major proportion of the transport sector budget is expended in improving and maintaining roads. The sector has the greatest potential of not only creating additional employment opportunities but also supporting the economic agenda of the nation for an accelerated growth.

The other area of investment is to identify and implement mega projects with the notion of reaping economic benefits. Implementation of projects like Kathmandu – Terai Fast Track, with high economic return (IRR 31 per cent), will boost the economy of the country.

Six decades of development in the transport sector’s agenda has so far remained in developing people-centered mobility (intra and inter). The efficiency was never a factor while planning and developing transport network. Competitive transport cost considerations were never carried out in selecting the road alignment. The political dictation in the making of the primary network pass through each village before reaching the final destination, this made our network costly as well as inefficient.

In its Country Program Strategy, both Asian Development Bank and World Bank have accorded highest priority for investment in the transport sector. The combined portfolio of WB and ADB is around 40 per cent of the current expenditures in transport sector (MoF, 2016b). Besides WB and ADB, the other major development partners involved in financing the transport sector are: a) Government of India (bilateral grant and loan); b) Government of People’s Republic of China (bilateral grant and loan) c) Government of Japan (bilateral grant and loan); Swiss Agency for Development and Cooperation (SDC); d) Millennium Challenge Corporation (MCC, USA); Department of International Development (DfID, UK) etc.

WB’s engagement in the sector is continuing in a) transport connectivity, with a focus on rural transport and connectivity to India; b) improving access to markets for the poor and to facilitate national and regional integration; c) strengthening key institutions in the transport sector, which remains hampered by overlapping institutional roles and mandates; d) improving the maintenance, safety and quality of transport infrastructure and services.

Recently ADB’s engagement to upgrade two-lane Narayanghat – Butwal section of East-West Highway to four-lane standards marks the beginning of an era of four-lane highway in Nepal. ADB’s engagement with rural transport is continuing and is demonstrating the impact on social and economic conditions of rural areas.

In upscaling the investment in road infrastructure, it is equally important to explore and establish a sustainable financing mechanism to support future road programs. Strengthening institutional capacity and the delivery are other areas which need greater attention. A strong collaborative approach with development partners is needed now to solicit additional resources as well as internalize the gains so far made in this sector.
**Improved Transport for Economic Growth**

Improved transport infrastructures and services play a major role in economic growth. Nepal Living Standard Survey 2010/11 illustrates that during the last 15 years, accessibility has improved almost universally for all types of facilities, which have a significant impact on the economic growth in the rural areas in Nepal. Efficient rural-urban connectivity helps connect rural areas to urban centers, boosts trade and commerce, and creates new jobs. It further allows for safe and efficient movement of people and goods from production to consumption through better supply chain and logistics.

Most of the studies demonstrate that investment in minor rural road remarkably reduces the travel time from farm to market, which in turn significantly reduces the transport cost of the agriculture product, and improves the productivity and economic growth in the rural areas.

Realizing the fact that the good transport infrastructure and services are essential conditions for economic growth and poverty alleviation, the Government of Nepal has given considerable emphasis on the development of the rural roads. As a result, transport connectivity has significantly improved in past few decades. Since then, rural connectivity has been playing an important role in economic growth of rural areas.

Improved rural transport connectivity further helps the rural people to enhance their traditional skills, support for microenterprises in rural areas, promote tourism industry and support planning and implementing other infrastructures such as hydropower, and industry etc.

**Overall Impact of Rural Transport in Achieving SDGs in Nepal**

To drive rural as well as urban economy and uplift the social environment, connectivity has been playing an important role in Nepal's development endeavor. Lately, transport infrastructure has gone into a substantial transformation from an early stage mule track to the motorable road. The road connectivity within the district started only after the district got connected with the National Road Network. At the end of Eight Periodic Plan (1993-1997), only 19 districts were yet to be connected to the National Road System (NRS). Today, only two districts- Humla and Dolpa are yet to be connected to the National Road System.

In 1997, 13 districts were identified by ICIMOD as the worst performing districts in 11 combinations of four dimension of development performance: namely, poverty and deprivation, socio-economic, institutional and infrastructure development, women’s empowerment, and natural resource endowment and management. Out of those 13 districts, 10 districts were not connected to National Road System at the time of the study in 2001. A comparative assessment of Human Development Index of 2001 and 2011 reveals the fact that the pace of human development in districts that were not connected to the NRS in 2001, is significantly higher than those of other districts which were recorded with higher HDI in 2001.

Nepal Living Standard Survey 2010/11 confirms that during a period of the last 15 years, accessibility has improved significantly. Within the same period, the accessibility to the paved road has just doubled and whereas for accessibility to dirt road has increased by 37 per cent.

A comparative finding of the Nepal Living Standard Surveys carried out in 1994/95, 2004/05 and 20010/11 is given in the following table (Table 5). It shows that the improved connectivity has made a significant impact on enlarging the coverage of household in making access to the basic services within 30 minutes.

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16 Districts: Achham, Bajhang, Kalikot, Humla, Mugu, Doti, Jumla, Bajura, Rukum, Dailekh, Jajarkot, Rolpa and Baitadi.

17 The average increase of HDI in 10 years (2001-2011) of these 7 districts (Bajura, Bajhang, Humla, Kalikot, Achham, Dolpa, Mugu) not connected to road network in 2001 is estimated to be around 29.7 per cent. The average increase for developed districts (Kathmandu, Lalitpur, Kaski, Bhaktapur), the increase is only 4.9 per cent.
Public and private buses are the most common means of long-distance travel in the country. Access to the bus stop is conditional upon access to the road. About 66 per cent of households are within 30 minutes of reach to the nearest bus stop. For nearly one-fourth of households, it takes around 30 minutes to 3 hours, and for around 10 per cent of households, it takes more than 3 hours to reach the nearest bus stop. Among development regions, the central development region has the best access to bus stops (78 per cent households can reach a bus stop within 30 minutes) while the far-western development region has the worst access, only 43 per cent of households are within this reach. In case of urban households, the mean time taken to reach a bus stop is much lower (12 minutes) than the time taken for rural households (73 minutes). Increase in access to road encourages mobility of goods and expands the labor market, which in turn positively affects living standards of people.

A survey gathered data on three types of roads: paved road, vehicle passable dirt road and vehicle impassable dirt road (including horse trail). Overall, 51 per cent households can reach the nearest paved road within 30 minutes, and three out of four households can reach the nearest paved road within two hours. Around 80 per cent of households, on the other hand, can reach the nearest vehicle passable dirt road within 30 minutes. Access to the paved road decreases with the household consumption quintiles. Meantime taken by a household in the richest quintile to reach the nearest paved road is 66 minutes and that for a household in the poorest quintile is 253 minutes.

External evaluation of six district project roads constructed and maintained by District Road Support Program\(^\text{16}\) presents a strong case for the positive impact on the socio-economic aspect of the project area contributed by improved road connectivity (Starkey, Sharma, and Tumbahangfe, 2013). The findings are summarized in the following Table 6.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Nepal Living Standard Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1994/95</td>
</tr>
<tr>
<td>Primary School</td>
<td>88.4</td>
</tr>
<tr>
<td>Secondary School</td>
<td></td>
</tr>
<tr>
<td>Higher Secondary School</td>
<td></td>
</tr>
<tr>
<td>Health Post/Sub-health Post</td>
<td>44.8</td>
</tr>
<tr>
<td>Public Hospital</td>
<td></td>
</tr>
<tr>
<td>Private Hospital/Clinic</td>
<td></td>
</tr>
<tr>
<td>Bus Stop</td>
<td>331</td>
</tr>
<tr>
<td>Paved Road</td>
<td>24.7</td>
</tr>
<tr>
<td>Dirt Road Vehicle Passable</td>
<td>58.0</td>
</tr>
<tr>
<td>Dirt Road Vehicle Impassable</td>
<td>94.3</td>
</tr>
<tr>
<td>Local Shops/shops</td>
<td>86.2</td>
</tr>
<tr>
<td>Haat Bazaar</td>
<td>41.4</td>
</tr>
<tr>
<td>Market Center</td>
<td>24.2</td>
</tr>
<tr>
<td>Agriculture Center</td>
<td>24.5</td>
</tr>
<tr>
<td>Cooperatives</td>
<td>25.9</td>
</tr>
<tr>
<td>Bank</td>
<td>20.7</td>
</tr>
</tbody>
</table>

---

\(^{16}\) Swiss Government funded project implemented in six districts: Kavre, Sindupalchok, Dolakha, Ramechhap, Okhaldhunga and Sindhuli.
<table>
<thead>
<tr>
<th>Impact</th>
<th>Indication</th>
<th>Link to</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| **Access to Roads**                        | • The proximity to road increased (i.e., to four hours or less walk to road) for about 100,000 of the population residing around the six roads.  
• Half of the beneficiaries are under one hour of the road. | Connectivity                      |                                              |
| **Access to Services**                     | • 95 per cent of the sampled population using access roads to reach district headquarters.  
• 55 per cent of the population used the access roads to travel to the regional markets with small retail shops being set up along the roads.  
• Increase in the number of women accessing health posts for antenatal care.  
• Women could travel and come back the same day.  
• Education facilities were opened nearby. | Access to Market, Education and Health Facilities |                                              |
| **Transport Services**                     | • Heavier vehicle such as buses, cars were more common.  
• Fare prices were in the range from NPR 2.6/km in Kavre and Sindhupalchowk to NPR 6.9/km in Okhaldhunga. | Affordability                      |                                              |
| **Impacts of Roads on Rural Livelihoods**  | • Although importance of agriculture has declined, it remains the main source of income followed by non-agriculture wage labor, micro-enterprises, etc. | Support to Agriculture             |                                              |
| **Impact on Agriculture Sub-Sector**       | • Increased productivity of cereal crops with increase in the cropped area for all crops, excluding maize.  
• Commercialization of potatoes and oranges with increase in access to markets. | Support to Agriculture             |                                              |
| **Impact on Off-Farm Activities**          | • Increase in off-farm income from 7 per cent to 17 per cent.  
• Increase in livelihood diversification of the population in the disadvantaged as well as non-disadvantaged groups.  
• New skills related to masonry and gabion weaving were acquired through road construction due to which the population with the skills could earn higher wages. | Support to Agriculture and skills development |                                              |
| **Migration and Remittance**               | • After roads were constructed, remittance contributed to only 2 per cent to the household income.  
• Agriculture and local employment remained more important for income than remittances. | Local income                       |                                              |
| **Changes in Household Incomes**           | • Average increase in the income since the roads were constructed was 25 per cent with Janajati and non-advantaged groups benefiting the most. | Increase in average income          |                                              |
| **Changes in Households Expenses & Savings** | • Only 55 per cent of the surveyed population said household produce was only sufficient for six months in a year.  
• 25 per cent of household expenditure was spent on buying food grains, which was followed by expenses on children’s school fees and buying vegetables, oils and spices. | Increase in household savings       |                                              |
| **Changes in Living Standards** | • Increase in latrines from 7 per cent to 65 per cent for disadvantaged groups and from 41 per cent to 80 per cent for non-disadvantaged groups.  
• Significant increases in the use of metal roofing sheets.  
• Access to the national grid due to grid expansion with the advent of the roads. | Access to better sanitation |
| **Gender Empowerment** | • Increase in security for women as they could travel to their destination and return on the same day.  
• Equal pay and work during construction of roads empowered the women.  
• Formation of groups gave opportunities to share knowledge about women's health, education, etc. | Gender equality |
| **Economic Impact and Benefits** | • The economic rate of return (based on traffic growth) of the Dolakha-Singati road, Sindhulimadi-Bhimsenthan road and Ghyangdanda-21kilo road is greater than the projections of the development banks.  
• Increase in the value of land in closer proximity to the road.  
• The economic rate of return (based on agricultural production, land and social benefits) of the Dolakha-Singati road, Ghyangdanda-21 kilo road and Sindhulimadi-Bhimsenthan road are in the range 33-39 per cent. | Economic return |
| **Impact on Governance** | • The DRSP transparency tools helped to provide fair opportunities for the poor and women.  
• Public audits and public hearing helped in smooth running of the project. | Support to good governance |
CONCLUSION

Inclusive, balanced, resilient, affordable, safe and sustainable road systems are pre-requisites of an efficient transport system in the country. Only an efficient transport system supports the socio-economic growth and avoids missed opportunities. The role of the transport sector is relevant to almost all SDGs. Transport connectivity acts as a catalyst in increasing livelihood of the majority of the population in the rural areas of Nepal. Locations that lack robust road transport systems not only deprive locals an opportunity to gain from trading in bigger markets elsewhere but also cause a loss of 25-30 per cent of the produce of those that dare to walk towards viable market areas. In addition to reducing the poverty level, the SRN and LRN have been seen to provide access to educational and health care services. Donor-supported projects through different projects, the Government of Nepal realizes the importance of road transport network in meeting the Sustainable Development Goals. However, lack of governance structures as well as proper monitoring and verification mechanisms and politically motivated constructions have been major hindrances in road construction. The issue of aligning transport sector development to SDGs (in terms of resource allocations, tracking results) has become further challenged by the ongoing institutional restructuring under federalization.

