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National Sustainable Transport Strategy (NSTS) for Nepal (2015~2040)

(Background Paper for Plenary Session 2 of the Programme)

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National Sustainable Transport Strategy (NSTS) for Nepal (2015~2040)

September 2015

Government of Nepal
Ministry of Physical Infrastructure and Transport (MoPIT)
with technical support from
United Nations Center for Regional Development (UNCRD)
Nagoya, Japan

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Executive Summary

EXECUTIVE SUMMARY

With an aim to create a new paradigm in transport practices and to build a common understanding across Asia on the need for the sustainable transport integrated into overall policy, planning and development, the Asian Environmentally Sustainable Transport (EST) Initiative was jointly launched by the United Nations Centre for Regional Development (UNCRD) and Ministry of the Environment of the Government of Japan (MoE-J) in 2004. The main objective of the EST Initiative in Asia is to integrate EST in the overall policy, planning and development, by sensitizing the local and national governments, private sectors and civil society.

As a part of Asian EST initiative, UNCRD is supporting Government of Nepal, Ministry of Physical Infrastructure and Transport (MoPIT) in preparing the National Sustainable Transport Strategy (NSTS) for Nepal in collaboration with other related government ministries. In fact, 'sustainability' aspect in transport development has already been a subject of policy priority as reflected in various policy documents from Ministry of Physical Infrastructure and Transport, and other related government agencies. Various initiatives have also been taken at the policy, planning and project level to improve sustainability of transport system. NSTS for Nepal would basically build on the past and on-going initiatives, and make attempt to complement and bridging the gaps. A broad review of past trends and current initiatives has been under taken and issues, challenges and opportunities are identified. Major strategic components and actions, which meant to support in achieving the objectives and the vision of NSTS, have been proposed after critical review by major stakeholders through two consultative workshops organized in Kathmandu involving all stakeholders.

Recently, respective agencies of the Government of Nepal have formulated strategies and guidelines, which address some key elements of Sustainable Transport System. These include road safety strategies, transport management strategies, and electric vehicle promotion strategies. This demonstrates that government of Nepal has given a high priority to the agenda of sustainable transport. However, the most identified measures demand a system approach of implementation in terms of thematic coordination (such as land-use transport coordination) and institutional coordination (among different agencies related to transport). This strategy would therefore make best effort to streamline all the existing straggles or guidelines (irrespective of their status as approved or in the process of approval), and to fill up gaps picking up other important elements of environmentally sustainable transport. Nepal was struck with a devastating earthquake in April 2015, and Government of Nepal has decided to turn this crisis into an opportunity of building climate and disaster resilient facilities including transport system. NSTS has addressed such needs and has made an attempt to articulate a strategic perspective to suit the context of a developing country like Nepal. This document has therefore come in the right time and would contribute significantly towards developing sustainable and resilient transport system in Nepal

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1. INTRODUCTION

1.1. Background

Economic growth, social transformation and rapid urbanization have dramatically increased vehicle ownership and usage in Nepal. The motorization trend is gaining pace particularly in urban areas including the capital region of Kathmandu valley. The current patterns of motorization adversely affect traffic congestion, air and noise pollution, and traffic accidents and injuries. The unsustainable trends in transport sector as presently observed would further worsen social equity, lower energy security, increase greenhouse gas (GHG) emissions, and destroy natural habitats and ecosystem, which ultimately have adverse impacts on national productivity and human development. At the same time, frequent natural disasters such as floods, earthquakes and landslides are on the rise across Nepal. These natural catastrophes cause the losses of a human life and immense damage to public transport infrastructure each year. The devastating earthquake of 7.8 Magnitude (7.6 on Rictor Scale) that struck central Nepal took a huge toll on life and property. About 9000 people were died, 22,300 were injured and 500,000 buildings were damaged. Fortunately no major structure on transport network got damaged. Yet, several land slides triggered by the quake closed major national highways for couple days. The earthquake has in fact been a wakeup call for Nepal to plan for a more disaster resilient transport system. In addition, given the climate change vulnerability Nepal is likely to subject to, making transport system resilient to possible climate change events is equally important.

To make Nepal's transport system more productive, resilient, and sustainable, it is important to strike a balance among economic progress, social equity, a healthy and protective environment and people-friendly infrastructure and transport services. The Sustainable Transport System calls for all these essential elements to be integrated at the level of policy formulation, plan preparation, infrastructure building and transport service operation.

With an aim to create a new paradigm in transport practices and to build a common understanding across Asia on the need for the sustainable transport integrated into overall policy, planning and development, the Asian Environmentally Sustainable Transport (EST) Initiative was jointly launched by the United Nations Centre for Regional Development (UNCRD) and Ministry of the Environment of the Government of Japan (MoE-J) in 2004. The main objective of the EST Initiative in Asia is to integrate EST in the overall policy, planning and development, by sensitizing the local and national governments, private sectors and civil society. As a key component of the Asian EST initiative, UNCRD provides technical assistance to developing countries for the formulation of National EST Strategy. It aims to promote the EST in Asia to build a sustainable society through the effective use of safe, reliable, socially inclusive, economically viable, environmentally protective, people-

friendly, and seamless transport system for the benefit of all. The EST initiative is build on the objectives of the *Bangkok 2020 Declaration*-Sustainable Transport Goals for 2010-2020 and *Bali Declaration* on Vision Three Zeros-Zero Congestion, Zero Pollution and Zero Accidents towards Next Generation Transport Systems in Asia, and the Rio+20 outcome -*The Future We Want.*

With the technical support from UNCRD, Government of Nepal, Ministry of Physical Infrastructure and Transport (MoPIT) is taking a lead to prepare the National Sustainable Transport Strategy (NSTS) for Nepal in collaboration with other related government ministries. Basically, UNCRD is supporting MoPIT as a part of Asian EST initiative. Since MoPIT envisioned this strategy as an umbrella strategy in coordination with all other transport related strategies, the scope of the document will be expanded to cover all relevant elements of sustainable transport. Hence to better, reflect the contents of the document, it is titled as National Sustainable Transport Strategy (NSTS). At the first stage, background papers were prepared on passenger transport (urban, intercity and rural), green freight and, climate and disaster resilience. This document basically builds on the contents of these background papers.

1.2. Sustainable transport system and relevance for Nepal

In order to judge on the sustainability of a transport system, relevant indicators are used. Table 1 lists such indicators under different dimensions of sustainable transport, namely economic, environmental and social. Both direct and indirect indictors are lumped together in the table for the sake of simplicity. Also some indicators may be common to all dimensions. For example, higher mode share of public transport is an indicator that simultaneously serves the purpose of economic efficiency (lower operating cost per pass-km), environmental sustainability (lower emissions per pass-km) and socially equitable and safe.

The most critical challenge for policy makers is that they may need to go for a trade-off between different dimensions of sustainability. There is a concern that improving environmental sustainability of the transport system may undermine economic efficiency. However, there is good scope of avoiding such a trade-off and achieve a win-win solution. For this, it is important to focus on the indicators that serve the underlying objectives across different sustainability dimensions. Public transport for passenger mobility and intermodal freight transport are policy options, which can produce win-win solutions.

Table 1: Common indicators for sustainable transport

Economic aspects	Environmental aspects	Social aspects
• Degree of accessibility • Transport costs • Productivity • Efficiency • Congestion • Mobility • Employment • Comfortability • Profitability • Energy efficiency • Public subsidy • Load factor • System reliability • Multimodality • Connectivity • Energy security	• Local emissions • GHG emissions • Pass-km per capita • Fuel consumption • Fuel quality • Ecological impacts • Soil/water pollution • Noise and wastes • Transport use of arable land • Per capita travel • Transit mode share • Natural resource exploitation • Climate resiliency	• Traffic safety • Accessibility • Inclusiveness • Affordability • Gender equity • Universal access • Resettlement • Poverty reduction • Road use parity • Participatory • Impact on heritage • Security • Fitness/health • Livability • Spatial separation • Disaster resiliency

In Nepal, environmental issues related to transport sector are addressed through several mitigative or project level instruments (such as emission mitigation, EIA, accident reduction etc). Broader meaning of Environmental Sustainability demands better integration of sustainability concerns into the sectoral policy. National Sustainable Transport Strategy (NSTS) is expected to serves as an important policy guide to formulate sustainable transport policies.

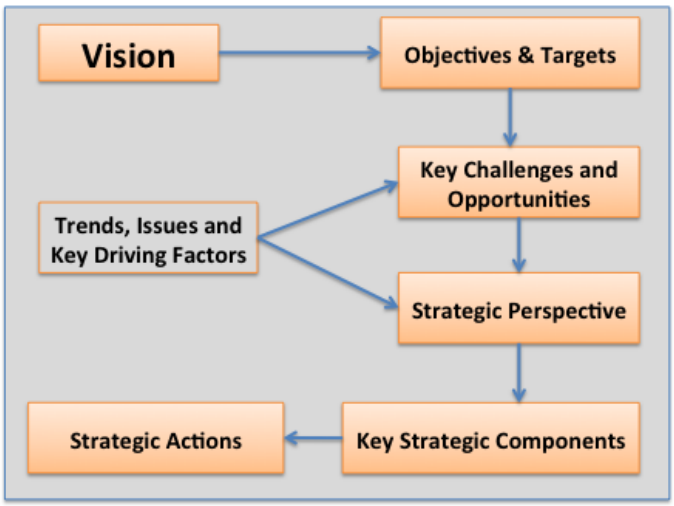


Figure 1: framework for formulation of EST strategy

1.3. Framework of strategy formulation

Figure 1 shows the framework for the formulation of National Sustainable Transport Strategy (NSTS) for Nepal. First a vision statement is articulated that encompasses key principles of sustainable transport. Relevant objectives and target are then set which support the realization of the Vision. However, perusing the objectives and achieving the targets is a quite daunting task. Intuitive policy instruments may not work effectively as the transport system itself constitutes a complex system, and for a long run vision, we have to deal with strategic challenges. In order to correctly pin down the challenges and opportunities (if any), it is important to examine the major trends and issues related to the different components of transport system. Also examined are the factors that drive the future scenario of transport sector in Nepal. After identifying key challenges and opportunities along with some defining features of Nepal's transport sector, an insight is drawn about strategic perspective, which would help to tailor strategies and actions to Nepal's context. Strategic components are then identified based on their relevance to address the key issues overcoming the challenges and reaping the opportunities. Finally, specific actions are proposed under each strategic component.

1.4. Vision

The vision statement for National Sustainable Transport Strategy (NSTS) for Nepal is set as

"Developing a transport system that is efficient, accessible, people-centric, affordable, reliable, safe, inclusive, environmental friendly, and climate and disaster resilient".

This vision is based on the following principles:

Efficient: Economic efficiency is the core element of sustainability that directly contributes to other aspects too. For example, efficiency requires low energy intensity and better operational performance, which automatically translate to lower emission and lower cost of operation making the service more affordable.

Accessible: Accessibility of transport system relates to the concept of both physical and social accessibility. Physical accessibility is about proximity of transport infrastructure and facilities for prospective users, where as social accessibility is about the possibility of use by all section of society. Well-developed road system in the absence of public transport system would not provide accessibility to users without private vehicles.

People-centric: Transport system includes infrastructure, vehicles and terminals, stations and transfer facilities. There is the movement of both vehicle (with passenger) and pedestrians, but the performance of transport system is judged on the basis of services rendered to the users, in-vehicle or pedestrians. The transport system should therefore be designed and operated to make it people-centric (comfortable for people) rather than vehicle-centric (convenience for drivers).

Affordable: The transport service should be affordable to various section of the society. For the economically weaker section, government may need to make provision of cross-subsidy or direct public subsidy. But the best option would be to bring down the cost through better productivity and efficiency.

Reliable: Service reliability is another important attribute of transport system. It is about high degree of predictability of service availability and travel time. Unreliable service may require extra time to be allocated to the trip in order to hedge possible uncertainties in service availability and travel time.

Safe: Transport infrastructure, vehicles and operating and maintenance system should ensure adequate safety for the users.

Inclusive: Transport system should not exclude or impose any sort of discrimination to any section of society (especially children, women, elderly, physically challenged, and other marginalized peoples) particularly in terms of accessibility and ease of usage. There should not be any physical or institutional barrier to use transport infrastructure and services.

Environmental friendly: Building of transport infrastructure involves use of natural resources and some degree of damage to natural habitat. In addition, service operation produces emissions, which pollute the environment. Utmost care should therefore be taken to make the transport system environmental friendly.

Climate and disaster resilient: Transport system is vulnerable the climate change events and other natural disasters that may incur physical damage service disruption. A resilient transport system can adapt to and recover from the hazards without compromising their long-term prospects.

1.5. Objectives and Targets

The vision envisages the transport system should be economically sustainable, socially inclusive and environmentally protective i.e. sustainability in all aspects economic, social and environmental. In order to deliver the vision effectively, it should be supported by relevant objectives. Appropriate targets need to be set to guide the process of formulating strategies and actions and monitor the progress of achieving the objectives. While setting objectives and targets, past trend and current situation along with strategic directions as reflected in various policy papers of the Government of Nepal have been taken into account. Targets are expressed either in the form of numerical target (subject to be confirmed in the final version of the document) or broad strategic directions of related indicators.

Key objectives and associated targets are listed below clustering under different aspects of sustainability (viz economic, environmental and social). Also indicated is the related transport subsector, namely Intercity Transport (ICT), Urban Transport (UT) and Rural Transport (RT) where applicable (if not specifically indicated, the item is for all transport subsectors).

Table 2: Objectives and Targets of National Sustainable Transport Strategies (NSTS) for Nepal

Objectives	Target/indicators
Economic dimension	
1. Efficiency in investment and service operation	• Reasonable IRR and profitability • Operating cost per vehicle km • Energy consumption per pass-km
2. Efficient and timely maintenance of infrastructure and facilities	• Pothole free roads • Acceptable International Roughness Index (IRI)

3. Improved accessibility	• Minimize time to road head (ICT, RT); • % Coverage of public transport (with 15 minute walk) (UT)
4. Secure higher mobility	• Average travel speed in city area (30 km/hr) (UT) • Average travel speed for ICT (general highway 50 km/hr; Exp ways 80 km/hr; railway 160 km/hr)
5. Ensuring affordable transport services	• ICT/RT- fare per Km as % of per capita income • UT- daily commuting cost as % of per capita income
6. Provision of reliable transport services	• Provision of schedule services (% of delay)
7. Leveraging transport for poverty reduction	• Degree of labor intensive technology • % of investment in backward areas
Environmental dimension	
8. Ensuring sustainability in the use of natural resources and nature conservation	• Minimize use of arable land for infrastructure • Minimize impacts on ecological resources (ICT, RT)
9. Maintain the standard of vehicle or engine condition	• Limit on vehicle age (years); Average age of vehicle • Emission compliance rate
10. Minimize local pollution and noise effects (UT)	• Minimize car/motor cycle ownership (#/population) • Mode share of public transport (> 60 %)
11. Promote electric vehicles	• Percentage of electric vehicles in total fleet
12. Minimize CO2 emissions from transport	• Per capita CO2 from transport sector • Average CO2 emission per pass-km (g CO2)

13. Increase climate and disaster resiliency of transport infrastructure	• Revising design standards and codes • Reduced incidence of infrastructure damage by climate related disasters
14. Greening the freight transport	• Develop database on freight transport • Higher standard of truck engines (Euro IV) • Efficient operation (fuel economy) • Modal shift to rail/water
Social dimension	
15. Improve transport safety and security	• Reduced traffic accidents (fatalities per vehicle, fatalities per vehicle-km) • Reduced incidence of travel related crimes
16. Ensure inclusiveness of transport system	• % of public transport coverage; % of barrier-free vehicles
17. Ensure gender equity in transport services	• % of all-women public transport vehicles; % seats for women
18. Minimize social impacts of transport development	• Minimize degree of community separation due to transport routes
19. Integrate transport and public health	• Minimize local pollution • Share of NMT modes in total trips
ICT: Intercity Transport; UT: Urban Transport; RT: Rural Transport	

2. PASSENGER TRANSPORT TRENDS AND ISSUES IN NEPAL

2.1. General context

Nepal is a landlocked country with an area of 147,181 sq km and a population of approximately 28 million. The northern part of the country, bordering with People's Republic of China, is a rugged terrain with Himalayas and the southern part is a plain land bordering with India. Nepal's topographical location is unique in the sense that within a 200 km distance, the ground altitude changes from 50m of msl to 8488m. Due to this drastic change in elevation within a short distance, Nepal offers a distinctive profile of five physiographic regions: Terai, Siwaliks, Middle Mountains, High Mountains and High Himalaya extended from the south to the north, respectively. Terai is mostly flat lands, which consists of extensive road networks. Geologically, Siwaliks are most unstable and unpredictable slopes that are very fragile in nature. The Middle Mountains and High Mountains are relatively stable. High-speed water currents that cause river cutting of the road toe is the only risk to roads in in the middle and high mountainous regions.