Nepal has pioneered in aligning the development activities (fiscal priorities and resource allocation) with SDGs, but the internalization of this process is yet to be functionally established. Sectors are yet to detail out their task/activities in line with SDGs target. The major challenge for the Government lies on: a) expediting macroeconomic policy reforms to promote domestic as well as foreign direct investment highly essential to harness infrastructure that drives the growth process; b) a complete needs assessment of the transport sector and its financing requirement under SDGs; c) disaggregating indicators of SDGs to match expectations of transport sector in areas specific to SDGs; d) Strengthening data, reporting, and progress dissemination system; e) coordinating SDGs implementation at the federal, provincial and local levels; f) improving governance around the SDGs; and g) putting apex monitoring and evaluation system in place.

The transport planning, design, technology adoption and implementation modalities have great influences on steering the results for the expected outcome, as can be seen through projects supported by Development Partners. The challenges lie in internalizing these well-documented initiatives into projects supported solely under Government funding. Hence, a strong nexus that exists between the transport sector and SDGs must be further explored and strengthened to achieve SDGs within 2030.
REFERENCES


DEVELOPING THE SUSTAINABLE URBAN TRANSPORT INDEX

Henrik Gudmundsson and Madan B. Regmi

ABSTRACT

The article describes the development of the Sustainable Urban Transport Index (SUTI) for cities in the Asia-Pacific region. The first step was designing a conceptual framework based on literature on sustainable development and transport while incorporating the Sustainable Development Goals (SDGs) of relevance for urban transport planning. The second step was to identify and select indicators for the index using literature, indicator criteria, and input from an expert group meeting. This led to a consolidated list of ten indicators. The final step was to construct the index itself. This involved decisions on ways to normalize, weigh and calculate the elements of the index. The resulting Second regional expert meeting expert endorsed the refined index with ten indicators and agreed for pilot application of SUTI in selected Asian cities. It is also recognized that additional work on data collection and analysis will be required to apply SUTI and regularly report and compare the performance of urban transport systems in cities in practice. The application of SUTI in four pilot cities is ongoing with preliminary results used for illustration. It is hoped that SUTI would be a useful tool to evaluate and assess the state of urban transportation systems in Asian cities. The analysis of urban transport systems would provide useful insights into policy suggestions and actions required for improving urban transport system and services. The SUTI would help measure progress in improving urban transport and contribute to the achievement of SDG target 11.2 on improving public transport in urban areas.

Keywords: Urban transport, Assessment, Asian cities, Sustainable urban transport index, Policies

INTRODUCTION

Sustainable transport is a major concern in connection with urban development worldwide, not least in the Asia-Pacific region (UN ESCAP 2016). The adoption of the United Nations 2030 Development Agenda with the 17 Sustainable Development Goals (SDG’s) in 2015 has provided a new impetus to address the sustainability of transport systems and urban areas across the world. The New Urban Agenda that was adopted at the Habitat III summit in 2016 also emphasized the urgent need to tackle transport as part of wider urban development challenges (United Nations 2016). In October 2016, the United Nations Secretary Generals’ High-Level Advisory Group on Sustainable Transportation submitted its report ‘Mobilizing Sustainable Transport for Development ’, calling for sustainable urban mobility plans that support intermodal and interconnected transport, and comprehensive monitoring and evaluation methodologies for sustainable transport by national and local governments (UN-HLAG 2016).

Today there is no comprehensive system in place to measure and report on sustainable transport across cities in the Asia-Pacific region. The UN ESCAP, therefore, initiated the Sustainable Urban Transport Index (hereafter: SUTI) project. The aim was to develop and demonstrate an index to measure sustainable urban transport and progress towards Sustainable Development Goals (SDGs) in Asian cities. The index is to serve as a tool to help summarize, compare and track the performance of cities across the Asia-Pacific region with regard to sustainable urban transport and the SDGs. The index has been developed with a view to balance between measuring what is necessary to support sustainable transport planning with the kind and scope of data likely to be operationally available for many different cities in Asia on a regular basis.

Key aims in developing the SUTI has therefore been to,

- Reflecting SDG’s and other sustainability concerns of relevance for urban transport
- Limiting the number of indicators to few most essential ones,
- Avoiding indicators that are overly demanding or sophisticated to collect, and

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20 UN ESCAP, Transport Division, Bangkok, Thailand, regmi.unescap@un.org
• Adopting an index calculation method that is as simple, transparent, and unbiased as possible. The paper describes how these aims have been fulfilled.

CONCEPTUAL FRAMEWORK

A conceptual framework is needed in order to design the scope of the index and the selection of indicators for the index. The key definitions and terminology for the conceptual framework are presented in table 1.

Table 1. Key terminology for the framework

<table>
<thead>
<tr>
<th>Indicator:</th>
<th>a variable selected to represent a key property of a system or a wider phenomenon of interest. Indicators may be used directly or as elements in other measurement tools.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index:</td>
<td>a special type of indicator that consists of two or more indicators that each measure distinct system characteristics in separate units that are normalized and aggregated.</td>
</tr>
<tr>
<td>Framework:</td>
<td>A mental construct that serves to delimit and organize topics and associated sets of indicators or indices according to conceptual, operational and utilization concerns.</td>
</tr>
<tr>
<td>Metrics:</td>
<td>The specific operational design of an indicator in regard to how the values are measured, parameterized, calculated, normalized, combined, etc. (e.g. as tons per capita, or per unit of GDP).</td>
</tr>
<tr>
<td>Topic:</td>
<td>Phenomenon or system property that an indicator seeks to measure (for example ‘transport demand’, ‘air pollution’ or ‘accessibility’).</td>
</tr>
<tr>
<td>Sustainable Development:</td>
<td>Meeting the needs of the present without compromising the ability of future generations to meet their own needs; measured according to the three dimensions of sustainable development, social, environmental, and economic.</td>
</tr>
<tr>
<td>Sustainable Development Goals (SDGs) and Targets:</td>
<td>The 17 goals and 169 Targets for the period 2015-2030 adopted by the United Nations on September 25, 2015.</td>
</tr>
<tr>
<td>Transport systems:</td>
<td>Infrastructure, vehicles, and propulsive energy jointly operated to deliver movement of people and goods.</td>
</tr>
<tr>
<td>Domain:</td>
<td>An area of interest for monitoring and assessment consisting of several related topics. A group of indicators of such topics belong to a domain. In sustainable development assessment, the three dimensions are often considered as domains. In addition, the transport system is considered as a domain of indicators in sustainable transport assessment,</td>
</tr>
<tr>
<td>Aspect:</td>
<td>Term used in this paper to describe three components of the conceptual framework: a) the main services and impacts that urban transport has in regard to the three dimensions of sustainability; b) the SDG targets addressing urban transport; and c) the generic strategies applied to pursue sustainability for urban transport, referred to as ‘Avoid’, ‘Shift’ and ‘Improve’ strategies.</td>
</tr>
<tr>
<td>City or urban area:</td>
<td>Built-up area with a high population density governed by one or more political/administrative bodies. Not defined more specifically for this work.</td>
</tr>
</tbody>
</table>

The aim for the SUTI is to help measure and support urban transport for sustainable development. Fundamental concepts to incorporate in the framework, therefore, include sustainable development, transport, and how they connect in the urban context.

Sustainable development is defined as in Table 1 according to the Brundtland report (WCED 1987). It represents a desired overall trajectory of development for people, the economy, and the planet as a whole. Sustainable Development has been made operational for the 2015-2030 period via the 17 SDG’s and the associated targets.
Transport systems form an integral part of society, the economy, and the human impact on the environment and they are therefore essential for sustainable development. The fundamental components of transport systems are infrastructure, vehicles, and propulsive energy operated by humans or computers. They deliver transport services, which include the movement of people and goods for a broad range of functions (Gudmundsson et al. 2016).

Urban transport is a particular transport market that is separate from but interlinked with long-distance transport. Urban transport markets mainly serve needs to access work, education, retail options, health services, and social interactions. Urban transport service is provided by private, public and semi-public forms of motorized and non-motorized transport. In this context ‘urban transport’ is not defined more precisely than ‘transport within in urban areas’, since what is considered ‘urban’ differ across cities and countries.

Sustainable transport is a term reflecting the need to govern transport according to sustainability. It has been defined in various ways but there is no agreement on a global definition (see e.g. Gudmundsson et al. 2016, Ieda 2010, and Rand Europe 2004). The sustainability of transport systems is conditioned by the range of services and impacts produced by transport. These are ones such as accessibility, pollution, and safety. It can be pursued via a broad set of strategies (Banister 2008). Generic strategies include to avoid unnecessary transport, to shift transport from individual motorized transport to active modes and public transport, and to improve transport with regard to the use of efficient, clean vehicles and fuels.

Partly due to the complex and conditioned character of ‘sustainable transport’, there is not one dedicated SDG for transport in the 2030 Development Agenda. However, transport is important for achieving many of the SDG’s, and several of the 169 specific SDG targets do address transport more directly.

Table 2 below highlights the SDG goals and targets that are most directly related to transport. Of these, some address urban transport directly (3.6, 9.1 and 11.2), while others refer to impacts such as energy and emissions where urban transport play important roles (especially 7.3, 11.6 and 13.2).

<table>
<thead>
<tr>
<th>Goal</th>
<th>Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Ensure healthy lives and promote well-being for all at all ages</td>
<td>3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents</td>
</tr>
<tr>
<td>7. Ensure access to affordable, reliable, sustainable and modern energy for all</td>
<td>7.3 By 2030, double the global rate of improvement in energy efficiency (*)</td>
</tr>
<tr>
<td>9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation</td>
<td>9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all</td>
</tr>
<tr>
<td>11. Make cities and human settlements inclusive, safe, resilient and sustainable</td>
<td>11.2 By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons</td>
</tr>
<tr>
<td></td>
<td>11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management (*)</td>
</tr>
<tr>
<td>12. Ensure sustainable consumption and production patterns</td>
<td>12.c. Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances (*)</td>
</tr>
</tbody>
</table>
13. Take urgent action to combat climate change and its impacts

| 13.2 Integrate climate change measures into national policies, strategies and planning (*) |

(*) these targets do not explicitly mention transport systems, but transport actions are implied or will be instrumental for achieving them.

Indicators are needed to make these targets operational, and actions are needed to achieve them. In summary, the conceptual framework for SUTI is understood in regard to three aspects,

- The main *services and impacts* that urban transport provides in regard to the three dimensions of sustainability.
- The *SDG targets* addressing urban transport.
- The generic *strategies* applied to pursue sustainability for urban transport.

The full conceptual framework is shown in Table 3. Each aspect is to be reflected in the construction of SUTI.

To further validate the framework, it was mapped on the 21 criteria in the ‘meta-framework’ for sustainable transport assessment developed by Cornet and Gudmundsson (2016). The mapping demonstrates that nearly all criteria are reflected in the framework (ESCAP 2017).

### Table 3. Summary of framework aspect and elements

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sustainable Development</strong></td>
<td>Economic Dimension impacts</td>
</tr>
<tr>
<td></td>
<td>Social Dimension impacts</td>
</tr>
<tr>
<td></td>
<td>Environment Dimension impacts</td>
</tr>
<tr>
<td><strong>Sustainable Mobility Paradigm</strong></td>
<td>Avoid strategy</td>
</tr>
<tr>
<td></td>
<td>Shift strategy</td>
</tr>
<tr>
<td></td>
<td>Improve strategy</td>
</tr>
<tr>
<td><strong>SDG Targets Relevant for Urban Transport</strong></td>
<td>3.6 Deaths and injuries from road traffic</td>
</tr>
<tr>
<td></td>
<td>9.1 Quality, reliable, sustainable, resilient infrastructure</td>
</tr>
<tr>
<td></td>
<td>11.2 Access to safe, affordable, accessible and sustainable transport systems for all,</td>
</tr>
<tr>
<td></td>
<td>11.6 Adverse environmental impact including air quality</td>
</tr>
<tr>
<td></td>
<td>11.7 Universal access to safe, inclusive and accessible, green and public spaces</td>
</tr>
<tr>
<td></td>
<td>7.3 Improvement of energy efficiency (*)</td>
</tr>
<tr>
<td></td>
<td>13.2 Integrate climate change measures (*)</td>
</tr>
</tbody>
</table>

(*) represents a ‘proxy target’ as this element summarizes energy/climate aspects that are essential elements for sustainable transport impacts and strategies, but for which no direct transport SDG targets are formulated.
INDICATOR SELECTION

Based on the conceptual framework the work to identify and select indicators involved three steps:

- Identification and organization of candidate indicators from the literature,
- Application of criteria to develop a consolidated indicator set
- Final adjustment of indicator set based on an expert workshop and a regional meeting.

This section explains these steps of the process.

**Identification**

The identification of potential indicators starts from relevant literature, including scientific articles on sustainable transport measurement as well as more practice-oriented reports. This approach allows SUTI to be built primarily on existing work and recognized indicators, rather than requiring entirely new, non-established indicators. However, in a few cases, new indicators for important topics were developed as part of the process and final adjustment. The material was collected via previous research projects and supplementary literature search on key databases and internet sources.

The main focus of the literature review was publications reflecting a similar understanding of sustainable urban transport as in the conceptual framework. Attention was also given to identifying indicators actually applied to measure sustainable transport in several cities, and at best including cities in the Asia-Pacific region. In total around 25 indicators, publications were reviewed in detail. The full list is shown in the background report (ESCAP 2017). In addition to a range of scientific papers on sustainable transport measurement, the most valuable sources included four recent major efforts.

**The Sustainable Mobility 2.0 Project** conducted by the World Business Council for Sustainable Development (WBCSD 2016). The project has developed a set of 19 urban transport indicators for use by cities worldwide. These had been applied in six cities, three of which are in Asia. A detailed methodology is offered that allows each city to operationalize the indicators.

**The Arthur D Little report “The Future of Urban Mobility”** prepared for the International Union for Public Transport (UITP) (Arthur D Little 2014). The study also includes 19 urban transport indicators. 84 cities are covered, 30 of which in Asia-Pacific region. Case studies illustrate the range of data reported for each indicator for a selection of cities.

**The ‘Sustainable Urban Transport Evaluation’ (SUTE)** system has been developed by the Korean Transport Institute and is applied annually to all major cities by the Korean government, using 24 indicators (KOTI 2015). 12 of the indicators are quantitative so-called ‘status’ indicators while 12 others represent more qualitative aspects of urban transport planning.

**The ‘Inter-Agency Expert Group on Sustainable Development Goal Indicators’ (IAEG-SDG 2016)** has developed a global set of indicators that have been adopted by the United Nations Statistical Commission for tracking progress towards all of the SDG targets, including those mentioned in Table 2. The UN-HABITAT has made important contributions to addressing indicators to measure SDG goal 11 “Sustainable Cities and Communities”, including a proposed indicator for target 11.2, which is the only SDG target that deals explicitly with urban transport (Habitat 2016). These reports do not report any actual applications or data.
The indicator topics and specific indicator definitions in all of the 25 references were extracted to a spreadsheet database. The full database has in total 426 sustainable transport indicators. This set could be significantly condensed. First, many indicators across studies are identical or measure essentially the same variables. Others could be eliminated because they were either poorly defined, reflected less essential issues, or would likely require extensive effort to be applied in practice. The result of the condensation process was a shortlist of 20 ‘top’ indicators reflecting key issues and with applications in practice. This list was organized into four domains, namely ‘Transport system’, ‘Social impact’, ‘Economic impact’, and ‘Environment impact’ indicators, following practice in literature on sustainable transport indicators (see e.g. De Gruyter et al. 2017; Gillis et al 2016; Martino et al 2010; Jean and Amekudzi 2005). The domains also reflect key aspects of the SUTI framework (Table 3).

While the three latter domains refer directly to impacts of transport on each of the sustainable development dimensions, the ‘transport system’ domain is important in support of planning and management of transport.

**Indicator Criteria**

As 20 indicators were considered a too large set for realistic application to cities across Asia the shortlist was further narrowed to the final elements using a set of sustainable transport indicator selection criteria. As proposed by Castillo and Pitfield (2010) two sets of criteria were applied in this process:

a) Criteria aiming to maximize the relevance of indicators to the concept of sustainable transport. This was done by scoring indicators from 1-3 for each of the aspects of the SUTI framework

b) Criteria aiming to maximize the methodological quality of the indicators. The six criteria were,

- Definition and concept available in existing reports,
- Has been applied in practice in several cities,
- Data regularly available or readily produced,
- Clear interpretation possible,
- Scale to normalize indicator for the index can easily be defined,
- Relevant and actionable for cities.

Also, here a score of 1-3 was used. The scores for the two sets of criteria were summed for each indicator and a ranking of all shortlist indicators emerged (Table 4).

**Table 4. Combined ranking of sustainability and methodology.**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air quality (pm10-pm2.5)</td>
<td>177.78</td>
</tr>
<tr>
<td>Access to public transport service</td>
<td>176.92</td>
</tr>
<tr>
<td>Walking and cycling networks</td>
<td>170.09</td>
</tr>
<tr>
<td>Share of active and public transport modes in modal split</td>
<td>154.70</td>
</tr>
<tr>
<td>Greenhouse gas emissions</td>
<td>154.70</td>
</tr>
<tr>
<td>Traffic fatalities [and serious injuries]</td>
<td>147.86</td>
</tr>
<tr>
<td>Transport fuel consumption</td>
<td>97.44</td>
</tr>
<tr>
<td>Costs of congestion</td>
<td>94.87</td>
</tr>
<tr>
<td>Access to urban functions (jobs, school, retail, health)</td>
<td>93.16</td>
</tr>
<tr>
<td>Access to transport system for vulnerable groups</td>
<td>90.60</td>
</tr>
<tr>
<td>Satisfaction with mobility services</td>
<td>90.60</td>
</tr>
<tr>
<td>Land occupied by transport infrastructure</td>
<td>83.76</td>
</tr>
<tr>
<td>Travel time to work</td>
<td>79.49</td>
</tr>
<tr>
<td>Noise levels</td>
<td>79.49</td>
</tr>
</tbody>
</table>
Public Transport reliability 70.94
Affordability of transport 70.94
Cars and two-wheelers per capita 61.54
Transport system costs to society 18.80
Security (crimes in transport) 11.11
Perceived economic opportunity 11.11

Final Adjustment

This list was further reviewed by the project team, resulting in some modifications. The shortlist indicator ‘Walking and cycling networks’ was redefined to measure existing urban transport plans in terms of how well they cover the alternative travel modes, including intermodal facilities. It was renamed as ‘Extent to which transport plans cover public transport, intermodal facilities, and infrastructure for active modes’. This emphasizes the role of sustainable urban transport planning of cities.

The shortlist indicator ‘Costs of congestion’ was found too difficult to define and measure due to lack of agreed methodology, even if the concept itself is relevant. Instead of another economic indicator ‘Affordability of transport’ is included. Despite somewhat lower score in the indicator assessment, this is an indicator proposed in many studies, with direct relevance for the economic and social dimensions.

Another economic indicator that scored high, namely ‘Transport fuel consumption’ was omitted because of overlap with the environmental indicator ‘Greenhouse gas emissions’. It was replaced by ‘Transport system costs to society’ with a definition related to the scale of investments, and renamed as ‘Investment in public transportation systems’.

The project team proposed to limit the full set of indicators to the eight, two for each of the four domains. This number was considered reasonable in order to reflect the key domains as well as likely being manageable from an urban data collection point of view. Each domain would form a ‘sub-index’ of two indicators; the sub-indices would be aggregated to the full SUTI.

The SUTI conceptual framework approach and draft indicator set were presented for discussion at an Expert Group Meeting held in Kathmandu, Nepal, on 22-23 September 201621. The experts were mainly urban transport expert representatives from Asian states and cities that are supposed to be the main users of the SUTI. It was considered more fruitful to invite the experts to confront an already elaborated concept with suggested indicators, rather than a so-called ‘long list of indicators’ that is prone to be less appealing.

One of the aims of the expert meeting was to discuss any needed adjustments to the preliminary selection of indicators proposed by the team. The experts discussed the proposed indicators with a view to their relevance, feasibility, and applicability to urban transport planning in Asian cities.

The main critique was that the performance and operation of the transport systems were not sufficiently well represented in the indicator set. System performance is essential for agencies responsible for implementing urban transport strategies, who are to be users of the index. Also, additional economic factors were found to be important for sustainable management of urban transport systems, not least the operating costs. The outcome of this discussion was an endorsement of the proposed indicator set with adjustments as well as a request to include two additional indicators, which brought the total number of indicators to ten. In the ‘transport system’ domain was added: ‘Quality and Reliability of public transport service’. In the ‘Economy’ domain was added: ‘Operational costs of the public transport system’.

21 http://www.unescap.org/events/expert-group-meeting-planning-and-assessment-urban-transportation-systems
Moreover, it was proposed to dissolve the rigid allocation of each indicator to a single domain as some indicators relate to several domains. This is well in line with some sustainability theory, according to which the sustainability dimensions (corresponding to three out of four of the SUTI domains) are more to be seen as mental constructs than as separate physical systems (Joumard and Gudmundsson 2010, p 53). Therefore, the notion of building rigid ‘sub-indices’ within the overall SUTI was abandoned. Nevertheless, each of the three sustainability dimensions is still well represented in SUTI with at least two indicators of significance for each dimension.

The refined ten indicators set, normalization process and index design, as well as further description of indicators and data requirement and data standardization approach, was presented to the Region Meeting on Sustainable Transport Index held in Jakarta in March 2017. The experts considered the refined SUTI and agreed for its pilot application in selected Asian cities and provided feedback on data collection and standardization. Table 5 shows the full set of indicators and illustrates which elements of the SUTI framework each indicator reflects.

### Table 5. Final set of indicators for the SUTI

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Dimensions</th>
<th>Strategies</th>
<th>SGD Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes</td>
<td>System</td>
<td>Shift</td>
<td>(11.2)</td>
</tr>
<tr>
<td>Modal share of active and public transport in commuting</td>
<td>System</td>
<td>Shift</td>
<td>(11.2)</td>
</tr>
<tr>
<td>Convenient access to public transport service</td>
<td>Social.</td>
<td>Shift</td>
<td>11.2</td>
</tr>
<tr>
<td>Public transport quality and reliability</td>
<td>Social.</td>
<td>Shift</td>
<td>11.2</td>
</tr>
<tr>
<td>Traffic fatalities per 100,000 inhabitants</td>
<td>Social.</td>
<td>Improve</td>
<td>3.6</td>
</tr>
<tr>
<td>Affordability – travel costs as part of income</td>
<td>Economic. / Social.</td>
<td>Improve</td>
<td>(11.2)</td>
</tr>
<tr>
<td>Operational costs of the public transport system</td>
<td>Economic.</td>
<td>Shift/Improve</td>
<td>(9.1)</td>
</tr>
<tr>
<td>Investment in public transportation systems</td>
<td>Economic.</td>
<td>Shift</td>
<td>(11.2, 9.1)</td>
</tr>
<tr>
<td>Air quality (PM10)</td>
<td>Environmental.</td>
<td>Avoid/Shift/Improve</td>
<td>11.6</td>
</tr>
<tr>
<td>Greenhouse gas emissions from transport</td>
<td>Environmental.</td>
<td>Avoid/Shift/Improve</td>
<td>7.3/13.2</td>
</tr>
</tbody>
</table>

**Indicator Descriptions**

In order to review the proposed indicators and to support the subsequent collection of data and standardization for each indicator, the following elements are considered and described.

*Indicator relevance for sustainable transport and the framework elements:* This element explains why each indicator is relevant for the conceptual framework.

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22 [http://www.unescap.org/events/regional-meeting-sustainable-urban-transport-index](http://www.unescap.org/events/regional-meeting-sustainable-urban-transport-index)
Proposed definition: A specific definition of what is measured. In most cases, the definition is drawn from literature. In some cases, (such as indicator 1) it is defined especially for the context of the SUTI. 

Unit of measurement. The metrics needed to actually measure and report the indicator (e.g. ‘number of traffic fatalities per 100.000 inhabitants per year’).

Interpretation: Two issues are considered here, a) to what extent the indicator has a clear interpretation with regard to sustainable transport. Only indicators with quite clear interpretation are included; b) the direction of change of the indicator that is positive and negative, respectively. For example, declining emissions are more sustainable. The direction for each indicator matters for calculating the index.