Despite several constraints and challenges, physical infrastructure has always remained at the center stage of the planned development. Over the last three decades, the Per Capita GDP has increased from USD 180 in 1980 to USD 762 in 2015 and the population below the poverty line has dropped to 25.16%. Road network which was virtually nonexistent in 1950 has now increased to around 80,000 km. Only two district headquarters (Humla and Dolpa) are yet to be connected to the road network. Although domestic airlines operate more than 30,000 flights a year connecting remote areas of the hills and mountains, the service is limited to those who can afford the services. In 2012, there were 70,877 aircraft movement by 17 domestic operators serving only 1.57 million passengers including tourists.

Road remains the predominant form of transport infrastructure in Nepal as 90% of the passengers and goods are transported through roads since air transport services is limited and expensive to the common people. Although accessibility has increased, lack of effective connectivity has hindered balanced economic growth and hence increased transport costs.

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 improvement and maintenance of roads. In the fiscal year 2015/16, out of total development expenditure of NRs 208 billion, NRs 53 billion (over 25 %) has been allocated to transport sector. Despite the lion's share in overall development budget, the public investment (as % of GDP) in transport sector is much lower by international comparison. Figure 2 shows the time series trend of public investment in transport, which shows declining trends after the mid 1990s. This is perhaps because of more pressing demands on government budget from social sector.

Roads Board is responsible for funding the road maintenance. Currently, it is funding the routine/recurrent maintenance of around 5,900 km of SRN, 500 km of urban roads and around 1300 km of district roads. In addition to the routine/recurrent it is also funding 700 km of periodic maintenance of SRN for the last two years.

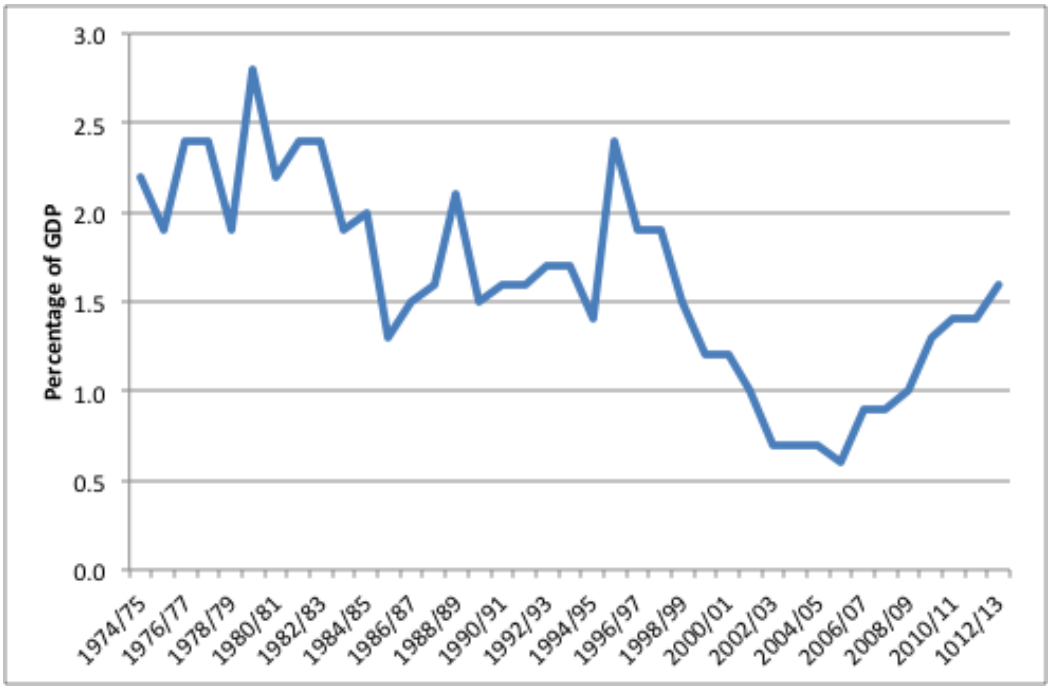


Figure 2: Trend of government investment in transport (% of GDP)
Data source: Nepal Rastra Bank, Public Finance Tables, various years

Nepal is one of the few countries in the world with significant proportion of its total population living in areas not served by an all-weather motorable road. In 2006, 58% of population in hills has motorable access within a reach of 4 hours whereas, 94% of population has a motorable access within a reach of 2 hours in Terai. An overall accessibility was 78%. A recent study carried out by DoR (2012) has estimated that there has been an improvement in accessibility in hills from 58 % in 2006 to 77.5% in 2011 and in Terai from 94% in 2006 to 98% in 2011 with an overall accessibility of 88 % of the population reaching motorable road head within 4 hours in hills and 2 hours in Terai. In 2012, the road density for Terai and Hills/Mountains are 11.63 and 6.78 km/100 sq. km respectively. This road density does not take into account of the seasonal road that is passable only during wintertime.

2.2. Overview of past policies and plans

At the early stage of transport development, government of Nepal focused on connecting the boarders of neighboring country, primarily with India and later with China. Construction of East-West Highway was then initiated. Connection of all district headquarters by road was targeted in the 10th plan (2002-2007), however, the

two district headquarters are yet to be connected. Recent policy emphasis is for rapid, safe, reliable, comfortable and low carbon technology.

Past national periodic plans (Five-year development plans) reveal that transport development received very high priority and various policy initiatives were taken. Yet, the physical achievement is far below the targets. For instance, in the first national plan (1956-61) the concept of 'value capture' was highlighted for "the land whose value is increased due to construction of road should be taxed", but it was never implemented. Moreover, the 4th Plan (1970-75) explicitly recognized the role of transport to reduce the regional disparity. But such a noble role has never been operationalized in practice. A brief summary of transport policies as spelled out in various five-year plans is presented below in Table 3.

Table: 3 Summary of Transport Strategy and Program by 5 Year Plan

Plan	Key features
1st Plan 1956-61	• Various taxation are needed such as ; fuel tax, registration levies, tax on vehicle, taxation on land whose value increased due to construction of road. • Extensive survey for ropeway were planned • Railway link planned to connect Hetauda (ropeway station)
2nd plan 1962-65	• First plan could not achieve due to lack of finance, technical manpower and equipment. • In 1958, Regional Transport Organization (RTO) was established • Program was formulated with the concept of East West and North-South highway.
3rd plan 1965-70	• In 1961 RTO was dissolved with the reason of not achieving the target. • Policy was initiated to provide Bus and Truck services by Individuals and companies • Grant were provided to Panchayat(district and village) to construct the local road • National Transport Organization was established (to coordinate the ropeway, railway and other means of transportation) Road
4th plan 1970-75	• Transport development is necessary to overcome regional disparity • Kathmandu ring road started to construct. • Provide market to rural economies

	• To connect isolated community • First priority was road and second was air transport • Road classification: Motor able(Highway , Trunk road, Road) and non-motor able (Jeep track, Mule track, Foot track) • Twenty year perspective plan aimed to connect zonal and districts headquarter by 1985
5th plan 1975-80	• Infrastructure is major for national development and regional balance • 4 regional headquarter established and road construction proceeded by those regional office • District and local roads were constructed through panchayat by providing grant and technical support • Promoted special activities along completed road to foster economic growth • Targeted to connect zonal and districts headquarter • Trolley Bus system was completed
6th plan 1980-85	• Railway development was not necessary because of situation of mobility • Small airport was felt necessary across the country. • Roads connected to main tourist destination and national level project location will be constructed based on regional balanced approach. • Policy will adopted to attract private sector in transport investment in urban area • Feasibility study will be conduct for alternative means of transportation which is based on electricity. • Labor based construction will be adopted for the employment generation
7th Plan 1985-90	• Long term policy will be adopted to construct roads East-West, and North-South • Focus more on maintenance and control road accidents • Straight alignment will be prioritized to construct East-West and North-South road. • Urban Road Master plan will be prepared and followed. • Slogan is "decade of transport and communication" of Asia and Pacific

	region • 20 year road master plan will be prepared and followed • District headquarter will connected through feeder road • A Separate unit at DOR will be established to reduce accident both in urban road and highway • Kathmandu Bhaktapur Trolley Bus will be expand up to Tribhuvan Univesity , Kirtipur • Transport service regulation will be adopted to participate private sector
8th Plan 1992-97	Objectives • To strengthen regional indivisibility • To connect village to urban area • To reduce transport cost Policy • Develop the foundation for toll collection in Bridge and such toll will be used for maintenance of bridge • Emphasize on road connecting "Farm to Market" • Encourage private sector for construction and operation of rood and BOOT system will be introduced with incentive.
9th Plan 1997/98-2001/02	• Objectives of physical infrastructure was to alleviate the poverty • Development of agriculture road for the promotion of agriculture productivity • Develop transport system less expensive and favorable to environmental conservation Develop traffic management system to control traffic accidents and pollution. • 20 years master plan will be formulated Problems • Weak relation between national and regional objective • Construction of road without appropriate study and research • Lack of interregional coordination and cooperation • Poorly utilization of locally available resources

10th plan 2002-07	• Road project will be selected based on minimum adverse impact on environmental and regional imbalance. • Adopt low cost technology, to minimize environmental degradation • In the area of heavy traffic road widening with cycle lane will provide • Adoption of planned system to repair and maintenance • All district HQ will be connected • Road will constructed to link northern mountain to Tibetan market • East-West highway will be developed as an Asian Highway and regional commercial route. • Roads under local transport system will be handed to local bodies • Institutional development for decentralization • Integrated transport master plan will be formulated • Vehicular pollution will be reduced in Kathmandu valley and other cities • Nepal emission standard 2000 will effectively implemented
11th plan (2007/08-2009/10)	• Road will be constructed based on sector wide road program (2007-17): roads should be available within 4 hours walking distance in Hill and 2 hours walking distance in Terai. • 8 trade transit which connect northern China and Southern India will be developed • 3 parallel East-West highway including current East-West, Mid Hill and Postal at Terai will be developed • Alternative highway will be developed to connect Kathmandu and Terai
12th plan (2010/11-2012/13)	Strategy: • District and regional headquarter connection • Identify railway and other means of transportation • Promote public private partnership in transport sector • Construction ropeway, waterways which are important for tourism sector will be attracted through BOOT/BOT system • Disabled friendly road will be developed

	• PPP Cell will be established to promote PPP • District connecting road and national strategic road will be made all weather • Construction of Mid hill highway and Kathmandu-Terai fast track road will proceeds • Road network will expand in Kathmandu Valley based on urbanization pressure and considering safety and environmentally friendly • Organizational structure will be developed for the Kathmandu-Pokhara and East-West electric railway • Footpath and bicycle lane will provide where possible
13th plan Policy paper	• Work will be started to prepare DPR of East-West Railway • Private investment will attract through PPP to construct Metro rail in Kathmandu valley • In the planning period, DPR of East-West railway will be prepared and construction of Simara –Bardibas section will be started

2.3. Road Infrastructure

2.3.1. Network and management

Road network development and management in Nepal is based on political classification rather than functional classification. Because of political classification, roads built with significant investment are found to be under-utilized. Substantial road length within Strategic Road Network (SRN) is all-weather, but the roads under Local Road Network is largely fair-weather and unpaved. Without proper motorable bridges, these fair-weather local roads become impassable during rainy season (road closed for a duration extended to months). The restriction of movement during the rainy season promotes deficiency of road system, which in turn seriously threatens the return on investment made on rural roads.

Table 4: Total length of roads (as of July 2015)

	Black topped	Gravel	Fair Weather	Total
Strategic Road Network (SRN) Km	11,349	6,192	9,394	26,935
Local Road Network (LRN) Km	1,697	12,548	38,898	53,143

Data Source: Economic Survey 2015

National Transport Policy, 2001 provides a classification of roads in Nepal: Strategic Road Network (SRN) and Local Road Network (LRN). SRN comprising of National Highways and Feeder Roads is under the jurisdiction of the Department of Roads. The LRN which comprises of district, village and urban roads is under the jurisdiction of the respective local institutions namely District Development Committees (DDC), Village Development Committees (VDC) and Municipalities. The Interim District Transport Master Plan (DTMP) Guideline (2010) define the rural roads as all roads that are not urban roads and do not form part of the SRN. In a hierarchical order, district roads are the link between village roads and the SRN. Table 4 shows total length (as of July 2015) of different classes of roads.

As can be seen from Table 4, substantial part of SRN and LRN (58 % of SRN and 96.8 % of LRN) are unpaved and are not passable during monsoon period when country receives more than 80% of annual rains during these periods (June – August). 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 transport sector of Nepal continues to be guided by the National Transport Policy 2001, 20-year SRN Master Plan and Priority Investment Plan (2007-2016). The Government recognizes the need to connect all the districts of the country as well as develop and extend a Strategic Road Network for an effective inter and intra mobility. This aims to bring people closer to the all seasonal road within four hours and two hours walking distance in Hills/Mountains and Terai respectively.

2.3.2. Major initiatives for road network expansion and improvement

As part of the long-term strategy the government has taken several initiatives in the extension of road network to support and facilitate the social and economic development of the country. These initiatives are targeted to support to the fulfillment of the objectives of other economic sectors in conformity in achieving the national goals. The major initiatives are:

- Construction and operationalization of Mid Hill Highway (approx. 1776 km) to support the development of 10 major cities identified along the road corridor. This highway runs from the eastern border to the western border of

the country, parallel to the existing East-West Highway. The alignment lies mostly in Middle Mountainous and High Mountains and substantial part of the alignment runs along the river banks.

- Construction and operationalization of Kathmandu – Terai Fast Track (76 km). Four-lane highway to link Kathmandu Valley with the Terai in plain. It is a north-south link crossing over most fragile Siwalik Hills. The project is expected to be implemented under Public Private Partnership (PPP) and with an estimated investment of 900 million US$. Detailed Project Report (DPR) is under preparation.
- Upgrading and operationalization of Postal Highway running east to west along the side of Indian border in south plain. The design and construction of postal highway is very challenging in terms of a) providing adequate drainage structure as the embankment could pose serious threat to the inundation of larger area of Terai; and, b) building stable embankment to allow overtopping of flood during high flood and keeping the maintenance cost to a minimum. The estimated length of highway is 1141 km of which 592 km is in serviceable condition, 76 km under construction and 77 km is planned for track opening.
- Developing roads along major river corridors: Koshi, Gandaki and Karnali. The track opening of river corridor is in progress.
- Construction of roads leading to development of hydropower, tourism and trade, and cement industrry.
- Bridge Construction on Strategic Road Network: In addition to the current bridge stock of 80 km on SRN, Department of Roads is currently engaged in the construction of 121 bridges (6000 m) and is due for completion within the next two years. DoR has also identified additional 751 bridges on SRN to be built within next five years.
- Construction and upgrading of District Core Road Network. District Transport Master Plan has identified the need of connecting all Village Development Center with the road network. Out of 3,634 VDCs, 815 remains to be connected with Local Road Network. The estimated District Core Road Network (DCRN) stands around 29,967 km road. Around 8,000 km of road is yet to be opened while remaining 22,000 km needs urgent upgrading/rehabilitation or reconstruction depending upon their condition. 844 river crossing on DCRN has been identified for the provision of bridges.
- Construction of tunnel linking Thankot to Japlekhola on Thankot - Naubise Section of Tribhuvan Highway. The feasibility study for 2.40 km tunnel is complete and design is in progress under JICA funding.
- Widening and strengthening of Pritvi Highway (Naubise – Mugling Section). Design work in progress to upgrade the highway to cope the current level of traffic with the provision of additional climbing lane.
- Widening and strengthening of Mugling – Narayanghat Highway. Existing highway is planned to upgrade to four-lane highway under WB assistance. Construction is going to commence soon.

- Widening of existing East-West Highway from two-lane to four-lane. Preliminary study is planned to commence soon.

2.4. Motorization

Lately, Nepal has witnessed rapid growth of motorized vehicles. In 2015, total vehicle number adds to 1,925,434, a large proportion (78 %) of which included motorcycle. Over 2008-2013, national level average annual growth rate for motorcycle and 4-wheel light vehicles (car, jeep, van) remained as 19.5 % and 8.4 % respectively. With easy access to the credit facilities, vehicle ownership in general and motorcycle in particular is increasing. Car ownership is expected to increase as residents become more affluent and young families riding motorcycles switch to cheap cars manufactured precisely for their needs.

Table 5: Trends of vehicle population in Nepal

Fiscal Year*	Car, Van, Pickup	Bus	Minibus MiniTruck	Microbus	Tempo	Motorcycle	Others
1990	21350	3978	2064	0	2359	34576	12051
1991	23703	4436	2501	0	3215	40273	15399
1992	26340	4967	2956	0	4422	49609	18700
1993	28606	5573	3141	0	4484	58122	21323
1994	31655	6741	3262	0	4697	68672	24831
1995	34698	7591	3345	0	4938	80073	28627
1996	38672	8077	3427	0	5055	92430	32019
1997	43193	8685	3602	0	5240	108169	34556
1998	47332	9584	3732	0	5584	120475	37163
1999	49839	10456	3751	0	5972	137565	40426
2000	53486	10950	3873	0	6761	157320	43899
2001	58638	12153	4123	0	6993	186611	48766
2002	63017	13021	4598	0	7241	222728	53839
2003	66504	13453	4896	232	7258	252132	57579
2004	74061	14185	5133	1116	7274	278679	61305
2005	78842	14938	5418	1700	7322	309952	64292
2006	83992	16466	6081	1766	7382	354562	67190
2007	89884	18030	6887	1904	7394	427130	74945
2008	96213	19449	8066	1935	7412	495797	82042
2009	104357	21292	8659	2063	7432	579131	90550
2010	118600	23180	9439	2208	7441	747838	106565
2011	130197	24790	10809	2323	7443	886745	116604
2012	141889	26875	11979	2478	7453	1031880	126441
2013	156906	30138	13307	2636	7510	1207261	139720

2014	173946	32914	14719	2814	7527	1371206	152695
2015#	186703	35289	16007	3425	8441	1513447	162122

Fiscal year ending in July of given year # till March
Data source: Economic Survey (various years)

- Total vehicle population in Bagmati zone for the year 2014 accounts for 755,546 that is 43 % of the national figure. Vehicles registered in Bagmati zone basically are plying on the roads in Kathmandu valley. From 2008 to 2013, average annual growth figure for motorcycle and light vehicles in Bagmati zone recorded as 12.4 % and 7.9 % respectively (DTM 2014). Figure 1-2 shows the trend of motorcycle and light vehicle population in Bagmati zone. Car ownership rate (include jeep and van) for Kathmandu valley is approximately 34 per thousand populations.

- One of the direct impacts of increasing vehicle population is in rapid increase in motor fuel (diesel and petrol). From 2008 to 2013, annual Diesel consumption increased by 2.36 times to 716,747 KL (Figure 3). Likewise, over the same period, annual petrol consumption increased by 2.2 times to 221, 676 KL (NOC 2014). This trend of fuel consumption obviously has serious implications for climate change concerns.

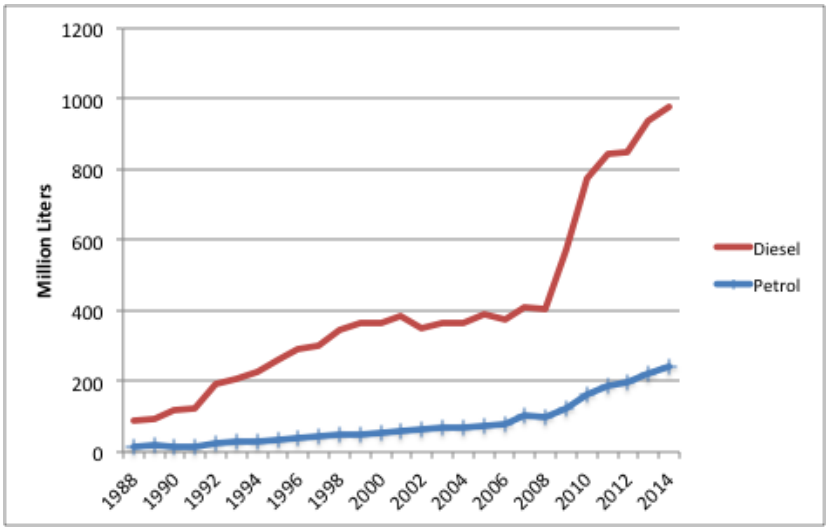


Figure 3: Trend of Diesel and Petrol consumption
Data source: Economic Survey, Ministry of Finance, Various Years

2.5. Railway development

In recent years, Nepal government has given priority for nation-wide electric railway network. Feasibility study for Mechi-Mahakali and Kathmandu Pokhara routes have already been completed (total 1318 Km). The total estimated cost for these routes is US$ 6.54 billion. Detailed project report (DPR) for Berdibas-Simara Section of Mechi-Mahakali route has already been completed and construction works for this section is under way. DPR for other sections is under preparation.

Five border town (Biratnagar, Janakpur-Bardibas, Bharahawa, Nepalgunj, Kakadvitta) are being planned to get connected with the Indian Railway Network. Construction work for linking Biratnagar and Janakpur is in progress. Government is soliciting funding support for the East West Railway. There is also discussion for possible railway connection to China.

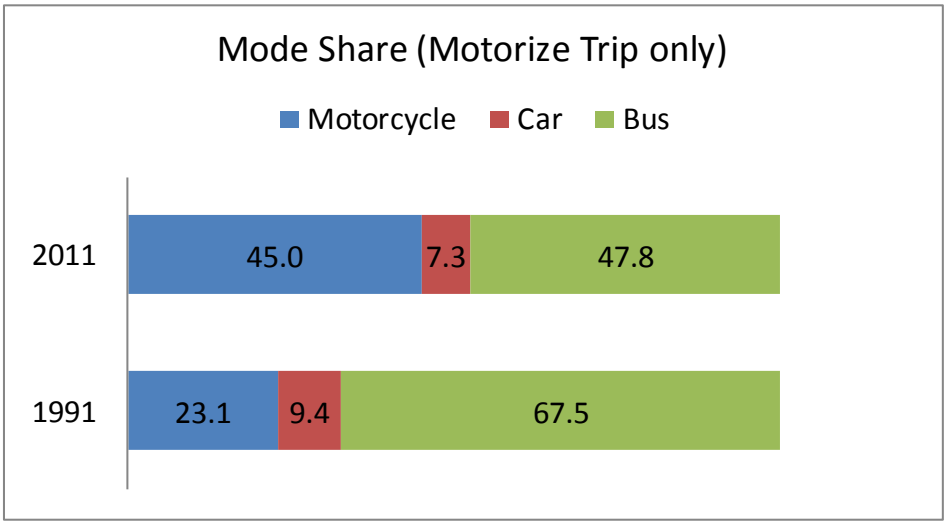
2.6. Local Transport

2.6.1. Urban Transport

- According to 2011 Census (CBC 2012), urbanization rate in Nepal is relatively lower at 17 % with average annual growth rate of urban population over 2001-2011 as 3.16 %. Urban population is distributed among 58 municipalities across the country. Kathmandu valley comprising three districts, namely Kathmandu, Lalitpur and Bhaktapur with total land area of 899 sq km has a population of 2.5 million. The urban core of the valley consists of five urban administrative units with total population of 1.4 million. Kathmandu Metropolitan city is the largest urban unit with a population of 975,453. Greater Kathmandu with an approximate radius of 12 km now function as a single contiguous urban area. Pokhara, the second largest city is home to 255,465 people. As the city rank goes down city population gets smaller. Population of the smallest municipality, Dhulikhel, is only 14,283. As the government is about to embark on a path of high economic growth, a rapid urban growth is expected in the future.

- Urban areas in Nepal depend on road and non-motorized modes for mobility. There is no urban rail system in Nepal. Road infrastructure is inadequate and the network is with inefficient hierarchy especially in the largest agglomeration of Kathmandu valley. Road network length in three district of Kathmandu valley totals to 1,595 km, out of 555 km road is managed by DOR and rest is by local government units. Average road area ratio in five urban administrative units (metropolitan city and municipalities) of Kathmandu Valley is around 6 % of total urban area (Panta 2010). Such figure for the road ratio falls in the lower bound range even by the standards in developing countries. There are continuous efforts to improve road network by constructing new roads, namely strategic missing links and roads along the river corridors. Recently, government also implemented road-widening projects in urban areas of Kathmandu valley. Despite such efforts, the pace of road network expansion and improvement lags far behind the speed of

motorization. As a result, road traffic in Kathmandu valley is facing severe congestion particularly during peak hours. JICA (2012) reports that average traffic speed within the ring road is less than 20 km/hr. In the top 5 busiest routes, evening peak average speed is 8.78 km/hr.



Data Source: JICA (2012)

Figure 4: Trend of mode share in Kathmandu

Expansions of metropolitan area and increasing motorization have direct impact on the share of different travel modes. JICA (2012), including both motorized and non-motorized modes, reports that between 1991 and 2011, share of walk decreased from 53.1 % to 40.7 % while share of motorcycle increased significantly. Figure 4 shows mode share pattern considering only motorized trips. Motorcycle share in 2011 reached 45 % from 23 % in 1991 largely at the cost of decreasing mode share of bus.

With assistance of ADB, Nepal government is currently undertaken Kathmandu Sustainable Urban Transport Project (KSUTP) with the aim of improving urban transport situation in Kathmandu Valley. The project involves four distinct components, viz public transport improvement through investment and management, improvement in traffic management, pedestrianization of heritage areas, and capacity building for emission monitoring and inspection. All of the project components have direct bearing on the various EST components.

In smaller size municipalities outside Kathmandu Valley, there is no provision of public transport services. Proper planning for pedestrian space is also lacking. Non-motorized three wheelers, known as Rikshwa, service as important public transport mode in municipalities in Terai region. There is increasing trend of motorized three wheelers replacing Rikshwa. Bicycle use, which was most common in the past, has now been replaced by motorcycle use.

2.6.2. Rural transport

Nepal's rural areas traditionally faced lack of access to road transport. Because of limited budgetary resources, priority was given to complete the basic national road network. The adverse topography and geology also posed challenges to rural road construction. 1970s, some efforts were made to construct rural road under the auspices of Integrated Rural Development Projects. Provision of direct block grant to VDCs initiated in 1995 provided an impetus to construct rural road mainly with people's participation. In 1997 a new department called Department of Local Infrastructure Development and Agricultural Road (DoLIDAR) was established to better plan and implement rural roads. DoLIDAR has issued guidelines for the District Transport Master Plan (DTMP). Following DTMP, each district prepare District Road Core Network (DRCN), which connects VDCs with the district head quarter or Strategic Road Network (SRN) (DOLIDAR 2010).

However, because of low cost and labor-intensive approach combined with local urge of quick completion of complete route, proper engineering standards are grossly lacking in rural roads. Large proportion of the rural road stock is just earthen or gravel most, which is not usable by vehicle especially during rainy season. In addition, in hilly area, non-engineered rural roads are causing ecological damage including erosion and landslide hazards (Upadhyaya 2002).

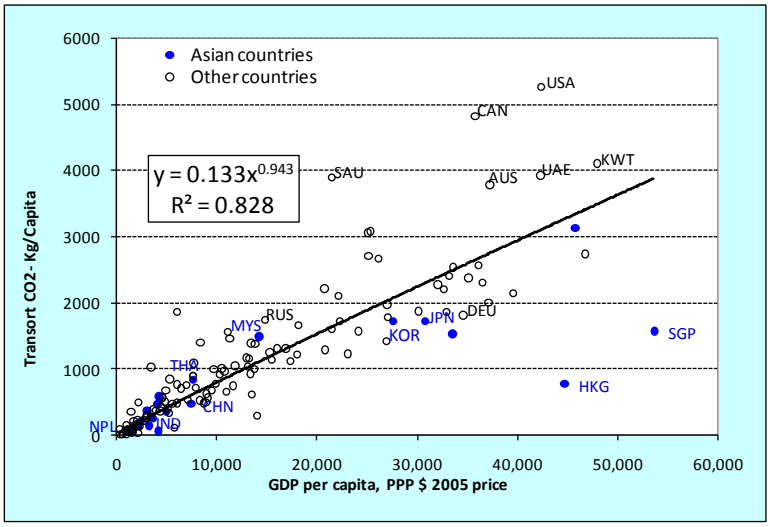
To address the issue of possible environmental damage by road construction particularly in hilly region, innovative approaches have been promoted by various agencies. Green road and bioengineering approach had been successfully applied to rural road construction in various hilly districts (GTZ/SDC 1999). This approach is about constructing roads with minimum disturbance of natural earth based on labor-based technology (without using heavy equipment), balanced cut-and-fill, and use of locally available materials. Bio-engineering and balanced cut-and-fill techniques were also used in JICA assisted Banaepa-Sindhuli road project.

Informal para-transit (jeeps, three-wheelers and vans) is the primary public transport in rural area. However, rural population face low coverage, monopoly behavior of operators, and very poor quality of service including safety risks. This has caused rapid growth of motorcycles in rural areas. Motorcycle has replaced bicycle, a popular non-motorized mode until recent years in the rural area of Terai region. Increasing motorcycle use has resulted in more accidents.

2.7. Transport externalities

2.7.1. Emissions

According to IEA (2013), Nepal's per capita CO2 emissions from fuel consumption in 2011 is only 133 kg against the world average of 4,504 kg per capita. However, growth rate of emissions is among the highest in the world. From 1990 to 2011, CO2 emission from fuel consumption increased by 395 % in Nepal while the average figure for Asia and the world is just 172.5 % and 49.3 % respectively. In 2011, the share of transport sector in the total CO2 emission of the world remained as 24 % while that in Nepal is 45 %. Relatively higher share of transport emissions in Nepal indicates importance of reducing transport emission to address the issue of GHG emissions.



Data Source: IEA (2012)

Figure 5: Transport sector CO2 per capita Vs GDP per capita

Figure 5 shows plotting of GDP per capita (PPP $) versus transport CO2 emission per capita across the countries in the world. The trend line has reasonably good fit, and shows that GDP per capita and transport emission per capita are strongly correlated (following a power function with exponent <1). We can see that some countries are above the trend line while others are below it. Per capita transport emissions in developed East Asian countries or region such as Japan, the Republic of Korea, Singapore and Hong Kong Special Administrative Region of China is below the cross-country trend while that in north American and oil producing middle east countries is higher than the cross country trend. Some rapidly growing Asian countries such as Malaysia and Thailand are also above the trend line. Nepal is just at the bottom of the trend line, but there is a risk of following upper bound trajectory if the country's transport system continues to depend on the road transport with conventional fuel. On the other hand, for Nepal there is real possibility of decoupling the GDP growth and transport emission by adopting low-carbon transport system. Under such scenario Nepal may follow a trajectory leading to a minimum level of CO2 emission with higher level GDP per capita.