Minimum and maximum values to use in the index construction: To build a normalized index it is necessary to use a common scaling for all indicators (see section 4). ‘Goalposts’ in terms of what constitutes ‘minimum’ and ‘maximum’ performance values must be defined. Values for ‘min’ and ‘max’ were derived from the literature on transport situation for cities in Asia (if data were found) or around the world (if not).

Sources in the literature: This refers to key sources that have been used to identify and define the indicator.

Data availability methods to provide data, and examples: This section offers qualitative comments about expected data availability and examples on how to possibly collect or provide data for the indicator.

Other comments: This addresses limitation of the proposed indicator and possible alternatives with regard to definition, measurement, delimitation, etc.

INDEX DESIGN

In this section, the design of the index is presented. The section explains the choices made and alternatives considered with regard to three steps, namely normalization, weighting, and calculation.

Normalization

Indicators on different scales need to be normalized before comparison and aggregation are possible. The method applied uses linear rescaling which is a common approach in composite index design (Nardo et al. 2005) and often used for sustainable transport indices (Zito and Salvo 2010; Zheng 2013; Ahangani et al 2015). This allows for a simple transformation to a linear scale 1-100 for each indicator. Formula 1 is used,

\[ Z_{i,c} = \frac{(x_{i,c})-(x_{\text{min},i})}{(x_{\text{max},i})-(x_{\text{min},i})} \times 100 \]  

(Formula 1)

Where,

- \( Z \) is the normalized indicator \( X \) for topic \( i \) and city \( c \).
- \( X_{\text{min}} \) is the lowest value of the indicator in actual units, whereas \( X_{\text{max}} \) is the highest value.

The next question is how to define the goal posts, the min. and max. The min and max were defined as lowest and highest value found or expected for each indicator based on real performance information in the literature. Key sources to identify min and max values are mentioned under each indicator in the background report (ESCAP 2017). Another option would be to use a desired level to the max. In this study, this approach was used in a few cases, including for indicator 5 ‘Traffic fatalities’ and indicator 10 ‘GHG emissions’. In both cases, the desired level is 0 (0 is therefore used as max value = best performance’). Political statements on Sustainable Transport like ‘Bali Declaration’ of 2013 explicitly speaks about zero-goals for accidents, pollution etc. (EST Forum 2013). A third option is to use relative ranking among the pool of observations that is, all cities (the min and max are set after worst and best city each year). This avoids the need to define the scale in advance. However, this method also makes it impossible to measure performance for one city in itself and to
track progress over time for each city compared to other cities. Increase in rank among cities could be the result of other cities performing worse and thus misleading. For the Human Development Index (UNDP 2015) relative ranking was abandoned for this reason and replaced by fixed goal posts.

**Weighting**

In constructing a composite index, it is necessary to decide how to weigh each element. Important elements affecting the desired outcome more than others should have a higher weight. Weights may be determined by statistical analysis or correlations (if data are available), by expert knowledge on the significance of each factor, or by political or subjective choice. ‘Equal-weight’ is obviously also a weighting choice.

In their sustainable transport indicator study, Zito and Salvo (2011) argue that by definition the three dimensions of sustainability should have equal weight in decision making. This is in accordance with a balanced view of sustainability. The same view is adopted by De Gruyter et al. (2017) in their recent study on sustainable transport for Asian cities.

However, as already mentioned, the framework adopted for SUTI does not recommend a rigorous balanced ‘domain’ approach, as several indicators overlap the domains. Instead, a formula is used that gives an equal weight of 0.10 to all of the ten indicators regardless of domain. This is considered the most reasonable approach, reflecting that all indicators can be considered important according to the selection process and the expert consultation, and no basis exists for assigning differentiated weights. The indicators with weights and min and max values (section 5.1) are shown in Table 6.

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicators</th>
<th>Natural units</th>
<th>Weights</th>
<th>Normalization MIN</th>
<th>Normalization MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modest</td>
<td>0 - 16 scale</td>
<td>0.10</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>Modal share of active and public transport in commuting</td>
<td>Per cent of trips/mode share</td>
<td>0.10</td>
<td>10</td>
<td>90</td>
</tr>
<tr>
<td>3</td>
<td>Convenient access to public transport service</td>
<td>Per cent of the population</td>
<td>0.10</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Public transport quality and reliability</td>
<td>Per cent of satisfied with service</td>
<td>0.10</td>
<td>30</td>
<td>95</td>
</tr>
<tr>
<td>5</td>
<td>Traffic fatalities per 100,000 inhabitants</td>
<td>No of fatalities</td>
<td>0.10</td>
<td>35</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Affordability – travel costs as part of income</td>
<td>Per cent of income</td>
<td>0.10</td>
<td>35</td>
<td>3.5</td>
</tr>
<tr>
<td>7</td>
<td>Operational costs of the public transport system</td>
<td>Cost recovery ratio</td>
<td>0.10</td>
<td>22</td>
<td>175</td>
</tr>
<tr>
<td>8</td>
<td>Investment in public transportation systems</td>
<td>Per cent of total investment</td>
<td>0.10</td>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>9</td>
<td>Air quality (PM10)</td>
<td>µg/m3</td>
<td>0.10</td>
<td>150</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>Greenhouse gas emissions from transport</td>
<td>Tons</td>
<td>0.10</td>
<td>2.75</td>
<td>0</td>
</tr>
</tbody>
</table>

1.0

23 A weighting option is retained in the calculation sheet for the SUTI. This allows to test its sensitivity to different potential weighting schemes, and may become relevant in case it should be decided to introduce a weighing option for cities. When data has been collected for multiple cities, statistical analysis may be applied to derive differentiated weights.
**Calculation Method**

There are different possible formulas to use to aggregate results from the indicators. Two basic options are to use either arithmetic mean or geometric mean.

The arithmetic mean is additive. The components are added together and divided by the number of components. However, there has been some critique of the additive index. First of all, this assumes linear substitution between the elements. One unit of negative change e.g. traffic accidents can be compensated by one-unit positive change in accessibility. This is not necessarily acceptable. It is also observed that ranking in the additive index is sensitive to a possible change of goal posts. These critiques informed the UNDP to change the calculation of Human Development Index to the geometric mean method (UNDP 2015).

For SUTI both methods were tested using partly hypothetic yet realistic data. The test showed that the SUTI results (ranking of cities) in some cases could be affected by the choice of aggregation method. Based on the similar argument as for the HDI it was decided to apply the geometric mean for aggregation, using Formula 2.

\[
SUTI = \sqrt[10]{i_1 \times i_2 \times i_3 \ldots \times i_{10}}
\]  
(Formula 2)

A formula for a weighted geometric mean is also developed but not applied.

**EXEMPLIFICATION OF PRACTICAL CALCULATION**

The procedure to calculate results has two levels. Both levels can use the Data Sheet developed as part of the project to calculate and analyse SUTI.

The first level is individual cities collecting data for the ten indicators and entering them in the SUTI Data Sheet for an individual city. There are ten cells to fill in, one for each indicator. When data are entered, normalized values are automatically calculated in a lower table, and a spider diagram is derived. The diagram shows the city’s performance within the min-max scale for all ten indicators without aggregation to one index (table 7). The performance on each indicator scale indicates where the city is compared to min and max values for cities as described in section 4.2. To support the calculation of each indicator the full Data Sheet is also included sub-sheets for each indicator. These offer procedures, tables and formula for deriving the respective SUTI indicator from collected data. The mainsheet for calculating SUTI is available at the website (ESCAP 2017).

The second level is that cities collect data and submit them to a coordinating agency such an ESCAP who enters data into the SUTI sheet for multiple cities. For each city, there are the same ten cells to fill in, one for each indicator. When data are entered, normalized values are automatically calculated in a table and a spider diagram derived. The spider diagram shows all the cities’ performance within the min-max scale for all ten indicators, allowing comparison across cities for each indicator. The sheet also calculates an aggregate SUTI value for each city. This allows for ranking the performance of cities according to the SUTI value if so desired. If actual data are collected for a significant number of cities (say, from 20 to several hundred) it is not practical to include all results in one spider diagram. An option to enhance diagram based comparisons of multiple cities in addition to comparing the aggregate SUTI ranks would be to break down the population into smaller, comparable groups of cities e.g. cities of similar size, cities in a sub region, or cities with similar geographical features.

Two examples were developed to illustrate SUTI. The first example shows the use of the index for a single city to assess its performance. The second example shows SUTI, for comparing and ranking across a range of cities. Both example cities are based on data from actual cities. However, the results are preliminary and not finally verified for comparison etc. Therefore, the cities are anonymized in this paper. Table 7 shows the normalized values for the individual ‘City X’ calculated in the sheet from the actual values entered into the city.
<table>
<thead>
<tr>
<th>No.</th>
<th>Indicators</th>
<th>Natural units</th>
<th>Weight</th>
<th>Range</th>
<th>Actual values</th>
<th>Normalized values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MIN</td>
<td>MAX</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes</td>
<td>0 - 16 scale</td>
<td>0.1</td>
<td>0</td>
<td>16</td>
<td>12.00</td>
</tr>
<tr>
<td>2</td>
<td>Modal share of active and public transport in commuting</td>
<td>Trips</td>
<td>0.1</td>
<td>10</td>
<td>90</td>
<td>27.00</td>
</tr>
<tr>
<td>3</td>
<td>Convenient access to public transport service</td>
<td>Per cent of population</td>
<td>0.1</td>
<td>20</td>
<td>100</td>
<td>50.00</td>
</tr>
<tr>
<td>4</td>
<td>Public transport quality and reliability</td>
<td>Per cent of satisfied</td>
<td>0.1</td>
<td>30</td>
<td>95</td>
<td>52.50</td>
</tr>
<tr>
<td>5</td>
<td>Traffic fatalities per 100,000 inhabitants</td>
<td>No of fatalities</td>
<td>0.1</td>
<td>35</td>
<td>0</td>
<td>2.10</td>
</tr>
<tr>
<td>6</td>
<td>Affordability – travel costs as part of income</td>
<td>Per cent of income</td>
<td>0.1</td>
<td>35</td>
<td>3.5</td>
<td>18.20</td>
</tr>
<tr>
<td>7</td>
<td>Operational costs of the public transport system</td>
<td>Cost recovery ratio</td>
<td>0.1</td>
<td>22</td>
<td>175</td>
<td>55.40</td>
</tr>
<tr>
<td>8</td>
<td>Investment in public transportation systems</td>
<td>Per cent of total investment</td>
<td>0.1</td>
<td>0</td>
<td>50</td>
<td>50.00</td>
</tr>
<tr>
<td>9</td>
<td>Air quality (pm10)</td>
<td>µg/m3</td>
<td>0.1</td>
<td>150</td>
<td>10</td>
<td>75.00</td>
</tr>
<tr>
<td>10</td>
<td>Greenhouse gas emissions from transport</td>
<td>Tons</td>
<td>0.1</td>
<td>2.75</td>
<td>0</td>
<td>0.53</td>
</tr>
</tbody>
</table>
Figure 1 shows the resulting spider diagram for City X. Each ‘corner’ represents one of the ten indicators and the rings show levels of performance from min (at centre) to max (outer rim). The city can immediately observe areas where it performs well compared with the expected range of low to high performance. For example, for indicator 5 (fatalities), and 8 (investments) the city performs particularly well, whereas indicator 3 (modal share), and 7 (operational costs) performance is much less impressive. The information allows the city to begin contemplating strong and weak points as well as potential policy measures to enhance sustainability.

Table 8 illustrates data for a set of four cities for each indicator. Normalized values are calculated automatically in the same way as for the individual city indicator and a diagram is derived.
### Table 8. Data entries (actual and normalized) for four cities

<table>
<thead>
<tr>
<th>#</th>
<th>Indicators</th>
<th>Actual values</th>
<th>Normalized values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Colombo</td>
<td>Kathmandu</td>
</tr>
<tr>
<td>1</td>
<td>Extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes</td>
<td>12.00</td>
<td>7.00</td>
</tr>
<tr>
<td>2</td>
<td>Modal share of active and public transport in commuting</td>
<td>27.00</td>
<td>10.65</td>
</tr>
<tr>
<td>3</td>
<td>Convenient access to public transport service</td>
<td>50.00</td>
<td>60.00</td>
</tr>
<tr>
<td>4</td>
<td>Public transport quality and reliability</td>
<td>52.50</td>
<td>79.97</td>
</tr>
<tr>
<td>5</td>
<td>Traffic fatalities per 100,000 inhabitants</td>
<td>2.10</td>
<td>7.75</td>
</tr>
<tr>
<td>6</td>
<td>Affordability – travel costs as part of income</td>
<td>18.20</td>
<td>5.71</td>
</tr>
<tr>
<td>7</td>
<td>Operational costs of the public transport system</td>
<td>55.40</td>
<td>51.95</td>
</tr>
<tr>
<td>8</td>
<td>Investment in public transportation systems</td>
<td>50.00</td>
<td>1.96</td>
</tr>
<tr>
<td>9</td>
<td>Air quality (pm10)</td>
<td>75.00</td>
<td>56.64</td>
</tr>
<tr>
<td>10</td>
<td>Greenhouse gas emissions from transport</td>
<td>0.53</td>
<td>0.33</td>
</tr>
</tbody>
</table>

The aggregate SUTI results for the four cities using formula 2 is shown in table 9. On the left the immediate scores for the cities; on the right, these are ranked according to performance.