In the largest urban agglomeration of Kathmandu valley, air pollution caused by vehicular emissions is once of the key public health concern. MoEP (2005) reported that air pollution is responsible for 1600 premature death annually in Kathmandu valley. Aging vehicles, inefficient engines, and poor quality of fuel is primarily responsible for emission of pollutant. Vehicles plying on the roads with poor pavement condition also contribute dust and particulate matters. According to MoEP monitoring data, In 2007, annual average concentration of PM10 in roadside and residential areas recorded as 173 and 115 micro grams per m3 (against the national air quality standard of 120 micro gram per m3 for average annual concentration of PM10).

Nepal government has taken series of policy initiative to address the problem of vehicular emissions. Table 6 shows the chronological list of major policy initiatives. As a result of the implementation of these policies, the situation of vehicular emissions improved to some extent. For example, in 2003, average annual PM10 concentration in residential area was 149 ug/m3, which dropped down to 115 ug/m3 in 2007. Despite such improvement there is still an upward pressure for worsening pollution because of increasing number of vehicles and road traffic congestion.

Table 6: Chronological list of major policy initiative targeting vehicular emissions

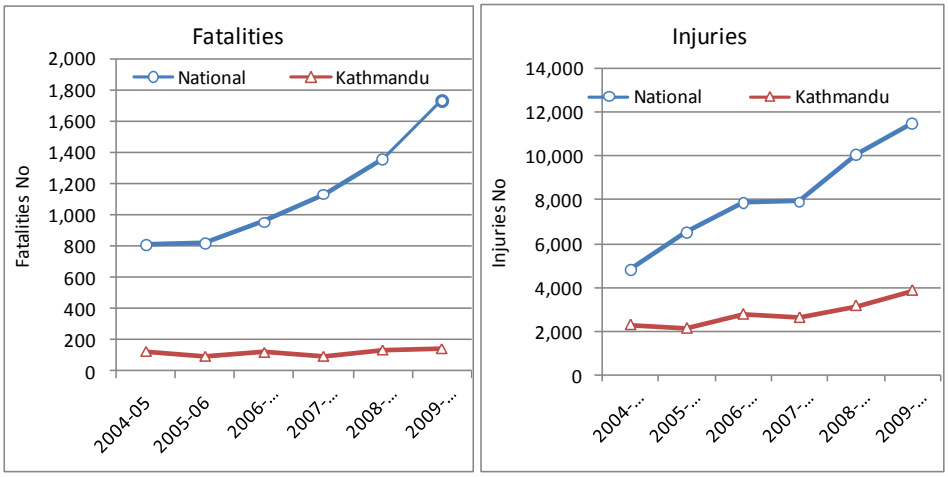
1991: Banned diesel three wheelers registration.
1994: Emission standards for in-use vehicles
1999: Banned three wheelers operated by diesel
1999: Subsidies for electric vehicles.
2000: Nepal Vehicle Mass Emission Standard EURO I.
2000: Stopped two stroke registration
2001: Announced the ban of 20 years old vehicle, but not implemented.
2001: National Transport Policy
2003: National Ambient Air Quality Standards
2004: Two stroke three wheelers banned from operation
2009: National indoor air quality standard and implementation guideline
2012: EURO III standard

2.7.2. Traffic accidents

As the process of motorization gains momentum and passenger mobility is dependent on the motorized modes, the problem of traffic accident is getting further aggravated. In Kathmandu valley, because of poor service quality and lack of accessibility, people have to rely on motorcycles, which characteristically is less safe mode. The mixed traffic involving different types of vehicles also increases risk of accident. In addition, lack of pedestrian facilities and public awareness about traffic rules and discipline makes pedestrians more vulnerable to traffic accident. Figure 6 shows the trend of traffic accident (injury and fatalities) at the national level and in Kathmandu.

Fatalities in Kathmandu modestly increasing but the is rapid increase in fatalities at the national level. The key sources of national fatalities is traffic accident involving public transport vehicles such as buses, vans or jeeps operating on intercity routes or regional or district level routes. In appropriate road geometry and poor road condition particularly in hilly regions are among the major causes. In addition, negligence of drivers and poor quality of vehicles are also the causes of frequent accident on long-distance routes. It is an irony that public transport mode- supposedly a safer mode- is subject to more frequent accidents in Nepal.

GoN/MoPIT (2013) formulated an action plan addressing road safety issues in Nepal. The action plan identifies five strategic pillars, such as road safety management, safer roads and mobility, safer vehicles, safer road users, and post crash response. Activities under each strategic pillars are proposed along with responsible agencies and estimated budget.



Data Source: MoPIT (2013)

Figure 6: Trend of Road Traffic Accident (Country Total and

3. GREEN FREIGHT AND FUEL ECONOMY[1]

3.1. Truck transport in Nepal

Trucks are the major players in the freight sector especially for Nepal, which is a landlocked country. The vehicles used in the freight sector in Nepal, characterized by road vehicles such as trucks and tankers, are aging, unsafe, inefficient and environmentally deteriorating. Not only are trucks and tankers unsafe, the drivers who drive them, like in many countries, are often undereducated entrepreneurs who have used their family resources to purchase a truck and go into business without proper training either for safety or environmental performance of their vehicles.

It is necessary for the government to make appropriate measures to control the adverse effect of freight movement-related problems without disturbing food supply chains and the economy at large. However, it is a challenge for government to manage the freight sector due to lack of appropriate institutions and infrastructural capacity for addressing freight issues appropriately. Not only are the government institutions that are responsible for regulating freight fragmented and lacking in enforcement capacity, the trucking industry itself is fragmented, said to be made up primarily of owner-operators, although some of their behavior such as price setting is managed by certain business interests.

Trucks account for less than 5% of vehicle registration in Nepal, or about 50,000 trucks registered as of 2013. However, the annual growth rate of truck registration is at 11%, which is nearly as fast as the total vehicle registration. Despite their small contribution to vehicle population, trucks are responsible for about 18-20% of total VKT as of 2010.11 Furthermore, many of the 4000 trucks that enter Nepal from Birgunj on the India-Nepal border on their way to Kathmandu are actually registered in India, meaning that it is particularly difficult to track their vehicle kilometers traveled (vkt) as a proportion of Nepal-registered vehicles – let alone other data that would help to better manage the freight sector.

The trucks registered in Nepal are extremely old. The vehicle population data in Table 3 suggest that nearly 2/5 of the trucks operating in the country were registered before the year 2000, meaning that the trucks are at the very least now 15 years old, given an unlikely assumption that the trucks were new when they were registered. Given the trend for about 11% growth in the truck population each year, it is likely that a large portion of the vehicle fleet is even 20 or 25 years old or more – and if the trucks were already second-hand when registered, the vehicles could be even between 30 to 50

[1] This section is heavily drawn from the Consultants' Report (background paper) on Green Freight

years old. Data could not be found on the age of the vehicle fleet. Such data would help to verify this situation.

Old vehicles, while serviceable, are extremely inefficient and offer no environmental protections, thus spewing with every kilometer traveled, vast quantities of particulate matter, black carbon (which has the dual problem of causing health problems as well as causing climate change), as well as oxides of nitrogen and sulfur and ozone.

3.2. Fuel consumption from the freight sector and cost to the economy

Trucks consume a large proportion of fuel, with 25% of the total fuel consumption by trucks. Similarly, about 42% of the total diesel demand from the transport sector is comprised of trucks. The next section will analyze the cost to the economy of this huge outlay. Figure 3 shows diesel and petrol consumption by transport from 1988-2-14, indicating an important increase trend, especially in the volume and proportion of diesel consumed over time, according to official numbers. It is key to address this consumption of diesel, as diesel engines – especially those of old, outdated trucks, are wasteful and large sources of pollution.

Nepal is facing a crisis for both air quality and fuel expenses. Given that a high amount of fuel demand is from the transportation sector, and that the freight sector is a key consumer, it is imperative that the economy of diesel consumption be part of the sustainability considerations.

Nepal imports 100% of its fossil fuel, including diesel. As a result, each and every liter of diesel purchased in Nepal comes with transaction costs associated with import. Yet, the Nepal government needs to ensure diesel prices do not rise to extraordinary levels in order to keep its economy running. In 2014, the subsidy to diesel was reduced in order to to reduce the financial risk to government and the Nepal Oil Company. Yet, each liter of fuel costs the national economy in subsidy as well as in foreign currency costs, which must be spent in order to import refined products from India.

Not only does the import of fuel result in import and energy cost to the economy, the transport of diesel and other fuels is undertaken by trucks. Much of the diesel fuel imported into Nepal is refined at the Indian refinery at Barauni, and taken by 10,000 liter tankers to Nepal, a distance of approximately 400 km. Given that Nepal imported 721,203,000 liters of diesel in 2012- 2013, it suggests that at least 144,000 single-direction truck trips are made per year to merely deliver diesel to Nepal. Given an assumed very poor fuel consumption of 29 l/100km for the truck, and an average distance of 400 km per trip, diesel import alone can result in consumption of 116 liters of diesel alone, or 8.3 million liters of diesel as a cost to import 721 million liters. Financially speaking, under conditions where fuels remain unadulterated, it cost Nepal as much as NRp 875.65 Million in fuel alone to import diesel.

There is currently a proposal for a pipeline to be built to cover the 41 km distance between a major storage facility near Raxaul (Bihar) in India to Amlekhganj in Nepal.18 After upgrading a fuel storage facility on the India side, this would eliminate the need for long-distance truck trips across the border, and would significantly shorten the truck tanker trips inside Nepal, thus saving fuel all-round. This proposal has not yet been approved, and would be a major upgrade to the fuel supply system. The pipeline alone could save millions and millions of Rupees per year in transport costs alone – not to mention the major air quality and GHG emission benefits of removing thousands of ton-km in road freight from Nepal's roads every year.

In the following sections, this report will analyze a number of solutions for this high amount of fuel consumption. What seems clear, however, is that by encouraging change where possible, and forcing change where necessary, Nepal could see possibly 10-15% reduction in the amount of fuel needed for import – a savings of NRp 11.8 billion or more per year – enough to buy 2500 brand new, clean, Indian or Chinese heavy duty trucks every year, or to purchase and maintain new and better infrastructure for freight and passenger movement across the country.

3.3. CO2 emission from freight transport

Nepal has an annual average road transport CO2 emissions growth rate of 8.7% from 2002-2010 as shown in the figure below. At this current rate, the CO2 emissions for 2010 amounting to 3.0 million tons will be doubled by 2019. Furthermore, Nepal is one of the countries with the lowest per capita road transport emissions with only 0.11 tons per capita in 2010.

Taking these into account, it is important to know which of the vehicle types has the highest contribution to CO2 especially that the preference for the means of transportation severely influences the amount of CO2 emitted from transport sector. The diagram below shows the share of vehicle numbers correlated to the share of CO2 emissions.

Although heavy commercial vehicles only made up approximately 5% of the vehicle fleet in Nepal in 2012, they contributed the highest amount of CO2 emissions amounting to more than 50% of the total. This is attributed to the lack or insufficient emission control technologies, inefficient fuel consumption and vehicle technologies. Reducing the emissions from trucks alone could result in significant reduction in CO2 emissions.

3.4. Key issues identified by government blocking greener freight

During the First Regional Workshop on Green Freight and Logistics in Asia, sponsored and organized by the Asian Development and Deutsche Gesellschaft für

Internationale Zusammenarbeit (GIZ), and held in Singapore in 2014, a matrix of challenges that countries face in implementing greener freight in their countries was established. Table 7, below, denotes the challenges that Nepal identified in its

Table 7: Challenges identified by government officials at the First Regional Workshop on Green Freight and Logistics in Asia (Source: ADB 2014)

Major Challenges Matrix	Infrastructure - Roads	Intermodal &Other Infrastructure	Old Trucks	Technology	Poor Enforcement, I&M	IT	Capacity	Data	Fragmented Industry	Overloading	Institutional	Access to Finance	High Cost	Awareness	Urban Freight	Partnerships
Bangladesh		✓	✓		✓					✓				✓		
Bhutan	✓				✓	✓										
Cambodia	✓						✓									
India		✓	✓			✓			✓						✓	
Indonesia	✓					✓	✓	✓		✓						✓
Laos					✓	✓			✓							
Maldives		✓														
Myanmar				✓			✓	✓						✓		
Nepal	✓	✓		✓			✓	✓				✓		✓		
The Philippines	✓	✓		✓										✓		
Sri Lanka														✓		

country, in the context of challenges faced by other countries in the region as well.

Based on the matrix, Nepal has identified as challenges:

- Road infrastructure
- Intermodal and other infrastructure
- Technology (vehicle and other)
- Capacity
- Data availability
- Access to finance
- Awareness of green freight and energy efficiency

3.5. Green Freight: Environmentally Sustainable Transport Concept

3.5.1. Framework for Sustainable Freight Transport and Logistics

With a foundation first established in Bangkok, at the 5th Regional EST Forum on 23-25 August 2010, Asian countries agreed on the Bangkok 2020 Declaration (2010-2020) where Goal 12 in the declaration was agreed on for freight transport -"Achieve improved freight transport efficiency, including road, rail, air, and water, through policies, programmes, and projects that modernize the freight vehicle technology, implement fleet control and management systems, and support better logistics and supply chain management".30 As this discussion evolved through continued EST forums, a definition of green freight was arrived at, in accordance with the results of the Rio+20 outcome document – "The Future We Want." Green Freight is defined as:

- A set of strategies, policies and practices;
- Targeted at the movement of goods via road, rail, marine, inland waterways and air;
- Aiming to: a) reduce the environmental, climate and public health impacts through reduced air pollution and greenhouse gas emission intensity; b) improve social conditions, including road safety and health and working conditions of people involved in freight movement; and c) enhance economic development through improved energy efficiency, fuel security, and efficiency and competitiveness of the freight sector overall;
- Developed and implemented by government, the private sector and other stakeholder groups jointly or individually.

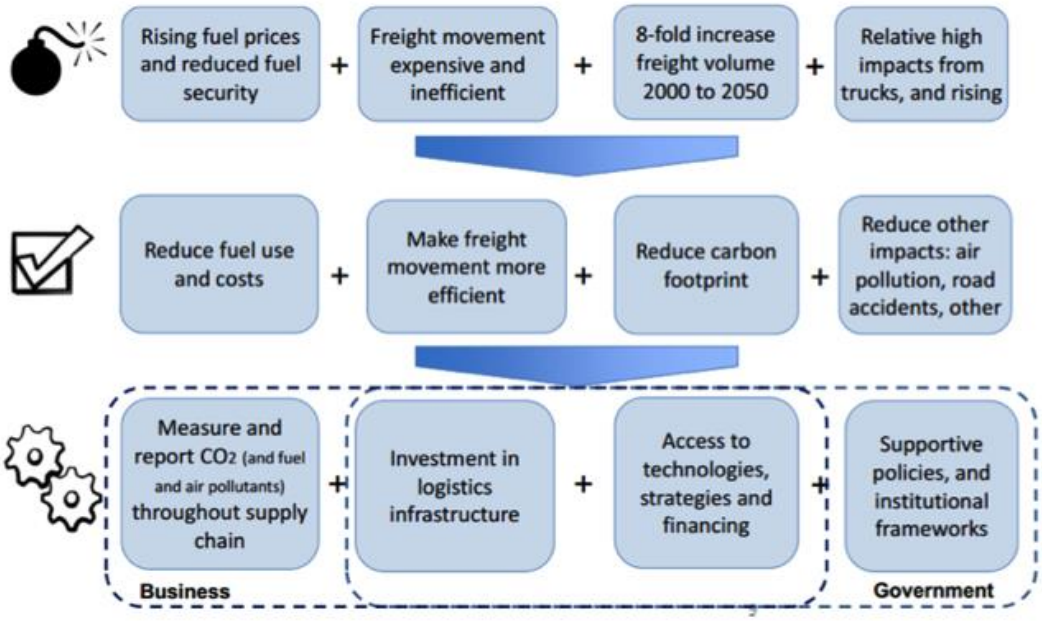
Green freight exists within a larger context of supply chains, where freight refers to the actual condition and operations of trucks and vessels; where logistics are defined as the system-wide allocation and movement of goods on those trucks and vessels; and these exist within the broader idea of green supply chains, which incorporate the lifecycle of the actual products and commodities which are being moved by the freight and logistics systems.

3.5.2. Drivers of Green Freight

Within ten years, the topic of green freight has evolved from nothing into a well-recognized concept with increasing support from all manner of agencies. However, many of the fundamental reasons for its rise still exist. The drivers of green freight, illustrated in figure 7 are the very challenges that Nepal faces today. Increasing fuel prices are proving a risk to national fuel security; freight movement is extremely expensive in Nepal, and at the same time there is increasing demand for transport services. Yet trucks are not improving – they are the same old wasteful and heavily-polluting trucks. These drivers are a call for change.

The needs and methods for change are also summarized in Figure 7

Figure: 7: Drivers of green freight and opportunities for change (Clean Air Asia 2012)



3.6. Factors in Reducing Emissions from Freight in Nepal

An approach to more energy efficient freight and logistics has been developed at Khune-Nagel University, entitled the TIMBER framework, where the acronym TIMBER reflects the following categories:

- Technologies
- Infrastructure
- Markets
- Behavior
- Energy Regulation

This section will seek to address each of these issues and solutions.

3.6.1. Technologies for Trucks to Reduce Emissions

Truck technologies make up perhaps the most immediate opportunity for improvement in the freight and logistics area. While truck technologies require the support of truck owners and truck divers to implement, and require a source of financing in order to purchase and install, some technologies can have immediate impacts on fuel consumption. Figure 8 illustrates the potential for various technologies to reduce fuel consumption on trucks, with the note that the savings are

not necessarily additive – rather the percentage savings are reflective of individual technologies replaced on operating trucks.

Different technologies are suitable for different scenarios. Capital-intensive technologies, for example, are not suitable for developing countries where capital is not readily available. Similarly, operating conditions affect which technologies will be useful in different areas. Figure 8 illustrates that when trucks are operating at slower speeds, the rolling resistance of tires has a significantly greater influence over fuel economy than aerodynamic resistance. Similarly, at higher speeds, the situation is reversed. In countries like Nepal, where freight typically travels at lower speeds, it will be beneficial to replace existing tire technology with improved tires that reduce rolling resistance while still carrying trucks through rough conditions.

Figure 8: Truck technologies for greener freight (Source: Polovick 2011)

A review of the 2011-2014 Phase 1 of the Guangdong Green Freight project, sponsored by the Global Environment Facility, found that amongst all the technologies piloted, that only low rolling resistance tires, as well as cab roof deflectors for trucks actually saved fuel and demonstrated a desirable payback period on Guangdong roads (Figure 9). This owes to the fact that roads in Guangdong are typically lower speed, meaning that rolling resistance is the largest resistive force acting on trucks in the area. Other technologies, such as aerodynamic technology and tire pressure monitoring systems were found to not save fuel. At low speeds, aerodynamic technologies merely make the vehicle heavier, and tire pressure monitoring systems were confusing for drivers, who were inadequately trained.

Even driver training was noted as only having a short-term effect as often drivers will leave the profession, or will forget their training without frequent reminders, leading to the conclusion that improving efficiency through driver training will require a sustained industry-wide effort.

Nepal would be well-advised to design a pilot project of appropriate technologies for trucks on Nepal's roads to demonstrate to truck owners and truck drivers that better technologies can save fuel and money, thus making their operations more profitable. This includes the implementation of vehicle technologies such as:

- Improved tires that reduce rolling resistance while maintaining safe operations: Reducing fuel consumption by up to 7% with proper installation and use
- Working with emission control companies to pilot after-market Selective Catalytic Reduction and Diesel Particulate Filters: reducing particulate emissions up to 90%
- Idle reduction technologies: saving up to 8% fuel consumption (See Figure 8).

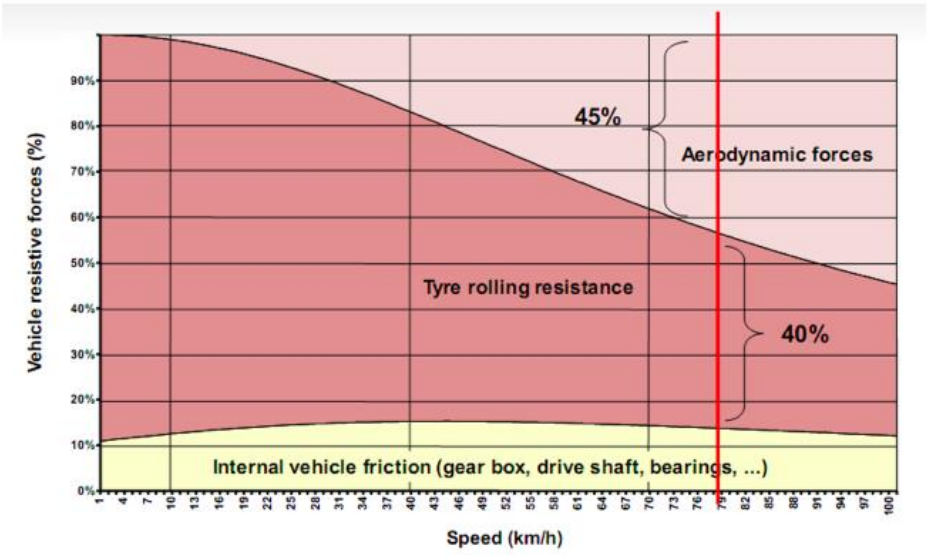


Figure 9: Technologies for truck to reduce emissions

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3.6.2. Infrastructure

Investment in logistics and infrastructure is one of the key drivers of green freight. In Nepal, the Strategic Road Network is the key facilitator of freight movement. However, the efficiency and reliability of the road transport in Nepal is poor compared to some of its neighbouring South Asian countries especially with its insufficient road connectivity and poor road condition. This causes road emissions to continue to remain high. In this regard, infrastructures are set in place and in considerations such as:

- Kathmandu – Hetauda Fast track highway which includes tunnel and options for a new alignment or upgrading of existing roads (Prithivi Highway and Tribhuvan

Highway) which facilitates 50% of trading between India and Nepal. According to the economic analysis, this project will help save 90 liters of diesel per vehicle per trip by reducing the travel distance to around 60 Km and travel time by 75%.

- The People's Republic of China (hereafter China) has proposed and begun construction on a Lhasa-Kathmandu rail link that is said to be planned for operation by 2020.35 This rail line would also open up an important trade link with China, offering Nepal greater options in terms of trade and travel.
- Better road surfaces and road maintenance has to be taken into serious execution. It has been established that 35% of the new SRN roads are still earthen and that only 90% of the paved roads are well-maintained.36 By ensuring good road conditions, truck speeds can be increased and made more consistent, meaning less need for fuel-consuming gear-shifting and truck speeds can be held closer to energy efficient engine speeds, meaning emissions and fuel consumption can be significantly decreased.
- Steps should be taken to reduce the number of non-engineered roads and also to match the road engineering with the truck given the apparent geographic condition in Nepal. Overloaded trucks must also be given much attention. Taking this to account will increase lifetime of roads in good condition, thus, reducing emissions from this sources.
- Fuels should be transported where possible by pipeline. Pipeline transport is substantially more efficient that tanker truck transport – and also significantly reduces the opportunity for illegal theft and adulteration of fuel along the supply chain.
- Rail network should also be improved to facilitate the freight movement. Switching freight movement from truck to rail can reduce GHG emissions down to 1/8th of truck emissions, with a corresponding reduction in the amount of diesel necessary.
- In the long-term, clean electricity could be a major driver for cleaner transportation. Electricity can drive cleaner urban freight vehicles, and can drive ultra-clean freight trains for long-distance freight. Nepal, with its underutilized hydroelectric resources, should make a greater effort to develop an electrical transport system in-step with the development of hydroelectric power.

3.6.3. Market

For the freight market, the emission regulations and environmental policies in Nepal enforces limited measures to promote the reduction of emissions. It only mentions 100% tax rebate for the import of pollution control aids and devices. Other than that, lesser import tax for mass transport and goods carrier vehicles is also endorsed. The Department of Transport Management recognizes the limited incentives for cleaner freight. And so it is planning on formulating a new national transportation (vehicle) policy, which will encourage the import and manufacture of environmentally-friendly and low pollutant vehicles in Nepal.

Additionally, the stakeholders for greener freight should be involved and encouraged. This can be done through different actions such as:

- Developing viable small-scale financing for truck drivers to upgrade trucks in partnership with development banks
- Providing finance support based on technology testing and allow for suitable technologies to be utilized
- Cooperating with multinational companies to insist on greener trucks for freight hauling and promoting Green Freight Asia or similar relevant labeling programs for creating a business case for cleaner freight
- Decreasing trip lengths to be able to reduce cost of empty return trips, thus reducing incentive for overloading, emphasizing the need to improve the road infrastructure on main freight routes.

3.6.4. Regulation

The Government has taken active measures to reduce emissions from vehicles including introduction of tighter fuel and vehicle standards as well as banning of leaded gasoline and polluting vehicles. However, it is evidently insufficient with the high level of PM contributed by transportation, and especially trucks that are part of the freight sector. It would be advisable for Nepal to adopt and strengthen policies and regulations using a set of recommended indicators in line with the Bangkok 2020 Declaration Goals and in the spirit of the Bali Declaration38 for development of an efficient freight system. This will be the first regional declaration on promoting environmentally sustainable transport in Asia which contains twenty time bound (2011-2020) goals that incorporate indicators to assess progress. The indicators included in the annex of the Bangkok 2020 Declaration are:

- Number of kilometers of freight rail lines
- Number of inland dry port
- Quantify improvements in freight vehicle fuel efficiency
- Quantify changes in freight vehicle types
- Quantify network efficiency gains

The goal focuses on strategies to avoid unnecessary travel and reduce trip distances, to shift towards more sustainable mode, and to improve transport practices and technologies.

Vehicle Emission Standards

The Government of Nepal has undergoing active measures, especially in the late nineties, to reduce emissions from vehicles, including introduction of vehicle emission standards, a ban on leaded gasoline and ban on polluting vehicles.

As early as 1994, Nepal already introduced vehicle exhaust tests under the Kathmandu Valley Vehicle Emission Project, funded by UNDP, Nepal. In July of 1997, banning of lead gasoline already started and fully enforced in 2000.

Subsequently, vehicles older than twenty years were banned through a resolution in 1999 together with the banning of importation of reconditioned and second hand vehicles in the same year. The twenty-year ban, however, has seen enforcement challenges, meaning that there are still many vehicles older than 20 years on the road in Nepal.

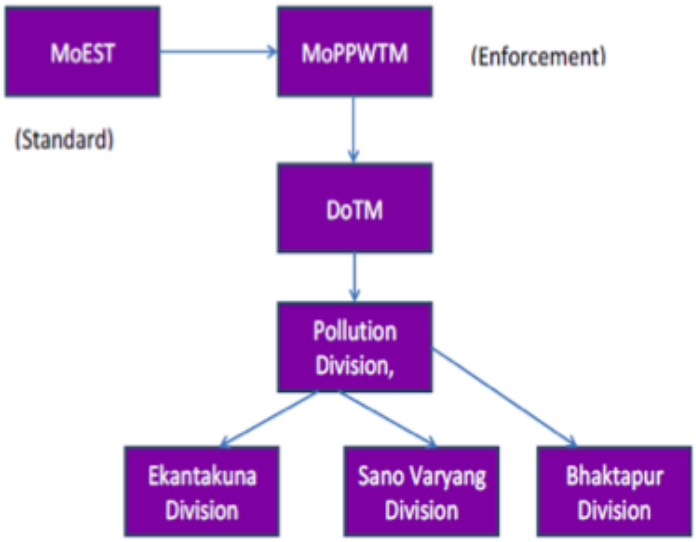


Figure 10: Regulatory structure for emissions regulation of vehicles in Nepal

The foremost regulation related to green freight was introduced in 1999, known as the Nepal Vehicle Mass Emission Standards Act set by the Ministry of Environment, Science and Technology. This act prevents emissions from vehicles, prescribes standards similar to Euro 1/I, and empowered authorities in punishing those who violate traffic and transport rules. There is a certificate of mass emission submitted at the Nepalese custom office.

In 2012, Nepal has moved forward in implementing Euro 3/III standards for all vehicles entering Nepal. In line with this, the government is planning to upgrade the Nepal Vehicular Mass Emission Standard similar to Euro 3/III as well.

The enactment of such policies is governed by the institutional framework as shown in the figure below. The two ministries that have the environment mandate and directly involved with green freight are the Ministry of Environment, Science and Technology (MoEST) and the Physical Planning, Works & Transport Management (MoPPWTM). The MoEST sets the standards while the MoPPWTM enforces it. For the enforcement under the MoPPWTM, the Department of Transport Management (DoTM) is directly involved to provide safe, reliable and easy transportation service to the public and goods carrier. They manage the enforcement of acts, regulations,

taxes and registration rules in the country. On the ground level enforcement, the Pollution Division and Area Divisions helps the DoTM.

As mentioned, most of the regulations were done in the last decade. Since then, Nepal has economically grown and there has been a vast increase in the freight and major changes in its movement. Thus, these regulations should be revisited and realigned providing clear focus on promoting green freight and providing safer and easier transport.

3.7. Recommendations

While Nepal's goals for Euro 3/III are admirable, it is indeed the case that Asian countries should aim for at least Euro 4/IV implementation as soon as possible. Clean Air Asia has recommended that Asian countries aim to at least have a hard target for Euro 4/IV implementation in place by 2016, and Nepal should also aim to put such rules in place in order to protect its citizens from the harmful effects of automotive emissions. Ideally, Nepal would explore the possibility of implementing Euro 5/V or Euro VI, especially for diesel vehicles at the earliest, as diesel emissions are now recognized to be Class 1 carcinogens by the World Health Organization.

Nepal's current fuel standards are matched to the Euro 3 (150ppm Sulfur petrol) and Euro III (350 ppm sulfur diesel) standards, but adulteration with kerosene and other chemicals is common. An inspection system is required in order to ensure that fuel at refueling stations is of adequate quality. Furthermore, it may become necessary for a diesel tracking system to be put in place to allow authorities to ensure that diesel-hauling vessels are not opened and adulterated during the transport of the diesel.
The challenge for Nepal is that the country is largely dependent on India for vehicles and fuel and cannot leap frog India in terms of environmental controls on vehicles. Nepal should continue to explore all possible options, in partnership with India, to improve vehicle emission standards across the board.

Vehicle In-Use and Maintenance Standards

Cars in the Kathmandu Valley are subject to inspection and maintenance procedures, where cars that pass a maintenance inspection are given green labels and those that fail are given red labels. Inspections take place once a year for private cars, and for commercial vehicles, twice per year. Vehicles that do not pass the test are required to be tested again three months later.

Unfortunately, the inspection and maintenance labeling system is not a strong one. Without an automated and centralized system for testing and tracking vehicles, the labeling system is subject to abuse and corruption. Media reports indicate that with an unofficial fee of 500~1000 Nepalese Rupees, a vehicle that does not pass the

maintenance test can still be given a green label, allowing polluting vehicles to drive on Kathmandu's roads.

A major challenge of enforcement in the inspection and maintenance system is that with trucks from India being permitted to remain in Nepal for 72 hours to make deliveries and return to India, many trucks entering Nepal are registered in India. They bring freight to Kathmandu and return to India empty. While from a common-sense perspective, it may be logical to demand that trucks entering Nepal meet a certain emission standard, the fact is that many trucks are controlled by private sector elements that reduce the competition in the freight sector, meaning that it is difficult to make demands on service, as there is little or no alternative service. A ban on existing vehicles entering Nepal could have an impact on Nepal's ability to import goods, without any alternative mode of transport available, unless appropriate subsidies or other means of encouragement were provided in order to assist the private sector in directly upgrading their trucks in India.