### Table 9. SUTI score for 4 example cities

<table>
<thead>
<tr>
<th>City</th>
<th>SUTI scores</th>
<th>Ranked city</th>
<th>SUTI scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombo</td>
<td>50.01</td>
<td>Colombo</td>
<td>50.01</td>
</tr>
<tr>
<td>Kathmandu</td>
<td>26.77</td>
<td>Greater Jakarta</td>
<td>41.91</td>
</tr>
<tr>
<td>Greater Jakarta</td>
<td>41.91</td>
<td>Hanoi</td>
<td>32.70</td>
</tr>
<tr>
<td>Hanoi</td>
<td>32.70</td>
<td>Kathmandu</td>
<td>26.77</td>
</tr>
</tbody>
</table>

A basic observation is that all cities score middle or lower in the overall 0-100 scale. This is hardly surprising since the examples are developing cities. Moreover, there appears to be quite a spread in performance. This may reflect a spread in development levels as well as differences in regard to historical and geographical conditions, cultural factors, etc. It may also partly be a result of...
different plans and policies adopted in cities to influence transport performance and sustainability. Such variations cannot be discerned at the aggregate level.

Figure 2 illustrates the variation in performance of the selected cities at a more detailed level. The diagram allows comparing results at the disaggregated level per indicator. For example, it can be observed that the four cities have quite similar (and good) performance for indicator 10 (GHG emissions). This is indicative of still relatively low motorization among the developing Asian cities compared to developed cities. For most other indicators, performance is much more diverse with both extremely high and extremely low scores. For example, indicator 4, quality and reliability of public transport where city 2 scores fairly, city 1 somewhat less so, with cities 3 and 4 at the very bottom of the scale. Such variations may partly be a reflection of the real difference in experienced satisfaction among citizens but also partly the result of differences in data sources and methodologies.

Further analysis is required to possibly disentangle such factors. The purpose of SUTI is not to offer detailed explanations but to inspire cities to track and compare performance and to use such results to reflect on both data issues and policy needs and results. The still ongoing piloting phase of SUTI suggests that such fruitful reflections may indeed be inspired, at the individual city level as well as collectively among cities.

Figure 2. Example illustrating performance across all indicators and four cities
CONCLUSIONS AND PERSPECTIVES

This paper has demonstrated the construction of a sustainable urban transport index reflecting urban transport-related SDGs relevant for Asian cities, based on literature review and expert consultations. A suitable framework was derived from basic sustainability dimensions, the SDG targets, and sustainable mobility strategies. The framework was used to identify a wide range of indicators in the literature as potentially relevant to measure for sustainable urban transport planning. After eliminating redundant, less relevant and infeasible indicators a shortlist of 20 remained. Conceptual and methodological criteria to review and select among these indicators were derived from literature and applied to the indicator set.

An Expert Group Meeting discussed the proposed indicators and the SUTI and found a need for further revisions. Two more indicators relating to public transport and the SDG 11.2 target on sustainable urban transport systems were added, and adjustments were made to some of the other indicators. In addition, the strict division of indicators into four domains, each forming a sub-index for the overall SUTI was abandoned. For each indicator, concise definitions were provided along with guidance on ways to collect data and report. The selected indicators were used to build an aggregate SUTI, partly inspired by methods used for deriving the Human Development Index, one of the most long-standing international composite indices. The calculation method is based on normalizing indicators using linear scaling along a range of min and max values for cities as goal posts. Where possible these values were based on data for lowest and highest performance for existing cities as reported in international studies and literature. The indicators were given equal weight in the index since there is no general basis for differentiating among them. However, the SUTI does allows for installing a different weighting scheme, should such a scheme be agreed. The calculation method for the index was described and illustrated.

An Excel Data Sheet was developed, which aim to supports the calculation of individual indicators, and the SUTI as well as and to drive illustrations of performance for an individual city and for several cities. The SUTI calculations and results were exemplifed using tentative data collected for four pilot cities. It has thus been demonstrated that SUTI is feasible in theory and in practice, although further analysis and review is required as to the scope for interpreting results, for improving the SUTI methodology further, and for potentially applying it more widely to cities in Asia. For most of the choices made in Developing SUTI has involved a number of choices that could no doubt be reconsidered. This includes, for example, to adopt a more extensive indicator set around SUTI, or to use more sophisticated index calculation methodologies. The most important issue to consider may, however, be the constraints on the availability of suitable, regularly renewed data in cities across the Asian continent. Without data even the most sophisticated index is useless. The data need not only to be available but also comparable (based on similar methods) and feasible to regularly update. While the SUTI project did not have its focus to uncover the data availability challenges in full depth, it is encouraging to observe that all of the piloting cities were able to deliver data for all of the ten indicators and calculate the SUTI. Moreover, a number of other international initiatives are currently ongoing to define and collect indicators to monitor sustainable transport at the urban level, either as the main focus or as part of wider monitoring efforts. These include efforts by bodies such as UN-HABITAT, the International Association of Public Transport (UITP), the World Business Council for Sustainable Development, the World Council on City Data, The International Telecommunication Union, and the Global Covenant of Mayors. Also, the emerging World Bank-led initiative “Sustainable Mobility 4 all” may offer new avenues for reporting on sustainable transport on a global scale. Such efforts, combined with further development and application of SUTI are likely to help empower Asian cities to address significant challenges and better pursue sustainable urban transport policies in the future. The SUTI would help measure progress in improving urban transport and especially contribute to achievement of SDG target 11.2.
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SUSTAINABLE TRANSPORT AND INTER MODAL MIX

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ABSTRACT

The inclusion of transport sector across 17 goals of SDG, in many cases directly brings out the significant role that transport plays in facilitating development, alleviating poverty, arresting the rise in pollution and congestion. The high growth rate achieved in recent years by developing countries like India is not only to be accelerated but it must be accompanied by the development of all sections of society. This will require expansion of transport. The challenge before policy makers and planners is to augment the supply of transport infrastructure and services and ensure the establishment of a sustainable transport system.

Various modes of transport have its own characteristics and significantly different capital intensities as well as technical and operations capabilities. The crux of transport planning is to assess the transport demand, facilitate allocation of resources to various modes and identify policy measures to meet the requirements at minimum resource/ social costs. The paper makes reference to specific SDGs and supporting targets and reviews the economic, social and environmental aspects of SDGs with reference to transport and brings out as to how the realization of an optimal modal mix leads to achievement of SDGs and facilitate the establishment of a sustainable transport system.

Keywords: Sustainable transport, Intermodal mix, SDGs, Transport policies

INTRODUCTION

Sustainable Transport and Inter Modal Mix

Mahatma Gandhi once mentioned that "The earth provides enough to satisfy every person's need but not every person's greed. When we take more than we need we are simply taking from each other, borrowing from the future, or destroying the environment and other species.". Here he was supporting the cause for what we call today sustainable development.

The need to promote sustainability and sustainable development has been recognized since the early nineteen seventies when the United Nation Conference on the Human Environment debated on rights of the human family to a healthy and productive environment. But it was only in 1983 when the World Commission on Environment and Development set up by the United Nation defined sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Subsequent developments which include the first United Nation Conference on Environment and Development known as Earth Summit, Millennium Development Goals (MDGs), the Rio+20 which adopted resolution "Future We Want" highlighted the need for sustainable development. While the role of transport was recognized at the Earth Summit and in the resolution of the Rio+20, the reference to transport was missing in MDGs. A fifteen-year development framework, the Sustainable Development Goals adopted at United Nation Summit in September included transport as a significant contributor to sustainable development.

The sustainable development and sustainable transport have assumed greater significance as a large number of developing countries have embarked on high growth path. A number of countries have already experienced high growth rate. But the growth rate not only needs to be accelerated but it must be accompanied by the development of all regions, areas and all sections of

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society. Achievement of this objective will require massive expansion and improvement in the various modes of transport.

The challenge before policy makers and planners is not only to augment the supply of transport infrastructure and services but do so in a manner and ensure that the entire transport system becomes sustainable.

The definition of sustainable transport is slippery and difficult to pin down. Victoria Transport Policy Institute (TDM Encyclopedia) lists some definitions of Sustainable Transport. Some of them are reproduced as follows.

European Conference of Ministers of Transport (ECMT) has defined "A sustainable transport system is one that is accessible, safe, environmentally-friendly, and affordable" (OECD, 2005). According to European Union Council of Ministers of Transport (2004), a sustainable transportation system is one that:

- Allows the basic access and development needs of individuals, companies, and society to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between successive generations.
- Is Affordable, operates fairly and efficiently, offers a choice of transport mode, and supports a competitive economy, as well as balanced regional development.
- Limits emissions and waste within the planet’s ability to absorb them use renewable resources at or below their rates of generation and uses non-renewable resources at or below the rates of development of renewable substitutes while minimizing the impact on the use of land and the generation of noise.

The Transportation Association of Canada is the view that a sustainable transportation system should have the following characteristics:

a) In the natural environment:

- Limit emissions and waste (that pollute air, soil, and water) within the urban area’s ability to absorb/recycle/cleanse;
- Provide power to vehicles from renewable or inexhaustible energy sources. This implies solar power over the long run; and
- Recycle natural resources used in vehicles and infrastructure (such as steel, plastic, etc.).

b) In society:

- Provide equity of access for people and their goods, in this generation and in all future generations;
- Enhance human health;
- Help support the highest quality of life compatible with available wealth;
- Facilitate urban development at the human scale;
- Limit noise intrusion below levels accepted by communities; and
- Be safe for people and their property.

c) In the economy:
• Be financially affordable in each generation;
• Be designed and operated to maximize economic efficiency and minimize economic costs;
• Help support a strong, vibrant and diverse economy.

Various other definitions tinker with this at the margin depending on what aspect of sustainable transport one wants to emphasize. But the broad agreement seems to be that the sustainable transport system is the one that is safe, environmentally cleaner, reliable, efficient, affordable, viable and adequate to serve the developmental requirements. Sustainable transport is, therefore, a system that creates economic, social and environmental benefits.

The above discussion on the definition of sustainable transport refers to the role and significance of transport while highlighting the need to contain negative externalities arising out of provision and development of transport sector. At this stage, it may be appropriate to dwell on role and importance of transport particularly in the socio-economic development process and the adverse impact of provision and operation of transport infrastructure and services.

Transport and Development

Transport economists would remind us that the demand for transport is derived from the demand for other goods and services. The production of any good would require transportation of raw material and other inputs and further consumption of the good that is produced would also need transportation. The human resource requirement in the development process and to make optimum use of these resources create demand for various modes of transport. However the derived nature of the demand does not mean that the causal relationship is one way. Causality flows another way too: the creation of transport infrastructure and facilities opens up new vistas and opportunities and strengthen markets for other goods and services.

The availability of adequate and efficient transport system has a favourable impact on promoting economic development in diverse ways. The investment tends to move in those locations that have adequate and efficient infrastructure facilities including transport. The availability of transport infrastructure leads to a reduction in the cost of production through an efficient and reliable delivery of inputs at a lower cost. The efficient transport network increases the size of the market and improves the accessibility to skilled labour. This leads to economies of scale and increase in productivity which results in more investment.

There are a number of examples that illustrate the link between transport and economic development. American railway and canal investments gave rise to entire cities and revitalized life in others. The Interstate highway network that crisscrosses America was an infrastructure idea conceived for other purposes and well before its time had come. These roads network which was developed with astonishing rapidity are now the pulsing arteries that knit together a vast country and effortlessly support the logistics of the world’s largest economy.

Closer home, in India, the Eastern and Western Dedicated Rail Freight Corridors and the piggybacking Delhi-Mumbai Industrial Corridor will give rise to new industrial areas, inland ports, logistics parks, and rewire the economic landscape—from agricultural to industrial—of a catchment area that is expected to extend 100 km on either side of the corridor. The augmentation of capacity of National Highways under the National Highway Development Project has not only facilitated surging intercity travel and freight traffic but also contributed towards overall wellbeing of the rural population. The availability of transport improves the accessibility to health and education facilities. It is very difficult to visualize the success of various programme aimed at rural development and poverty alleviation without the provision of adequate road infrastructure.

Adverse impacts of transport

The development of transport system is vital but at the same time it consumes scarce natural resources such as land and energy and causes severe pollution. The heavy dependence of transport
on non-renewable sources of energy and its adverse impact on the environment may limit the growth of transport. The significance of scarce natural resources such as energy in transport is not only that it is one of the major users of energy but also different modes of transport use energy with varying efficiency and intensity.

The growth of transport not only leads to pressure on the limited availability of non-renewable energy sources but raises broader environmental issues. In fact, the form of energy consumption, operational pollution, land intrusion, and congestion are some of the areas of conflict between transport and environment.

Both the construction of transport infrastructure and the provision of transport services have also an adverse impact on the environment. There are four main modes of transport- Railways, Roadways, Aviation and Shipping-and there are three main natural resources - Land, Air, Water- which are liable to degradation in varying measures by the impact of development and operation of diverse modes of transport. If we add to these three natural resources one more factor called noise, we have in theory four types of pollution fallout of each of four modes of transport. The rail track and the roads use up scarce land and their construction has an adverse effect on the physical or the natural features of the areas, including a reduction in the vegetation cover. The road transport causes air and noise pollution, while the water transport poses the risk of marine pollution of the coastal waters. While there is a need to contain pollution and environmental degradation caused by all modes of transport, what is more urgently required is the need to tackle the environmental degradation including generation of emission by the road transport sector.

Another important adverse impact on transport development is the pain, grief, and loss of life and limbs caused by transport accidents. In the railways, human failure and lack of a proper man and machine interaction has affected safety. In road sector, the number of accidents and its severity has been increasing in developing countries. In the Civil Aviation sector, inadequate provision of infrastructure facilities and other support services compared to increase in air traffic may jeopardize the objective of providing safe air services. Country boats carrying men and material are often involved in accidents caused by overcrowding coupled with the use of unserviceable crafts, inadequate traffic regulation and total absence of safety equipment on board.

In developing countries like India transport safety particularly road safety has become extremely challenging task considering its magnitude and consequent severe negative impact on the economy, public health and general welfare of the people. In 2015 road crashes in India resulted in 0.15 million deaths and 0.5 million injured (MoRTH, 2016). In economic terms, these crashes tantamount to a loss of 3 per cent of GDP (Planning Commission, 2001). About 47 percent of the fatalities occurred among vulnerable users, namely, motor cyclists, cyclists, and pedestrians (MoRTH, 2016). Most of the victims were in the age group 15 -34 years (MoRTH, 2016). This group forms the most productive and potential human capital.

Sustainable Development Goals (SDGs)

The role of transport in the development of a country and its adverse impact points to the need for the provision of transport infrastructure and services while minimizing the adverse impact of transport development. Some of the SDGs with supporting targets seem to aim at achieving this very desirable objective.

As pointed out earlier the transport sector would play a key role in the achievement of SDGs and its targets. The inclusion of transport across the SDGs, in many cases explicitly through supporting targets, highlights its significance as a key sector that also acts as a facilitator for achieving goals pertaining to other sectors. In many cases, the substantial benefits of measures taken in transport accrue to other sectors. For example, the major gains from investing in transport infrastructure and will get displayed more vividly in economic outcomes such as poverty alleviation.

Transport Goals and Targets

The Sustainable Development Goal structure has 17 goals supported by 169 targets. There are eight targets relating to 6 goals are directly pertains to the transport sector. These are as follows:
Direct Transport Targets of the SDGs

SDG 2  End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Target 2.a  Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries.

SDG 3  Ensure healthy lives and promote well-being for all at all ages.

Target 3.6  By 2020, halve the number of global deaths and injuries from road traffic accidents.

SDG 7  Ensure access to affordable, reliable, sustainable and modern energy for all

Target 7.3  By 2030, double the global rate of improvement in energy efficiency.

SDG 9  Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Target 9.1  Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Target 9.4  By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities.

Target 9.a  Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support to African countries, least developed countries, landlocked developing countries and small island developing States.

SDG 11  Make cities and human settlements inclusive, safe, resilient and sustainable.

Target 11.2  By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

SDG 12  Ensure sustainable consumption and production patterns.

Target 12.11  Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities.

Transport is an important facilitator and it plays a crucial role in the achievement of targets for other sectors. As a matter of fact, the actions taken in transport would determine the extent of success in many of targets of SDGs. The targets of SDGs where adequacy and efficiency of transport would be critical are listed below:

Indirect contribution of Transport towards achievement of SDGs Targets of other Sectors

SDG 1  End poverty in all its forms everywhere.

Target 1.1  By 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day.

Target 1.2  By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.

SDG 2  End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
Target 2.3  By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment.

SDG 3  Ensure healthy lives and promote well-being for all at all ages
Target 3.9  By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

SDG 6  Ensure availability and sustainable management of water and sanitation for all
Target 6.1  By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

SDG 11  Make cities and human settlements inclusive, safe, resilient and sustainable.
Target 11.6  By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

SDG 12  Ensure sustainable consumption and production patterns.
Target 12.3  By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses.

SDG 13  Take urgent action to combat climate change and its impacts.
Target 13.1  Strengthen resilience and adaptive capacity to climate related hazards and natural disasters in all countries.
Target 13.2  Integrate climate change measures into national policies, strategies, and planning.

SDG 16  Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
Target 16.2  End abuse, exploitation, trafficking and all forms of violence against and torture of children.

Link between Sustainable Development Goals and Transport

Having to identify the direct transport targets of SDGs and those of other sectors where facilitating the role of transport in their achievement is critical. It may be in order now to discuss the inter linkage between transport on the one hand and SDGs and supporting targets on the other. SDGs have economic, social and environmental dimensions. In what follows we would attempt to highlight the significance of link of transport with these three dimensions and the crucial role of transport in achieving some of the SDGs and the significance. We may hasten to add that here no attempt is made nor is it possible to classify various SDGs under these three dimensions as one SDGs has more than one dimension. For example, eradication of poverty is the outcome of economic development and is also part of social development sector.

Economic Dimension

One of the important Sustainable Development Goals relates to end poverty in all forms (SDG 1). The main objective of development is to achieve higher growth rate. This objective is pursued by the planners and policy makers. It follows that the development policies may be guided by this objective. However, the question arises as to whether economic growth is a potent instrument for reducing and eliminating poverty. In other words, to what extent the growth process is pro poor and inclusive.

While economic growth and acceleration of growth rate are important for reducing poverty, it is recognized that the benefits of economic development may not trickle down to the poor. Therefore, it may be necessary to introduce targeted poverty alleviation programmes.
Earlier, we have elaborated that adequate and efficient transport infrastructure and services are required to facilitate economic development. It is the availability, adequacy and efficient transport infrastructure and services that to large extent determine the disparity in economic growth across the regions and sub regions. There are some studies that indicate that physical access may lead to pro poor growth and investments in transport contribute towards poverty reduction. While Ali and Pernia (2003) point out that the infrastructure development has a positive impact on poverty reduction in rural areas; Fan, Hazel and Thorat (1999) and Fan, Zhang and Zhang (2002) brings out the contribution of roads in bringing down rural poverty. A study carried out by The Asian Institute of Transport Development (AITD) clearly indicates a strong inverse relationship between connectivity and poverty on the basis of data on State-Specific Poverty Ratio for 2004-05 and State-wise connectivity for 2005 (AITD, 2011).

Figure 1. Statewide Connectivity and Poverty in India, 2005

![Figure 50: Statewise Connectivity and Poverty 2005](image)

Source: AITD, 2011, Socio-economic Impact of National Highway on Rural Population

It is clear from the above figure that generally the States with a low level of connectivity have higher poverty ratio.

AITD (2011) confirms that the development of highways promote economic and human development and has a favourable impact on alleviating poverty. The study also brought out the role in the success of targeted poverty alleviation programmes of other sectors.
It is clear from above discussion that transport apart from supporting economic development (Goal 9) also facilitate achievement of other SDGs including Goal 1.

**Social Dimension**

While discussing economic dimension of SDGs and transport in the preceding sub section we mention the significance of transport in reducing poverty, improvement in access to education and health facilities leading to increasing in school enrolment and better literacy levels as also in almost all aspects of household well-being and greater opportunities for employment. These elements are parts of social sector as well.

One of the important negative externalities relates to loss of life and limbs and consequent economic deprivation and mental trauma caused by transport accidents. The situation is particularly alarming in case of road accidents. It becomes grimmer when one considers that it is the poor and disadvantaged section of the society which suffers the most in developing countries. As pointed out by the National Transport Development Policy Committee (NDTPC 2014)

"Since each accident is a result of a combination of human, technology and environmental factors, one cannot understand the risk factors associated with an event unless sophisticated systems approach is followed. This understanding was behind the Zero Vision of the Road Safety Bill adopted by the Swedish Parliament in October 1997. The vision states that “the entire transport system must be designed to accommodate the individual who has the worst protection and the lowest tolerance of violence”.

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**Box 1. Main Findings of Study on Socio-Economic Impact of Highways**

Proximity to the highway has significant influence on major aspects of socio-economic well-being of the rural population. Greater opportunities of employment and earnings in non-farm activities are generated. Access to education and health facilities improves. Household incomes rise and so do asset holdings. Poor rural households living in its vicinity thus also derive considerable benefits.

The immediate net benefits of the upgraded highway mostly relate to improvement in access to work and educational opportunities. This is borne out by: three-fold increase in the share of income from non-agricultural activities; 85 percent increase in female labour participation; two-fold increase in per capita trip rate for education; and about 50 percent increase in school enrolment.

The temporal shifts in the level of well-being, as revealed by the pre and post project surveys, indicate strong and mostly inclusive growth impulses in the economy. The post-project analysis has shown improvement in almost all aspects of household well-being including poverty reduction. The benefits are, however, not uniformly spread either spatially or across economic classes. The differences have remained but have substantially narrowed.

There has been a distinct structural shift in the rural economy in terms of an increase in non-farm activities, higher workforce participation, an increase in school enrolment and better literacy levels. There is a noticeable increase in female participation in the workforce as also the school enrolment of girls. These beneficial changes help in the empowerment of women, a development of considerable importance for the country.

Contrary to the traditional view that a national highway mainly facilitates intercity travel and transport of goods, the results firmly bring out that it is also an integral part of the road network serving the rural areas. This is borne out by the fact that almost 50 percent of the total trips originating from the selected villages involve the use of the national highway.

Source: Asian Institute of Transport Development (AITD), 2011, Socio-economic Impact of National Highway on Rural Population, AITD, New Delhi
It is only through a comprehensive strategy covering all aspects which include Road Safety Management, Safer Roads and Mobility, Safer Vehicles, Safer Road Users and Post-Crash Response and using a proven and effective method right from the beginning that an inclusive sustainable road transport system can be created and the targets relating to road safety included in SDG may be achieved.

**Environmental Dimension**

Ever increasing carbon emissions are considered to be the main source of global warming and transport has been identified as one of the main culprits. According to international energy agency (IEA) in 2013 world total consumption of oil was 3694 million tonne equivalent (Mtoe) registering an increase of 65.6 per cent in the period between 1973-2013. During this period share of the transport sector in total consumption increased from 45.8 per cent to 64.3 per cent. (Figure 2)

**Figure 2. Total Final Oil consumption from 1973 to 2013 by Sector (Mtoe)**

![Graph showing total final oil consumption from 1973 to 2013 by sector](image)

Source: International Energy Agency,
Other: Includes agriculture, commercial and public services, residential and non-specified other

Thus in 2013 transport consumed two third of global oil consumption.

**Carbon Emission**

Transport is one of the major contributors to carbon emissions. The sector accounts for almost one fourth of world’s total CO\textsubscript{2} emission. Road transport is not only heavy on fuel but also emits higher emission compared to marine and rail transport per unit of throughput. Out of total global CO\textsubscript{2} emission, 18 per cent is accounted by road transport sector alone.
According to IEA, the CO\textsubscript{2} emissions from road transport system has been increasing at a rapid rate which experienced 68 percent growth during 1990-2013 and accounted for three-quarter emission in 2013 (Figure 3).

It is clear from the above discussion that greening of transportation would require less use of road transport and encouragement of movement of passenger and freight by other modes of transport that are light on energy and emit minimum carbon emissions. It would also be necessary to take policy measures which ensure the safety of pedestrians and bicyclist so that more and more people prefer this mode of transport. The most important measures for greening passenger transport is to make provision for affordable adequate, comfortable and easily accessible public transport.