Vehicle scrappage system

While vehicles older than 5 years old are, by law, not permitted to enter Nepal, the country has also established rules for scrappage of vehicles. In 2001, a rule was established to remove all commercial vehicles older than 20 years in the Kathmandu Valley, with owners given an 18 month period to replace the vehicle.41 Furthermore, In 2010-11, a plan was established to remove 25% of outdated vehicles, 50% of outdated vehicles by 2011 and 100% by 2013. However, in a consultation performed in April 2014 in Kathmandu, officials noted that this policy, in large part, had not been implemented. If the fuel savings from the replacement of old trucks with new trucks could be used to subsidize the purchase of new trucks, the fleet could be completely replaced within 10-15 years.

3.8. Green Freight Priorities for Nepal

During the "Green Freight and Logistics in Asia" workshop held in June 2014 in Singapore, officials from Nepal positively identified the following strategies as potential areas of focus for Nepal:

- Dry ports
- Railways
- Technology in Waterways and Railways
- Tires packages
- Telematics
- Lower weight trucks
- Engine replacement/improvement
- Fleet optimization
- Traffic Management Systems

 Logistics information platform
 Vehicle Sizing

It is key for officials to carefully note these strategies and analyze them in terms of costs and benefits, speed of implementation, and be realistic in evaluating these processes. Missing from this list is the simple, but gravely important topic of emission standards for trucks and cleaner fuels.

3.9. Green freight in Nepal: Summary

Nepal, as a landlocked developing country, faces multiple challenges in addressing the related challenges of green freight, fuel economy and energy security. Due to its landlocked nature, the country is required to be dependent upon its neighbor, India, for nearly all imported goods, as well as for improvements to its automotive and fuel industry. Furthermore, a great deal of this import trade is facilitated along one single corridor from Baganj to Kathmandu – where more than 4000 trucks enter Nepal from India every day.

First and foremost, in order to make accurate and high-value decisions in transportation, the state of transport data must be improved dramatically. Data including annual t-km hauled, v-kt traveled and local and foreign fleet characteristics are absolutely essential for estimating the potential for improvement, either by improving vehicles, or by shifting to other modes such as rail.

At the same time, Nepal should follow the global trend of establishing small pilot projects in cooperation with private sector trucking companies to test and prove the utility of different energy-saving technologies for trucks given Nepal's special conditions. The pilot projects should be done with the objective of demonstrating to the private sector that investment in trucks will be worthwhile, will be paid back in a reasonable amount of time, will make their operations more profitable through energy savings, and when infrastructure improves, will bring even greater benefits. At the same time, it is critical that policy action be taken to strengthen the emission standards of trucks, aiming for Euro IV or stronger trucks across the entire fleet within 10 years.

While improving the technology of trucks is an important aspect of improving fuel economy and reducing the demand for imported diesel fuel, infrastructure plays a major role in the picture of greener freight in Nepal. Ensuring that trucks need to travel a shorter distance on every trip – whether they are empty or full, should be the first priority for saving fuel. Ensuring that the road is of high enough quality for implementing technologies such as low-rolling resistance tires will also be a key benefit.

However, more emission reductions could be seen through the implementation of a rail link from the rail terminal in Baganj, directly to Kathmandu, thus reducing significantly the need for trucks at all. Rail freight movement has been demonstrated in countries such as Japan to reduce the GHG emissions of freight travel to only 1/8th that of road freight. Other rail lines proposed by both India and China should be encouraged and accelerated on the Nepal side so as to quickly install this efficient mode of transport.

At the same time that infrastructure is being addressed, fuel economy standards and incentives for cleaner vehicles need to be put in place to ensure that all vehicles arriving in Nepal achieve lower and lower rates of fuel consumption. A model that could be considered for Nepal might be that of Saudi Arabia – also a country that primarily imports used vehicles and whose population is highly sensitive to changes in fuel prices. This program might gradually improve the fuel economy performance of the Nepal vehicle fleet – although if the fleet grows at its current rate, it is not likely to reduce total fuel demand. Implementation of fuel economy standards as well as vehicle emission standards and fuel standards will require cooperation with sellers in India who will provide the vehicles and fuels to the market.

Nepal has a high potential for reducing the impact of inter-city freight transport and automotive traffic on the health of its people and on its energy security. All actions in this area will require investments of various degrees – but all actions will equally result in direct savings in fuel and medical costs to the national accounts as well as to the accounts of the country's citizens. Improving the fuel efficiency of vehicles and of freight transport will directly reduce costs that will eventually repay these investments, if managed carefully. Nepal also has tremendous natural resources, including hydroelectricity, which if developed carefully and properly, will bring not just clean transport, but prosperity to the whole country.

4. KEY ISSUES

Chapter 2 and Chapter 3 discussed major trends and current status on the passenger transport and green freight respectively. When the trends and status are filtered through the framework of sustainable transport, we can identify key issues, which have to be addressed by the strategies. Table 8 summarizes major trends and discussed above, and associated issues.

Table 8: Major trends and key issues related to various components of transport system

Components	Trends and Issues
Intercity Transport	• Road transport- always a priority investment in five-year plans • Two districts yet to be connected to Strategic Road Network (SRN) • SRN standard- basic mobility • Only 47% of SRN is paved road • Recent initiatives for higher grade roads eg Kathmandu-Terai-Fast-Track (KTFT) and Kathmandu-Kulekhani-Hetauda-Tunnel (KKHT) • East-West Railway- DPR under preparation • Poor condition of bus services in intercity routes • Haphazard settlement along national highway routes (ribbon-type settlement) • Growing concern for ecological damage from new road/rail construction • Increased landslide vulnerability due to road construction in hilly areas
Urban Transport	• Lower urbanization rate (17 %) • Higher growth rate of urban population (3.16%) • Problem of urban primacy- Kathmandu valley 2.5 million population • Rapid motorization (growth of cars and motorcycles) • Over 2008-13, annual rate of growth for four-wheel light

	vehicle was 8.4 % • Over 2008-13, annual rate of growth for motorcycles was 19.5 % • Car (includes van, jeeps) ownership rate in Kathmandu- 34 per 1000 pop • Over 2008-13, petrol consumption increased by 2.2 times • Total road length in Kathmandu valley 1,595 km • Average road area ratio in urban area of Kathmandu valley is only 6 % • Road expansion lagging behind the pace of motorization causes congestion • Evening peak average speed in five busiest route is 8.8 km per hour • Poor condition of infrastructure for NMT- walk ways and bicycle lanes • Disparity in road space allocation in Kathmandu- expanded road mostly for vehicle movement • NMT share decreased to 40.7% (in 2011) from 53.1 % (in 1991) • Public transport mode share decreased to 47.8 (in 2011) in motorized trips • Weak regulatory provision is reinforcing syndicates in public transport • Initiatives are under way to improve urban transport in Kathmandu • In smaller cities, limited provision of public transport; NMT plays a major role • Ten market towns (50,000 population) are being planned along the mid-hill highway- road infrastructure is the key element of the plan • Need of better public transport and NMT provisions in cities and towns that are popular tourist destination (eg Pokhara, Janakpur etc)

Rural Transport	• Rural road initiatives since 1970s under IRDP
	• DoLIDAR for rural roads since 1997
	• Low cost, labor-intensive and non-engineered rural roads
	  ○ Ecological damages
	  ○ Land-slide hazards
	  ○ Road safety hazards
	  ○ Poor service and maintenance problems
	• Exemplary initiatives for green roads and bio-engineering
	• Transport service through formal/informal paratransits
	• Rapid growth in motorcycle use (replacing bicycle)

GHG emissions and local pollution	• Per capita CO2 emission from fuel combustion is low (133 kg) • Growth rate of CO2 emission from fuel combustion is higher • Share of transport sector in total CO2 in Nepal is 45%- higher in the world • For given per capita income, Nepal's transport CO2 is still at the bottom • Good prospect of developing low-carbon transport • Vehicular pollution is an issue in Kathmandu valley • Average PM10 concentration is higher than national standards • Important policy initiatives were taken in the past to control vehicle emissions • EURO III standard was enforced in 2012
Transport safety	• Road traffic accidents are in rise (in Kathmandu and at the national level) • Fatalities trend is on rapid increase at the national level (may be because of rapid expansion of sub-standard roads) • Increasing trend of accidents involving intercity bus- supposed to be safer • Government of Nepal formulated road safety action plan (2013)

Transport Management	• Weak regulation is promoting syndicates of operators • Problem of monopoly- barrier for service improvement • Ad-hoc route permits causes inefficient operation of public transport • Domination of small public transport vehicles- inefficient road use • Initiatives underway to improve public transport service in Kathmandu • Plan to replace small public transport vehicles by higher capacity buses • Plan for regulatory reform • Draft National Strategy for Transport Management- emphasis on efficient public transport, transit oriented development (TOD) and demand management.
Freight transport	• Domination (or only mode) of truck transport • Old and inefficient vehicles, inefficient operation • Emission problems • Fuel security • Overloading and pavement damage

5. CLIMATE CHANGE AND DISASTERS VULNERABILITY[2]

Transportation is directly affected by climate change. The transport infrastructure, an asset created over the last six decades is susceptible to the impacts of rapid climate change. The traditional way of designing and implementing transport infrastructure is not adequate if long-term sustainability of the road network is to be considered. There is a need to respond to the impacts of climate change, which are often limited to designing measures to address the felt impacts in transport infrastructure development. Enhancing the resilience of development plans to climate risk in its entirety is a strategic and proactive move requiring that anticipated climate threats be assessed before implementing plans so that measures to reduce those threats can be built into the plan itself.

Table 9. Stages of transport infrastructure development and linkage to disaster threats

Stages	Elements to be considered	Disaster threats to investment
Feasibility	• Alignment selection • Design life • Annual maintenance cost	• Premature failures (frequent) due to excessive rain, toe cutting of road slopes by high flowing rivers. • Continuous drought situation and massive migration • Shifting agriculture activities in hills and road slope vulnerability due to change in drainage pattern
Detail design/construction	• Design standards for road works • Standards for drainage structures • Bridge standards • Pavement including the use of bitumen • Assessment of aggregates availability and haulage distance • Use of other construction materials	• Availability of natural construction materials • Exhaustion of river source • Increased haulage of natural materials • Pavement behavior and life • Adequate capacity of existing drainage structure • Resilience of bituminous pavement (additional fatigue due to temperature rise) • Limitation on thermal expansion of

[2] This section is a compilation of parts of background report from Mr. K Pande, UNCRD consultant

	• Slope protection	bridges • Limitation on free board provision on bridges • Limitation on overtopping of bridges by flood • In urban area, maintaining and aligning utilities along with the standards of road infrastructure
Maintenance	• Maintenance standards • Asset preservation	• Emergency maintenance and readiness plan • Frequency of maintenance cycle • Rehabilitation/reconstruction cost • Social cost

A proactive move helps to assess how climate change might impact the sustainability of a proposed development work and the possibility that the proposed development work might impact natural systems, inadvertently amplifying the climate threats. A proactive effort to enhance the resilience of development plans and programs can be concurrent or anticipatory. For adaptation to impacts of climate change, what needs to be looked at is the means of disaster reduction strategy and management. The following table explores various stages of transport infrastructure development and its linkages to the possible disaster resulting from climate change and other natural calamities.

Since, significant percentage of rural roads is not built with adequate engineering inputs, they are found most vulnerable to damages if disaster of any kind strikes. These roads have high gradient sections with seriously tight horizontal curves and the structures that are not properly secured. These road not only contribute to the higher cost of transportation but also demand for higher share of maintenance allocation.

5.1. Assessment of Disaster Impact on Road Infrastructure

Over the decade, Nepal has been experiencing early impacts of climate change that has caused unprecedented heavy rain and massive floods followed by long spells of drought. Different research has reported that there has been a rise in maximum temperature in Nepal by 1.8^0C between 1975 and 2006. This has caused rapid depletion of glaciers in many regions such as Dudh Koshi basin, Imja Glacier, etc. The heavy rains followed by flood in 1974, 1981, 1993, and 2004 have caused a substantial damage to the road assets including bridges in various parts of the country.

During the monsoon time the vulnerability of the road increases due to landslide triggered by rains and constant toe cutting by the flooding river. The economic and social implications during road closures caused by these natural disasters are huge.

In between 1970 and 2010, there were 35 flooding instances recorded at various parts of the country damaging around 3.1 km of highways and feeder roads with economic loss in terms of road closures lasting up to 3 days. The damage to the rural road has not been properly accounted for so far. The road closure during monsoon is very common in Nepal. There is a disruption on the movement of traffic, but resulting economic loss is yet to be assessed.

5.2. Impact to Road Infrastructure in Terai, Middle Hills and Mountains

The Terai region is prone to disasters such as floods and landslides causing premature failures of roads. Flood poses high risks of bank cutting and sediment deposition on roads that are lower in altitude. As the topography changes from flat lands to hills, the roads are more vulnerable to landslides induced mostly by earthquakes and humans. As the terrain becomes steeper, the chances of glacial lake outbursts and landslides increase. These disasters are severe threats to the existing road networks in Terai, Hilly and Mountainous region.

5.3. Impact to Road Transportation in Kathmandu Valley

There are approximately 750,000 vehicles registered in the Bagmati Zone which is almost half of the total vehicles registered in Nepal and significant proportion of these fleet are concentrated in Kathmandu Valley. The number of registered vehicles is rapidly increasing in Kathmandu, particularly, in the recent five years accompanied with the rapid increase of urban population and economic development. The share of motorcycle has increased at an alarming rate of more than 20% in the past five years. The motorcycle now constitutes around 74% of the total vehicle fleet in Nepal and in absence of effective public transport system, it is bound to grow more in future.

In Kathmandu Valley, public transport system is running under the private investment. The quality of the services is considered below the satisfactory level. Vehicles used for public transport are usually old and the total number is not sufficient to cater with the demands of the riding public. Since there is no railway system in the valley at all, public transportation in Kathmandu Valley has been provided by bus and minibuses on major roads, micro buses, and tempo network on secondary roads. In absence of effective road hierarchy, the services are very complicated and most of these routes end in the central area of the city contributing to the chaotic traffic jam of the city road. Organizing and operating effective public transport system in Kathmandu valley remains a challenge. Government is currently

pursuing the agenda to promote public transport in the valley as part of the sustainable transport initiatives.

Kathmandu Valley occupying 5% of the land but represents around 9.5% of the country's population according to population census of 2011. Over the period of 1971 – 2011, the disaster (earthquake, flood and landslide) has caused 160 deaths and 235 injured. This has further caused the loss of 1213 houses and damaged 2261 houses in the Valley.

Climate change adaptation measures have not been used in the construction and maintenance of these roads in Kathmandu. With careful consideration of the life cycle costs, adaptation practices should be integrated into these processes to lessen the impact of climate change on the population living in the surrounding areas.

5.4. Impact of Climate Change on Road Transport

In Nepalese condition, defining the climate impact linkage for infrastructure, the Climate Resilient Planning document has stated that "infrastructure sector is influenced by floods, mass wasting and debris flow, sedimentation, rise in ground water levels, and rain and windstorms. The anticipated problems include damage to infrastructures, increased fatigue of infrastructures, silting of drains, increased instability of land through the weakening of river banks or hill toes or land subsidence, and inundation and submergence of infrastructures." Drought is now emerging as one of the possible result of the climate change in Nepal. Despite increased forest cover, water sources is drying up and forcing the villagers to opt for permanent migration. Seven districts (Jajarkot, Mugu, Kalikot, Dailekh, Saptari, Achham and Siraha) have already been listed as districts with high vulnerability index. Fifteen districts have been classified with high vulnerability index. This could turn out to be a bigger challenge in future in planning investment for infrastructures including transport. The criticality of the road infrastructure, compared to other physical infrastructure, lies in maintaining the serviceability at the time of disaster and during post recovery period. This checks on reducing further damage, which may be caused by secondary impacts.