Greening of transport should not end with addressing the issues relating to pollution caused by carbon emissions. The transport community including policy makers must consider factors like the comparative efficiency of use of land by various modes of transport, issues relating to safety and noise pollution, health effects, etc. while determining the intermodal mix for establishing integrated intermodal transport and logistics system in the country. It is only then the process of the greening of transport would be comprehensive and complete. The environment-friendly transport system would be sustainable and contribute towards achievement of SDGs.

**Inter Modal Mix**

We have discussed the transport linkage with development and transport as a key contributor to sustainable development. While deliberating on the economic, social and environmental dimension of SDGs, it is clear that there is a need to formulate transport policies, plans, and programmes and implement them with a view to maximise economic, social and environmental benefits. Determination and realisation of optimal inter modal mix may be one instrument through which this objective may be achieved.

Various modes of transport differ significantly from one another in terms of capital intensity as well as technical and operations capabilities. While railways and water transport are high capacity modes and suitable for movement of heavy and bulky loads over long hauls at low cost, road transport is mainly linked to high value and low volume commodities where rapid movements of freight in small batches are the norm. It is the more flexible mode of transport that can reach remote
and difficult areas. On the other railway is a more environment-friendly safer mode of transport. The main advantage of air transport lies in speed, but it is heavy on fuel and causes pollution.

In view of above, it is necessary that the modal choices should be made more prudently. The central issue is the determination of optimal inter-modal mix. This requires the adoption of an integrated approach to a devising strategy for the development transport infrastructure and service delivery. This integrated approach to transport planning advocates considerations that go beyond ensuring the availability of a variety of transport modes and beyond accommodating easy intermodal transfers of passengers and freight, though these are important in their own right.

Instead, the integrated philosophy is about more than the simpler choices over intermodal transport. Choices within each transport mode—intra-modal or trans-modal choices—are also brought to the forefront of the planning exercise. While making such choices, a number of factors need to be considered. These include (a) quantum of traffic (b) length of haul (c) nature of commodity (d) characteristic of modes and (e) technology developments. The primary objective of such an approach with regard to the development of transport is that the resource cost of providing transport infrastructure and services is minimum. The resource cost of a particular mode of transport or a transport service would include (a) cost to the operator (b) cost to the user and (c) cost to the society which includes cost involved in externalities such as accident, pollution, and congestion.

AITD (2002) highlighted the significance of resource cost which they termed as a social cost. According to the study "social cost is a valuable tool in developing efficient and sustainable transport system and in facilitating an optimal mix of different modes of transport." The study also compared the social cost of two main modes of transport in India i.e. rail and road taking in to account the fact that there is a large variation in external costs of various modes of transport (see box 2).

**Box 2. Social Cost Ranges in Passenger and Freight Transport (Base Year 2000)**

![Social Cost Graph]

*The option of 'bus only' is considered for road passenger transport.

Source: AITD (2002)

*In terms of social costs, railways have a huge cost advantage over road transport. The advantage is greater in freight traffic than in passenger traffic. * Policy changes can induce shift of modal choice in favour of rail and in favour of public road transport over personalized transport.
The broad areas that are studied for integrated approach include:

- Generation and analysis of inter-regional and intra-regional origin-destination, mode-wise traffic flows, both freight and passenger traffic.

- Determination and analysis of modal transport costs in terms of both resource cost and financial cost for each mode of transport, incorporating existing as well as future transport technological advancement.

- Compilation of a ‘comparative analysis' of the past growth in freight and passenger traffic for each mode of transport.

- Assessment of the total transport demand and share of each mode of transport as it exists today and likely to be for the horizon years.

- Determination of the desirable share of a mode of transport on the basis of resource cost consideration.

A study commissioned by Planning Commission (now NITI Aayog), Government of India carried out analysis for optimal modal mix through optimization on traffic flows. The result has been encouraging which indicated that while the overall throughput increased by around 3 per cent the cost to the economy decreased by more than 16 per cent. (RITES, 2010). The optimization of traffic was carried out for two modes of transport viz. rail and road. It may be mentioned that if coastal shipping and inland water transport is included in the picture, the savings in the cost of transportation to the economy would be substantial. These savings occur not only in terms of user cost but also in terms of accident and environmental cost.

**CONCLUSION**

It is axiomatic that the economic development requires adequate, effective, efficient and balanced transport infrastructure and services. But transportation is not entirely harmless activity. It consumes scarce natural resources, emits injurious pollutants, generates undesirable wastes and causes loss of life and limbs. In the process, it endangers the sustainability. While recognizing the significance of transport in development process SDGs framework highlights the need for reducing its adverse consequences. Transport is to play a critical role not only in realizing the SDGs' targets directly related to the sector but also act as a facilitator in achieving the targets of other sectors to promote sustainability.

Different modes of transport cause varying levels of stress and consequent damage. Hence, there is growing recognition that the transport systems and modal choices should take into account cost of environmental degradation and social damage in the interest of promoting sustainable development and establishment of a sustainable transport system. This can be achieved by following an integrated approach to transport development. This will facilitate in realizing optimal inter modal mix that will establish transport system— a system in which each mode of transport play its role for which it is best suited on the basis of total cost (including social costs) advantage.
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A SUSTAINABLE URBAN TRANSPORT INITIATIVE IN DHAKA:
INTRODUCING BUS RAPID TRANSIT SYSTEM

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ABSTRACT

Rapid urbanization in Bangladesh has far outstripped the capacity of the urban transport infrastructure, leading to low level of efficiency and overall quality of the transport system. The transport condition of Dhaka city is characterized by chronic traffic congestion, lack of comfort, safety, and poor air quality. Due to increasing pressure on low capacity conventional public transport, it has become necessary to seek for a more efficient means of moving passengers, reduce travel time as well as lower air-pollution from motor vehicles. Greater Dhaka Sustainable Urban Transport Project (BRT Gazipur-Airport) is the first initiative by the Government to introduce rapid road based mass transport system in Dhaka. The Bus Rapid Transit System (BRT system) will present sustainable public transport system by replacing existing fuel-inefficient fleet with larger capacity modern BRT buses and improving average vehicular travel speed in the corridor. BRT system will address several Sustainable Development Goals (SDG), i.e. Goal 11 by improved urban public transport and reduce air pollution, Goal 13 by mitigating impacts of climate change in Dhaka and Goal 3 by improving road safety.

Keywords: Public transport, Bus Rapid Transit (BRT), Sustainable Development Goal (SDG)

INTRODUCTION

Dhaka, one of the most densely populated cities in the world, has a population of almost 17 million, which is expected to rise to 35 million by 2035 (World Bank). The city currently suffers from various impacts caused by lack of affordable, inclusive, efficient and safe transport mode for mobilization of its people. Insufficient malfunctioning old small buses and some informal paratransit against the demand of such an enormous population causes several externalities; congestion, accidents, air pollution, and climate change. Due to increasing pressure on public transport, it has become necessary to opt for a more efficient means of transport mode for moving passengers. In this regard, to ease the congestion and provide a safe, affordable, comfortable, and environmentally friendly solution, Bus Rapid Transit (BRT) has been introduced to Dhaka.

Greater Dhaka Sustainable Urban Transport Project (BRT Gazipur-Airport) is the first initiative by the Government of Bangladesh to introduce Country’s first road based mass transport system along Gazipur-Joydevpur-Airport road and named as “Dhaka BRT”. This technical paper focuses on how Dhaka BRT, through its operation, will contribute towards making Dhaka a liveable and safe city and showed how Dhaka BRT will assist in achieving some Sustainable Development Goals (SDG) goals.

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MAJOR COMPONENTS OF DHAKA BRT

To ensure a sustainable future and in line with the Strategic Transport Plan, STP (2016-2035) for Dhaka (figure 2), Dhaka BRT aims to provide efficient, sustainable, environmental friendly, affordable and safe urban mass transport system along one of the busiest corridors of Dhaka city. This corridor is the main get-way to Dhaka from the northern districts of Bangladesh. Proposed BRT corridor passes through many industries, universities, public and private offices including the Bangladesh Rice Research Institution, engage a large number of people and economic activity. Medium and small buses are the main mode of travel for the commuters along this corridor. Some paratransit's (auto rickshaw, human-powered rickshaw, CNG etc.) are also used for some short trips.

The length of the Dhaka BRT corridor (BRT line 3, north Part) is 20.5 kilometres with 4.5 kilometres of elevated BRT at the narrowest section of the corridor. At the elevated section, there will be space both for BRT bus and mixed traffic. The project cost is USD 255 million, financed jointly by the Government of Bangladesh, Asian Development Bank (ADB), France Development Agency (AFD) and Global Environmental Facility (GEF). The BRT corridor will have one BRT lane in each direction between Hazrat Shajajal International Airport to Gazipur. Based on available land, the BRT corridor is divided into 4(four) sections. From Uttara to Housebuilding (Type 1), Housebuilding to Cheragali (Type 2), Charagali to Joydebpur Chowrasta (type 3) and Joydebpur Chowrasta to Gazipur (type 4).

All sections have the following components:
- BRT lane (lane width 3.5m, at stations 3.0m)
- Mixed traffic lane (lane width 3.5m, at stations 3.0m)
- Non-motorized traffic (NMT) lane (2.5 – 4.5 m)
- Footpath (1.5-3.0m)
Due to this road widening, the dedicated BRT Bus lanes will not obstruct other traffic on this corridor. All access roads along BRT corridor will be upgraded to ease the accessibility to the BRT stations.

BRT Stations, Terminals and Depot

Dhaka BRT will have 25 stations along the corridor including Airport and Gazipur Terminal. The average distance between stations is 750 meters. Passengers will have access to the stations through Foot-Over-Bridges (FOB) with easy accessibility for all passengers with the provision of automated escalators and lift especially for the female, physically challenged and elderly passengers.
Station height will be same as the bus floor, that is 900 mm, to reduce boarding and alighting time of passengers and increase convenience, comfort, and safety.

All station will be equipped with e-ticketing system for the absolute convenience of the passengers. Passengers will have to make a prior purchase at the ticket counters to board the buses. Stations will be equipped with high-security systems by CCTV, information screens, and voice information systems. Entrance and exit to all Stations will be controlled with electronic gates. There will be adequate queuing space to wait for the buses and some seating arrangement for special need passengers. At the terminals, separate spaces for parking and drop-off points for cars, auto-rickshaws, and rickshaws will be developed. A depot for 100 articulated BRT buses will be located at Gazipur. The bus depot will be equipped with parking and maintenance facilities for the buses and provision for refuelling and restrooms for drivers. Detail feasibility study in processes for Transit Oriented Development (TOD) which will create a new opportunity for residential and commercial development around major BRT stations.

BRT terminals will act as the integration point with other modes. There will be a multimodal hub near airport BRT terminal where interchange facilities will be established among Rail, BRT, MRT, Air and intercity bus passengers. BRT buses will extend its service to link with MRT depot as Uttara.

**Figure 5. Proposed Multimodal Hub at Airport**

Articulated buses of approximately 18 metres in length, with right-hand drive and doors on the right side, were selected for operation of the BRT Line 3 corridor. Buses with emission standard of at least EURO III are selected. Bus capacity will be 140-160 passenger including seating and standing. Hi-capacity buses will include special seats for women, elderly and handicapped people. LED panels will announce the approaching next stations, time and the weather outside. On board systems will be installed for possible communication between the bus and the control centre, where vehicle position will be monitored using GPS. Low sulphur diesel and Compressed Natural gas (CNG) will be used as fuel of BRT buses. In future Hybrid and Electric bus will be introduced.

**BRT Coach and Fuel**

A platoon of 3 articulated buses will run with a headway of 2 minutes (peak hour) and 5 minutes (off-peak hour) from 7 am to 11 pm. While open to the passengers, the system will carry approximately 250,000 passengers each day and has been designed to carry a maximum of 400,000 passengers per day. The government established a 100 Per cent government own company named “Dhaka Bus Rapid Transit company limited (Dhaka BRT)” to operate and maintain the BRT system. There will be regular BRT service (all stops) and express BRT service (limited stops). For express
services, there will be provision for bypass lanes at stations. Dhaka BRT will engage BRT bus operator from the existing bus operator initially through a negotiated contract, so that existing operator will get adequate compensation through a fleet scraping program and can continue their business as BRT bus operator.