IPCC's Fourth Assessment Report predicts the weather pattern in South and Southeast Asia to be dominated by rainfall and increased temperatures and Northern Asia to be affected by heavy winter rain. As Nepal is a landlocked country, the rise in sea level does not have as much an impact as the melting of glaciers in the Himalayan region.
Climate change poses a major challenge to the policy makers in developing the most appropriate guidelines for construction and maintenance of road infrastructure. Since Nepal is a country with varying topography, different parts of the country will be subjected to differing climatic conditions. In addition to this, the increase in the temperature and rainfall will have substantial impact from the planning stage through the operation stage of the roads. The mountainous region of Nepal is more prone to

landslides, mud flow, debris flow and rock-falls, due to heavy rainfalls, that will block the flow of traffic and can also cause damage to the road infrastructure. In the Terai regions, the increase in the 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 the chances of accidents and delay the transportation of basic necessities to the rural communities. Increase in the consumption of fuel, which is mostly associated with high costs, is another consequence of the traffic jams caused due to the damaged roads.

Table 10: Impact of Climate Change and Disaster on Road Transportation and Potential Design Considerations for the Future

		Primary Impacts	Secondary Impacts	Design Considerations
Climatic Condition	Temperature increase	**Road Investment** • Road investment marginalized by excessive migration due to water scarcity (local roads)		• Consideration of appropriate design life • Stage construction • Design based on existing traffic (Low Volume Road)
		Pavement • Increased fatigue bituminous pavement needing additional maintenance cost • Deterioration of gravel surface due to excessive moisture loss leading to additional cycle of resurfacing.	• Increased VOC with additional consumption of fuel. • Possibility of increase in road accidents.	• Use of stiff bitumen • Soft bitumen with solvent in water (emulsion) • Control soil moisture • Adapt gravel sealing (Otta seal/grav-seal) • Additional road safety provision
		Bridges • Thermal expansion of bridges • Buckling of joints of steel structure • Higher corrosion activity at locations with high humidity.		• Careful attention to material used for joints • Extensive use corrosion protection material
	Temperature decrease	**Pavement** • Exposure to snow condition • Affect road transport operations • Increased OM costs	• Increase in road accidents	• Adapting micro-texture pavement standards for urban and high volume roads.
	High rainfall/flooding	**Pavement** • Deterioration of gravel surface due to excessive moisture. • Deterioration of bituminous pavement with faster deterioration trend calling for early intervention for periodic maintenance or overlay.	• Increased VOC with additional consumption of fuel. • Possibility of increase in road accidents. • Increased maintenance cost	• Adopt resilience drainage system • Improve soil strengthening and rock stabilization technique • Resilience asphalt and concrete pavement • Regular survey and maintenance measures
		Road Embankment & Drainage Structures • Damage to road drainage structures including foundation resulted due to high runoff. • Breaching of road embankments resulting loss of road section. • Submersion of road • Landslides and road blocks • Erosion	• Traffic disruption • Road closure for indefinite period • Weakening of pavement structures due to submersion of road embankment for longer period of time.	• Proper discharge estimation to design the size and shape of drains and drain slope • Slope protection in Mountainous roads • Proper subsurface drains and catch drains • Increase road surface camber for quick removal of surface water for pavement • Building line defense for embankment to prevent complete failure (reinforced earth)
		Bridges • Scouring of bridge foundation • Submersion of bridge • Bridge washout	• Disruption of traffic	• Creating additional free-board (flood return period estimation) • Protection of river and banks • Revising bridge selection criteria specific to location with possible climate change impact.
Earthquake		**Road Embankment & Drainage Structures** • Failure of embankment and drainage structures. • Bridges • Damage to bridge bearing & column	• Traffic disruption • Damage to utilities (urban roads) • Traffic disruption	• Building second line defense for embankment to prevent complete failure (reinforced earth) • Classifying roads and developing and implementing special code/norms for roads and associated utilities (urban roads). • Quality control regime developed and implemented in bridge building in remote area (local road)
Landslides		**Road Embankment & Drainage Structures** • Failure of embankment and drainage structures.	• Traffic disruption • Damage to utilities (urban roads)	• Vulnerability of the road slopes regularly checked and monitored (Highways and Feeder Roads).

The central region of Nepal faced a major climate change impact in 1993 when heavy rainfall and flood washed away bridges and numerous road sections. In July 1993, heavy rainfall with a maximum daily rainfall of 540 mm with hourly rainfall of 70 mm on 19th July, created havoc in central Nepal with serious damages to the transport infrastructure. Kathmandu Valley remained isolated (no land transport connection) for 21 days from the rest of the country. In Both highways (Tribhuvan and Prithvi) linking Kathmandu valley with the rest of country, three bridges (washed out), 23 culverts and 534 meters of road section at 19 places suffered major damage.

Regmi and Hanaoka (2011) outline the potential impacts of climate change on road infrastructure and the design parameters that should be adopted in order to avoid damage caused by the different climatic conditions. The table below has been adapted to include dimensions of climate change impacts on roads in Nepal.

5.5. Adaptation of road infrastructure to climate change and disaster impacts

Since the majority of the local population as well as tourists in Nepal predominantly use road transportation, a need to plan and construct roads that can withstand extreme weather conditions is increasingly necessary.

Adaptation, in general, is either adaptation through making changes in the structural design (engineering) such as specifying materials, having standard dimensions, constructing proper drainage systems, etc or through non-engineering methods such as planning for maintenance, alignment, land use and environmental management. In addition to this, ADB's report on the "Guidelines for Climate Proofing Investment in the Transport Sector" (2011) emphasizes that a "do nothing" approach could also be one of the actions to take in order to minimize costs on roads that have low economic feasibility.

In addition, there are two types of responses that can be planned by the government: i) Pre-disaster response and ii) Post-disaster response. In the pre-disaster section it is important to discuss about policy, resilience design, quality of material use, regular basis inspection and maintenance (I/M), research and institutional development, etc to resist with the climate induced disasters and climate impacts. Post-disaster includes how to make the people and infrastructure adapt during and after the disasters. This part mainly covers management, maintenance, medical facilities, and public awareness, etc. for the resilience society.

At the moment in Nepal, most of the adaptation measures being taken are geared at mitigating the effects of natural disasters such as landslides, which frequently occur in different parts of Nepal. Bioengineering has played a major role in stabilizing the slopes of hills in different parts of Nepal. It is a cost effective, environmentally friendly and sustainable method that has proven to be successful in solving road weathering and blockage caused by landslides . However, bioengineering is only one

way of disaster proofing roads. Other adaptation measures need to be included in the plan in order to make the road infrastructure of Nepal disaster as well as climate resilient.

Currently, road construction and rehabilitation projects in Nepal don't consider the impacts climate change can have on road infrastructures. The only consideration that is made is on flood proofing road sections with priority, keeping in mind the 50 years and 100 years flood cycles. Significant consideration should be given to flood proofing roads that are lower in the hierarchy in order to avoid flooding and damage to the roads. These roads, although low in priority for employing flood proofing method, could be the only access point for the population living in the vicinity.

ADB outlines the steps to screening and scoping projects in order to determine the risks associated with the infrastructure development projects due to climate change . The existing framework of the Local Adaptation Plan for Action (LAPA) has similar steps but is more focused on the local level rather than the national context . Key steps to plan for roads that are durable during changing climate, in developing countries like Nepal, have been adapted from ADB (2011) and Regmi and Hanaoka (2011):

- Identification of roads that are most prone to extreme climate conditions and disasters
    - Project screening and scoping – To screen the project's exposure to climate change and establish the objective of adaptation. In this step, identification of the key stakeholders is very important.
- Prediction of climate events in the future in the identified areas
- Risk analysis and impact assessment
    - Vulnerability assessment – It is important to continuously carry out the vulnerability assessment even after the program has been implemented.
    - Adaptation assessment – Similar to the vulnerability assessment, the adaptation assessment should also be continuous so that future adaptation practices are incorporated into the roads and the population accessing it.
- Planning the response to the risks present.
    - In the context of LAPA, in this stage, the local adaptation plans are developed.
- Life cycle costing – This will provide the decision makers with criteria in assessing the feasibility in including adaptation measures into the road structures. Priority should be given to roads that have high and medium traffic density.
- Design the infrastructure
- Implementation and construction
- Monitoring and Evaluation

Identification of roads that are most vulnerable to varying climate conditions, however, is very challenging due to the uncertainty in the weather patterns as well as the differing topography of the country. In addition, majority of the roads in Nepal are earthen roads, which may require higher costs to implement the adaptation policy. As per the study carried out in Ghana to assess the cost of climate change in road infrastructure, the cost of implementation of adaptation policy is higher than the "no adapt" policy .

Although the Nepali government as a policy of allocating NPR 3 million to each VDC for development including road construction and maintenance, the VDCs utilize this resource without proper design addressing the climate change issues.

5.6. Recent Gorkha Earthquake and implications for disaster resilience

On the noon of Saturday, April 25, 2015, 7.8 Moment Magnitude earthquake struck the central region of Nepal and on 12th May, 7.3 moment magnitude of a big aftershock again jolted. These unfortunate events took a heavy toll in terms of loss of life and property. About 9,000 people died and 22,300 people injured, over 1,000,000 households were affected including about 500,000 houses damaged. Moreover, 7000 schools and many public buildings and infrastructures were completely damaged. National Planning Commission (NPC) in assistance with numerous international experts from bilateral and multilateral donor agencies undertook post disaster need assessment (PDNA), which presented a picture of immediate damage and made recommendations for the reconstruction needs.

Moreover, Nepal's infrastructure development and urban form is in primary stage. Many people are living in remote villages with difficult topography where even providing basic facilities like schools, hospitals, and access roads is quite challenging. In some places people have to walk more than a day to travel from one village to another. In addition, most of the people are living with the subsistence agriculture and income is not enough to sustain even the basic needs. Youths from village are going abroad for foreign employment, such as in Malaysia and Gulf Countries, and housewives are migrating to urban area for schooling of their children. Therefore, it is necessary to make a plan for resettlement of some earthquake affected areas and this is the right time to initiate because people are aware that they should reside in a safe habitable place. Identifying geographically and geologically suitable habitable places across the country, identifying carrying capacity of that places, planning for town/city or municipality, planning for hierarchical connecting transport infrastructures based on size of the relocation places might be the important tasks for the regional restructuring of whole country and proceed towards the sustainable development.

Likewise, in case of capital region of Kathmandu Valley, the earthquake reconstruction strategy should go beyond the just recovering the damaged physical structure. Urban expansion in the in the valley was the result of haphazard land

development to respond the increasing demand of housing as the city population expanded. Inadequate and unplanned road network, weak land-use regulation and lack of earthquake resistance constriction practice resulted in range of urban problem including higher vulnerability to disaster. There is a broad realization at the political and policy making level to use this crisis as an opportunity to reshape the urban structure of Kathmandu Valley possibly by adopting the concept of transit oriented development with new urban centers.

Fortunately, the otherwise devastating earthquake did not incur much structural damage to transport facilities. There were only some instances of quake-triggered landslides, which disrupted services in the some highway routes. The unprecedented scale of other damage has however alerted policy makers to better prepared for the future disaster, and there is a great deal of awareness and willingness to consider for disaster resilience of transport infrastructure.

6. STRATEGIC PERSPECTIVE FOR SUSTAINABLE TRANSPORT

The vision, objectives and targets set above basically reflect the desirable path that the Nepal's transport development should follow. However, in a developing country like Nepal, there is a wider discrepancy between the business-as-usual and desirable paths as reflected in the major trends and issues discussed above. There is a range of factors that may act as barrier in perusing identified objectives and achieving of intended targets. It is important to clearly understand such key challenges in order to formulate effective strategies and actions. In addition, some of the defining features of Nepal may also offer unique opportunities to achieve the objectives of National Sustainable Transport Strategies (NSTS). This section first extracts a set of drivers that would broadly determine the future transport scenarios in Nepal. Key challenges and opportunities for developing environmentally sustainable transport system in Nepal are then identified.

6.1. Future driving factors for transport sector in Nepal

- *Higher economic growth and socio-economic restructuring*
- *Significant change in the pattern of spatial development*
- *Rapid urbanization*
- *Increasing demand for transport (all purpose)*
- *Increasing demand for fossil fuel*
- *Higher awareness for climate change and other disaster vulnerability*
- *Introduction of new technology in transport sector*

6.2. Key challenges

- *Making adequate investment for transport infrastructure*
- *Overcoming technical constraints for infrastructure building*
- *Decoupling economic growth and motorization (cars and motorcycles)*
- *Haphazard urban development and settlement patterns*

- *Maintaining environmental and safety standards in low-cost rural roads*
- *Shifting from road to railway mode (after railways development)*
- *Promoting non-motorized modes (NMT)*
- *Enhancing institutional capacity- regulation, database and research*
- *Poor transport safety and security*
- *Limited mobility, accessibility and connectivity*
- *Poorly developed transport information systems*
- *Likelihood of natural disasters and vulnerability for transport system*
- *Limited financial resources*
- *Energy efficiency and security issue*

6.3. Opportunities

- *Possibility of achieving more appropriate physical form- Physical structure of transport and spatial system still evolving*
- *Real prospect of developing a comprehensively integrated transport system*
- *Public transport is still dominant mode- just need to keep it on track*
- *Good prospect for commercial viability of public transport due to higher population density in urban area*
- *Possibility of corridor development and appropriateness of rail-based intercity transport*
- *Real prospect of zero emission public transport because of hydropower generated electricity*
- *Possibility of synergy rather than trade-off between environmental and economic dimensions.*

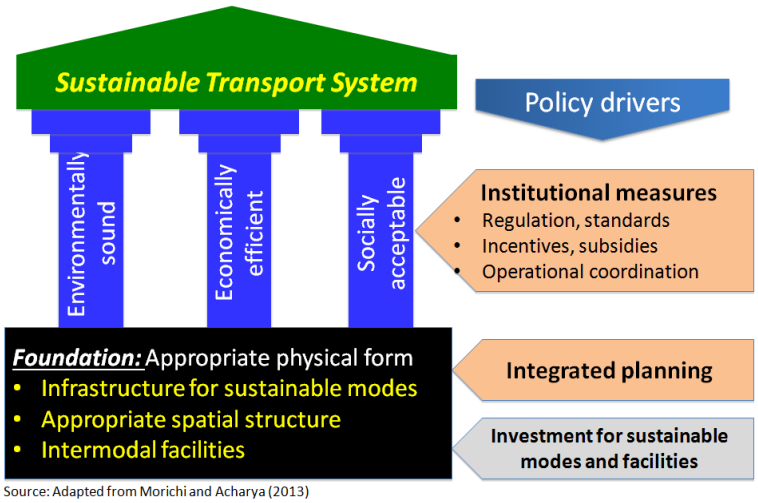
- *Possibility of improved quality of transport- mobility, accessibility and affordability*

- *Possibility of developing water transport in rural and urban areas.*

6.4. Perspective for National Sustainable Transport Strategy (NSTS) for Nepal

Nepal, a least developing country, is featured with some special characteristics, which may demand specific perspective while formulating ST strategy. Transport infrastructure and other physical system are at the very preliminary stage of development in Nepal. This offers an important opportunity of better integrating transport and land use at the national and urban level. The concept of integrated transport has recently been broaden to achieve integration at different level, such as integration at the planning level, at the investment level, at the operation level and also integration between transport and other sector (such as health, education). As the overall physical and spatial structure in a developing economy like Nepal is just evolving, it is possible to go for comprehensive integration.