SUSTAINABLE DEVELOPMENT GOALS AND DHAKA BRT

The Sustainable Development Goals (SDGs) also known as transforming our world: the 2030 Agenda for Sustainable Development was adopted at the UN Sustainable Development Summit 2015 in New York, USA. It is a set of 17 "Global Goals" with 169 targets. It has been prepared in essence of the achieving the follow-up goals of Millennium Development Goals (MDG). SDGs related to Dhaka BRT that this paper intends to address are Goal 11, 13 and 3. Target 11.2 of Goal 11 focuses on providing access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons. Target 11.6 of Goal 11 aims to reduce the adverse per capita environmental impact of cities, including by paying by 2030. Target 13.3 of Goal 13 emphasis on mitigation measures of climate change. Target 3.6 Goal 3 targeted to halve the number of global deaths by 2020.

Sustainable and Inclusive Public Transport with Dhaka BRT

Bus Rapid Transit (BRT) has been adopted as an initiative towards improvement on regular bus services through a combination of features like the construction of a comprehensive corridor that includes exclusive BRT lanes, mixed traffic lanes, non-motorized traffic lanes. High-capacity buses will replace defective and polluting buses with adequate safety measures.

Figure 6. Change in modal share along the BRT Corridor

Elevated BRT sections will enhance the overall capacity of the corridor and improve traffic flow. BRT Bus with an average speed of 25Km/h, journey time from Gazipur to Airport will be 45 minutes while currently it takes 2.5 -3 hours. Primary Business Model indicates that Dhaka BRT will be profitable with current fare structure due to higher ridership (max. 400,000 passengers per day). Thus, the city dwellers will have better options with safer, comfortable journey with affordable cost.  

Dhaka BRT will be accessible to all groups of the society. The level boarding, alighting, escalator, and elevator at stations will make easy access for women, elderly and disable people. Adequate lights at stations and on streets will be provided to ensure safety for women. Thus, the
Dhaka BRT will make a significant improvement in the public transportation system in Dhaka. After the opening of Ahmedabad BRT in India modal share to public transport (BRT) increase rapidly. According to a survey conducted by centre of excellence in urban transport of CEPT University, India in 2014 17.5 per cent of auto (shared) / 12 per cent of two wheelers / 6 per cent of cycle/ 2.5 per cent of car/ 5.5 per cent auto-rickshaw passenger shifted to BRT due to more comfort, affordable, safe and time saving mode. Dhaka BRT is expecting similar modal shift as well as shaping the transport culture in Dhaka thus addressing Goal 11.

**Better Environment and Dhaka BRT**

Bus rapid transit systems can have positive impacts on environment by reducing air pollution, smog and greenhouse gases that contribute to global warming. Reductions in vehicle emissions can be achieved by through Dhaka BRT in two ways:

**Table 1. Ambient air quality test results for five locations along the project corridor**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Location</th>
<th>Bangladesh Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Airport</td>
<td>Tongi Station Road</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>µg/m³</td>
<td>315.7</td>
<td>137.9</td>
</tr>
<tr>
<td>PM₂.₅</td>
<td>µg/m³</td>
<td>94.3</td>
<td>79.2</td>
</tr>
<tr>
<td>SO₂</td>
<td>µg/m³</td>
<td>106.53</td>
<td>50.44</td>
</tr>
<tr>
<td>NOₓ</td>
<td>µg/m³</td>
<td>390.75</td>
<td>198.47</td>
</tr>
<tr>
<td>CO</td>
<td>mg/m³</td>
<td>9.86</td>
<td>9.69</td>
</tr>
</tbody>
</table>

Source: Environmental baseline monitoring report 2017

**Direct reduction of Air pollutants and GHG**

a. Dhaka BRT operation will reduce fuel consumption by replacing older transit buses (5-10 years old and 30-40 passenger capacity) with modern articulated (140-160 passenger)

b. Black carbon and other harmful pollutants will be reduced due to use of ultra-low sulphur diesel and CNG.

c. Dust from the existing road will be reduced due to the better asphalt surface of the new roads.

d. Dhaka BRT buses will run with an average speed of 25 km/hour due to the dedicated lane and uninterrupted flow at all intersection (flyovers will be built at all intersections). As a result, overall vehicle kilometres travelled (VKT) will be reduced thus reducing overall emission.

**Indirect reduction of Air pollutants and GHG**

a. Due to better service, a significant number of passengers will shift from private vehicle to BRT buses. On a per-passenger kilometre basis, emissions from single-occupancy vehicles are on average four times higher than the per-passenger kilometre emissions of public transport; these figures are even higher during peak periods.

b. Transit-oriented Development (TOD) along BRT corridor will make BRT corridor more compact nature thus reduce the number and length of daily trips.

c. With improved walking and cycling facility, shorter motorized trips can be avoided.

d. All BRT station will have solar Panel which will reduce the demand of electricity.
The impact of exposure to harmful air pollution is a function of both the concentration of the pollutant in the environment as well as the duration of the exposure. BRT systems can, therefore, help reduce personal exposure to air pollution of passengers who switch to BRT from other modes in two ways:

- Lowering the concentration of ambient air pollution citywide or inside the BRT vehicles;
- Reducing the amount of time BRT passengers are exposed to air pollution at stations or inside the bus by reducing travel times.

After 5 years of operation of Ahmedabad BRT, results showed that there is a reduction of 122-177 per cent of P.M 2.5 along BRT corridor (UNESCAP, 2014). As per Initial Environmental Examination (IEE) report of Dhaka BRT, toxic residues from vehicle emissions near the GDSUTP road should be less likely under the improved conditions when the BRT is implemented, and are unlikely to accumulate or create worse impacts than at present under local conditions. Therefore, the project is believed to be sustainable in terms of particulate emissions. As per Environmental Impact Assessment (EIA) report of the project, it is estimated that about 42 tons/day of GHG emission can be avoided due to this project. Thus, the new BRT system will assist in achieving Goal 11 and Goal 13 of the SDG.

Urban Road Safety improvement and Dhaka BRT

There has been an alarming rise in the number of road accidents in Bangladesh over the past few years, especially on highways. The BRT route which is a part of the national highway N3 (Dhaka-Joydebpur-Mymensingh Road) has been well known for being a death trap recently, especially for pedestrians. In 2012 there were 19 major accidents and most casualties were with pedestrians (Accident research center, ARI 2013). Many Garment factories, universities, college, and schools which engages a large number of pedestrian movement (table 2) every day along BRT corridor. Especially during the opening and closing time, sudden pedestrian crossing causes accidents along this corridor. Therefore, to ensure adequate safety, Dhaka BRT aims to provide the following safety elements.

Modern Articulated Bus

It is revealed from field visit that old buses and inexperienced driver with higher speeds, invariably leads to increased incidents. The Operational Plan of Dhaka BRT suggests using 18.0m long High Platform vehicles with preferable 3 doors of 1.0-1.2m wide. The buses aim to carry large number of passengers, thus, reducing the number of vehicles on the road. Thus, an overall reduction in Vehicle Kilometer Travel (VKT) results in fewer drivers on the road and a safer transport environment for drivers, pedestrians, and cyclists.

Figure 7. Proposed BRT station and BRT Bus
### Table 2. Pedestrian Volume at major Intersection along BRT corridor

<table>
<thead>
<tr>
<th>Location</th>
<th>AM Volume Peak Period (3 hours)</th>
<th>AM Max Volume on Peak Period (15 minutes)</th>
<th>PM Volume Peak Period (3 hours)</th>
<th>PM Max Volume on Peak Period (15 minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joydebpur Chowrasta</td>
<td>68,170</td>
<td>2,040</td>
<td>60,337</td>
<td>1,190</td>
</tr>
<tr>
<td>Bhogra Intersection</td>
<td>32,623</td>
<td>2,165</td>
<td>32,312</td>
<td>1,187</td>
</tr>
<tr>
<td>House Building Intersection</td>
<td>30,139</td>
<td>726</td>
<td>46,041</td>
<td>84</td>
</tr>
<tr>
<td>(Azampur) Intersection</td>
<td>45,193</td>
<td>1,560</td>
<td>48,700</td>
<td>1,643</td>
</tr>
<tr>
<td>Airport</td>
<td>28,413</td>
<td>677</td>
<td>38,269</td>
<td>1,086</td>
</tr>
</tbody>
</table>

### Segregation of traffic

The implementation of a BRT system generally results in improved vehicle and pedestrian safety by reducing conflicts between the various modes. Dedicated bus lanes reduce interaction between buses and other vehicles, minimizing the risk for traffic crashes.
A closed system

Closed station design will improve safety by ensuring that access can only be made at designated points allowing pedestrian access to be better controlled. This is particularly relevant in Dhaka, where pedestrian behaviour and discipline is means that people cross outside of controlled or designated crossing areas.

Access to station

Passengers will be made to access the stations from footpaths on both sides of the road through Foot-Over-Bridges (FOB). This will integrate the BRT system, particularly at stations, with pedestrian and non-motorized vehicles in a safe and efficient manner, minimizing conflicts between fast-moving and slow vehicles and pedestrians by separating these movements while maximizing efficiency in how people transfer between modes and access the BRT system.

Construction of Elevated BRT

To ensure uninterrupted flow and restrict collisions, 8.5 kilometres of elevated BRT will be provided at busy intersections and areas where the existing road is narrow, to segregate BRT buses and high-speed vehicles. This will also minimize the collision between the Non-motorized vehicle with others vehicles.

Overall, the condition of the road facilities will be enhanced and driving conditions should improve. Routine safety measures, signage, and road markings will assist to reduce driving risk further in accident-prone areas and provide enhancements to driving conditions on the BRT corridor. Thus it is projected that the target 3.6 of SDG on the proposed BRT corridor can be achieved easily. As this corridor is well known as pedestrian accident prone, it is expected that with the measures taken by Dhaka BRT project, there will be a decrease of 50 per cent of injuries of the pedestrian. Thus, the new BRT system will address the Target 3.6 of Goal 3 of the SDG. A direct evidence of improvement of road safety can be found from the case of TransMilenio BRT in Bogota, Colombia.

Figure 9. A high quality public system of TransMilenio in Bogota, Colombia improves safety

![Graph showing fatalities over time](source)

Potential road fatalities averted on account of the

Source: Road Safety and Bus Rapid Transit- Workshop on Quantifying the Environmental, Social and Economic Benefits from Bus Rapid Transit Systems, EMBARQ India
Potential reasons behind expected success of Dhaka BRT

Despite many challenges to implementing BRT in an overcrowded city like Dhaka. It is expected that Dhaka BRT will be a successful mass-transit initiative. During Planning and design phase, several case studies were examined thoroughly both failure and success of BRTs worldwide. Two specific systems: Delhi and Bangkok BRT were studied due to their unsuccessful history. Complex operational plan (direct service), inadequate branding and marketing effort & introduced in a small corridor where the numbers of cars are very high, thus did not get much support of the daily commuters. Corridor selected for Bangkok BRT has very less demand and does not get political goodwill to push the project to success. Considering the failure of BRT systems discussed earlier, Dhaka BRT has the following potential reasons for being a successful BRT system.

- The first phase of Dhaka BRT is being implemented from Gazipur to Hazrat Shah Jalal International Airport, which is located on the outskirts of Dhaka demarcating the entrance of the city. The location of the corridor has high passenger demands.
- According to the Operational Plan, Dhaka BRT will provide Trunk and Feeder Services. An express service, running the entire length of the corridor will benefit the BRT operation, reducing the stops of some buses to a few strategic stations. Passing lanes in both directions and at all stations is recommended at all BRT stations.
- Communication with the stakeholders is an ongoing process for the system since its planning stage. Workshops have been organized to introduce the system and disseminate the information of potential problems during implementation. The system has also been introduced in the print and electronic media.

CONCLUSION

A BRT system is expected to improve quality of life in a city like Dhaka, by saving travel time, reduce air pollutant and greenhouse gas (GHG) emissions. BRT systems have gained worldwide popularity as an option for public transport system due to its capacity to deliver low cost, quickly-implemented, flexible and high-quality solutions to developing cities' transport needs. The introduction of the BRT and widening of the usable width of the existing corridor (Gazipur –airport) will improve traveling conditions along the BRT corridor. The proposed BRT system will help to achieve few Sustainable Development Goals for Bangladesh. Goal 11 (Target 11.2) will be achieved by providing a dedicated corridor containing BRT lanes, mixed traffic lanes, and non-motorized traffic lanes. The use of modern high capacity articulated buses will reduce the emission of GHG in the corridor, which will ensure the achievement of Goal 11 (Target 11.6) and Goal 13. Goal 3 (Target 3.6) will be achieved by introducing routine safety measures, signage, foot over bridge for pedestrian and road markings to reduce safety risk in accident-prone areas and provide enhancements to driving conditions near the BRT corridor. The implementation of the proposed improvements will bring a wide range of social, political and economic benefits including a forward-looking image of Dhaka city.

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