High population density and inadequate road infrastructure is another defining feature of Nepal. The road space or the reserved right-of-way in major metropolitan area is much inadequate to serve the rapid trend of motorization. Because of land scarcity, land acquisition for roads is now a thorny issue even in non-urban areas. On the other hand, the current national road network in Nepal is just for very basic accessibility. The transport service has to be speeded up to cater a high-growth economy. Such a condition in Nepal demands that public transport be fully utilized for mobility to make efficient use of limited road space. In addition, railway may offer even better option given the future scenario of large-scale demand for both urban and intercity transport. Higher population density at the national and urban level further provides



Source: Adapted from Morichi and Acharya (2013)

Figure 11: Foundation and Pillars of Sustainable Transport

an opportunity to run public transport services on commercial basis.

In developed economies, strategies for sustainable transport normally involve institutional, regulatory or technological solutions. New investment for infrastructure or facilities is rarely applicable since infrastructure and facilities are already there. However, in a developing country like Nepal, transport infrastructure and facilities are grossly inadequate. Under such circumstances, only institutional or regulatory (so-called software) instruments may not be that much effective. Hence, in Nepal, it is important to adopt a strategic perspective that places equal emphasis on both hardware (infrastructure and facilities) and software (institutional) aspects. In a way, integrated development of infrastructure and facilities provides a sound foundation on which soft policy measures can more effectively work (Figure 11). In addition, appropriate physical structure (involving transport infrastructure and spatial patterns) would make it possible to achieve a synergy rather than trade-off between environmental and economic objective.

Another element of strategic perspective is appropriate 'timing' of policy implementation (Acharya and Morichi, 2013). Long-range vision as articulated here demands a range of actions– all of these would be important but may not be feasible because of resource and capacity constraints. On the other hand, some effectiveness of policy measures is more time-sensitive in the sense that delayed or ill-timed intervention may not be as effective as intended. It is therefore important to identify time-sensitiveness of all recommended actions and set priority in the action plan accordingly.

Fortunately, several elements of environmentally sustainable transport have already been adopted as the key policy objectives in various policy strategies or guidelines related to transport sector. These include road safety strategies, transport management strategies, and electric vehicle promotion strategies. National Urban Development Strategy (NUDS) is currently under preparation (and the strategies and measures outlined in this documents has been adopted in NUDS). This demonstrates that government of Nepal has given a high priority to the agenda of environmentally sustainable transport. However, there are some challenges in getting these strategies and guidelines. In particular, the most identified measures demand a system approach of implementation in terms of thematic coordination (such as land-use transport coordination) and institutional coordination (among different agencies realted to transport). This strategy would therefore make best effort to streamline all the existing straggles or guidelines (irrespective of their status as approved or in the process of approval), and to fill up gaps picking up other important elements of environmentally sustainable transport.

7. STRATEGIC COMPONENTS AND ACTIONS

7.1. Strategic components

The issues, challenges, opportunities and the strategic perspective discussed above lead to few strategic components that require priority focus in the future in order to deliver the articulated vision of National Sustainable Transport Strategy (NSTS) for Nepal. Commonly discussed strategic components in the literature include so-called Avoid, Shift and Improve (ASI) strategies. Here, Avoid means avoiding excessive travel, Shift is about moving from environmentally damaging to environmentally friend modes, and Improve means improving various aspects of transport system. These strategic components are quite relevant for addressing environmental issues. Since the scope of sustainable transport also involve economic, social and disaster resilience aspects, we need to explore few more strategic levers. Nonetheless, ASI framework would serve as the core component.

Key components for National Sustainable Transport Strategy (NSTS) for Nepal are listed below. A brief discussion including intended issues to be addressed under each component is also included.

7.1.1. Investment for essential, people friendly and sustainable transport infrastrcture

Because of grossly inadequate transport infrastrcture, higher degree of infrastrcture investment is urgently needed for intercity transport, urban transport and rural transport. Priority should be laid first for essential infrastrcture for basic accesibility, such as general roads adpting a peop-friendly perpective rather than the usual vehicle friendly perspective. People friendly perspective would demand adequate facilities for pedestraian and non-motorized modes, special design consideration to ensure easy access to and use of transport infrastrcture and services for childeren, elderly, and phusically challenged people. At the later stage when higher development stage demands more efficienct and relible services, priority should be placed more more on sustainable infrstrcture, such as intecity railway and urban mass transit (BRT or MRT) rahter than expressways for private automobiles. The issues to be addreessed by this strategic components includes: Provision of high-quality public transport; expansion of road capacity and easing of congestion; expanded coverage of public transport; better connectivity of regions and local cities; improved accessibility and mobility; reduced emissions due to sustainable modes (railways). Equally important is efficient and timely maintainance of infrastrcture and facilities.

7.1.2. Planning and development of integrated transport system

The core element of sustainability is to make the best use of transport infrastructure and facilities developed with scarce capital resources. For this, it is important to plan,

develop and operate transport infrastructure to produce a truly integrated transport system. Such an integrated system allows making the best use of each mode offering flexible and high-quality transport services to the users. It is important to achieve integration at the level of physical infrastructure (including land-use and transport coordination), intermodal and network coordination, service operation (coordinated scheduling and fare integration) and regulatory integration (level-playing field for competition between different modes). The issues to be addressed by this strategic component include: transit oriented development; seamless public transport; competitive public transport; transport efficiency; higher mode share of public transport and NMT.

7.1.3. Introduction of technology for efficiency and sustainability

Since Nepal is a backward country in terms of use of modern transport technology, there is good prospect of serving ST objectives through technological options. These involve improved vehicle engine, improved fuel quality, introduction of low-emission fuel such as biofuel, introduction of mass transit technology (BRT, MRT), and high speed railways, introduction of ITS, use of bio engineering etc. The issues to be addressed by this strategic component include: energy efficiency, vehicular emissions, quality of transport service, congestion in urban roads, road safty, erosion and land slide hazards.

7.1.4. Priority for improving public transport and non-motorized transport

The dynamics of modal competition normally works in favor of private mode mainly because of unfavorable cost dynamics for public transport and users' preference for private mode as income grows. Because of such phenomena, just a provision of good public transport facilities is not enough to attract users. Some kind of public support (not necessarily a subsidy) may be necessary to maintain competitiveness of public transport. Also important is to give priority for NMT on its own merit and also as supporting factor of promoting public transport. The issues to be addressed by this strategic component include: improving mode share of public transport; transport safety; lower transport emission; inclusive transport; improve public health.

7.1.5. Travel demand management (TDM)

Travel demand management is about reducing need of travel, shortening the trip length, shifting to or maintaining share of public transport modes, and scheduling trip time to avoid congestion. The issues to be addressed by this strategic component include: lower transport emissions per capita; public transport mode share.

7.1.6. Environmental and social safeguards

This component includes environmental and social impact assessment for transport projects. Because of steep and rugged topographical, fragile geological and vulnerable seismic condition of Nepal, transport infrastructure projects should be carefully assessed to minimize ecological damage, and landslide and other hazards. The issues to be addressed by this strategic component include: ecological impacts of intercity and rural roads; landslide and flooding hazards due to low-cost rural roads; separation of community by high-speed transport routes.

7.1.7. Adopt the concept of green freight

Being a land-locked country, Nepal's freight transport gas to overly rely on the truck transport, which is inferior economically and damaging environmentally. Fortunately, recently emerging concept of green freight is offering various doable measures to improve the performance of the road-based freight transport.

7.1.8. Building climate and disaster resilient transport system

Nepal is vulnerable to climate change events and also other recurrent natural disaster. Building resilient transport system would allow adapting to and recovering from the hazards. In the aftermath of the recent devastating earthquake, government of Nepal has placed emphasis on developing disaster resilient transport system. The reconstruction efforts currently underway have already identified

7.1.9. Enhance institutional capacity and undertake reform

In order to make all above components more effective, institutional capacity of Nepal's transport sector needs to be significantly enhanced. Also necessary is to undertake reform to be responsive to emerging challenges. The issues to be addressed by this strategic component include: public transport regulation; database and research; organizational coordination. The institutional capacity of local government need to be strengthened in particular since the local transport infrastructure and services are under the jurisdiction of local government.

7.2. Strategic Actions

This section presents a list of strategic actions under each strategic components discussed above. At this stage of draft document, the actions are just identified and yet to be put in the format of action plan showing a clear time line. This part will be completed after the consultative meetings with the related government agencies. Table 4 shows relevant actions for achieving the objectives and thereby delivering the vision.

Table 11: Strategic Actions under each strategic component

▪ *Investment for people and environment frinedly transport infrastructure*	
Intercity transport	• Completion and upgrading of Strategic Road Network (SRN) • Construction of Kathmandu Terai Fast Track (KTFT) and Kathmandu Kulekhani Hetauda Tunnel (KKHT) highways • Acquire right-of-way for by-pass roads in towns along national highways • Construction of service lanes and pedestrian facilities on national highways • Construction of service stations on national highways • Construction of Mechi-Mahakali-Kathmandu-Pokhara electric railways • Study for Kathmandu-Hetauda high-speed railway (HSR)
Urban transport	• Expand road network in Kathmandu Valley and other major cities • Introduce advance and innovative construction/maintenance methods for urban roads • Acquire adequate right-of-way (RoW) for strategic urban roads in secondary and tertiary cities • Designate the road hierarchy and complete missing links in Kathmandu • Improvement of major intersection in Kathmandu valley and other major cities (including provision of flyovers) • Improvement of traffic management system in Kathmandu valley and other major cities • Provisions of pedestrian facilities, such as overhead bridges • Planning and implementation of outer ring-road and other suburban arterial roads in Kathmandu valley • Prepare a Master Plan for mass transit in Kathmandu (high capacity bus, BRT, LRT, MRT) • Improve the condition of road-based public transport with viable options, such as introduction of high-capacity buses, provision of bus lane or Bus Rapid Transit (BRT) system.

	• Make use of value-capture mechanism to fund urban transport infrastructure investment and integrate transport and land development. • Invest for pedestrian and Non Motorized Transport (NMT) infrastructure in Kathmandu and other cities • Make provisions for bus terminals, bus stops, taxi stands and bicycle stands and transfer facilities • Make provision of parking facilities in Kathmandu and other major cities • Undertake road network planning in secondary/tertiary cities
Rural Transport	• Introduce agricultural roads and integrate them with rural roads • Improvement of existing rural roads especially in hilly and mountainous regions. • Upgrade the design standard of rural roads
▪ *Planning and development of integrated transport system*	
Intercity Transport	• Coordinated planning of transport network with other sectoral plans, such as industrial zones, hydropower development, eco-tourism, agro-industries and so on. • Achieve integration between national transport network and regional development plan • Match transport hierarchy with city hierarchy • Coordinate railway development with regional development and local town development plans • Physical integration with good connectivity of highways, railways and airports with the provisions of intermodal (transfer) facilities • Coordinate the development of road-side service station with the function of market for local agricultural and other productions • Balancing social cost and benefits of different intercity modes through subsidies and taxes

Urban Transport	• Coordinate land-use and transport development • Promote transit oriented development (TOD) in big and small cities • Promote high-density and compact city development (minimize travel) • Plan for future Mass Rapid Transit (MRT) routes and locate the high-density housing (such as apartments) along the MRT routes • Make adequate provision of transfer facilities (connecting different modes) • Make provision of parking for introducing park-and-ride system • Enforce integrated fare system (eg distance-based) for public transport • Seek balance between the cost of private mode and public transport fare • Recognize walk and NMT modes as the means of improving public health
Rural Transport	• Undertake settlement planning/restructuring in the rural area before planning for the rural roads • Integrate rural roads with rural economic activities, such as productions of cash crops, diary products, poultry and livestock, small industries, rural tourisms and so on.
▪ *Introduction of technology for efficiency and sustainability*	
General	• Improved standard for vehicle energy efficiency • Upgraded emission standards • Use of alternative and low-emission fuels • Electrification of transport vehicles • Introduction of electric rickshaw in small/medium cities • Exploring possible use of Intelligent Transport System (ITS) for enhancing road safety and transport service improvement, and designing new infrastructure considering possible use of

	ITS in future.
Intercity Transport	• Consideration for possible use of high-speed rail (HSR) in future for the proposed East-West railways routes (civil structure to be designed for HSR)
Urban Transport	• Introduction of trolley buses or electric buses in Kathmandu • Introduction of bus lane or BRT routes where the existing road width permits. • Provision of high-quality buses (with bus info system, WiFi) • Barrier free public transport vehicles (eg., low floor buses)
Rural Transport	• Use of green road technology and bio-engineering to minimize ecological impacts and landslide hazards due to construction of rural roads
▪ *Priority for improving public transport and non-motorized transport*	
General	• Taxing private modes (vehicle tax and fuel tax) and provide subsidy to public transport form the collected revenue • Improve service level of public transport (speed, vehicles standard, reliability, safety)
Intercity Transport	• Planning for bus lane in newly constructed intercity expressway routes • Pedestrian way and dedicated bicycle lanes along national highway sections passing through the settlement areas.
Urban Transport	• Make provision of bus lane during peak hour • Setting standards for pedestrian way and NMT lanes in urban areas • Study for possible restriction of motorcycles and cars (during peak hour) on the busiest routes in Kathmandu valley • Provision of public transport (electric vehicles) and NMT facilities in cities/towns that are popular tourist destination
Rural Transport	• Make provision of public transport in rural areas • Discourage replacement of bicycle by motorcycle through public awareness and bicycle lanes. • Promote bicycle clubs targeting rural tourists

▪ *Travel demand management (TDM)*	
Intercity Transport	• Plan for regional economic zones and transport connectivity to minimize intercity travel and for better economic integration among the regions. • Planned city development along national transport corridors giving priority for making use of public transport (intercity) more efficient and convenient (such as with provisions of bus terminal, access/egress modes).
Urban Transport	• Reduce travel demand by o Land-use and transport coordination o Pricing transport to reflect real social cost • Arrange staggered working/school hours • Promote tele-commuting • Promote modal shift (from private to public) o Raising public awareness on the benefits of public transport o Imposing higher cost on private modes ('push' factor) o Making public transport attractive ('pull' factor) • Plan and implement urban development schemes under Transit Oriented Development (TOD) in Kathmandu valley and other sub-metropolitan cities. • Early planning intervention to ensure land-use and transport coordination in newly (recently) declared municipalities or newly extended areas of existing municipalities or metro (and sub-metro) cities.
▪ *Environmental and social safeguards*	
General	• Reviewing guidelines for environmental and social assessment • Provision of considering positive environmental benefits of railways in EIA guidelines • Strengthening vehicle testing and green sticker system. • Monitoring of vehicle/engine condition for compliance • Regulation on aging vehicles

	○ Implement the policy decision of phasing out 20 years old vehicles ○ Prepare guidelines for limiting vehicles ages by the kind of vehicles (such as private, taxis, buses, mini-buses, freight vehicles, vehicles for urban, intercity and rural; vehicles for terai and hill areas) • Provision of safety audit for infrastructure and vehicles • Checking drivers' health and other condition • Stringent conditions for issuing driving licenses for public transport vehicles
Intercity transport	• Provision of service lanes on national highways • Provision of over/under pass on national highway and railways
Urban Transport	• Up scaling vehicle emissions standards in Kathmandu valley • Strict monitoring of compliance of vehicle emission standard
Rural Transport	• Upgrading engineering and environmental standards of rural roads
▪ *Adopt the concept of green freight*	
Long-haul freight transport	• Coordinate production and consumption places (minimalize transport distance) • Minimize empty-running of trucks • Improve engine efficiency (fuel economy) • Improve operational efficiency of truck transport • Modal shift to railway/water transport • Provision of container port (dry port)
Urban freight transport	• Provision of appropriately located freight station • Design of efficient distribution logistics • Clean vehicles
▪ *Building climate and disaster resilient transport system*	

General	• Awareness raising among key stakeholders • Developing and mainstreaming project screening guidelines • Adopt design standards to adapt climate change and other hazards • Provision of network redundancy in transport planning • Classification of road system based on the degree of vulnerability • Adopting hierarchical design standards based on the strategic importance of a particular route of link
Urban	• Adopt higher design standard for strategic roads (eg access to hospital etc)
Rural roads	• Utilize bio-engineering techniques • Avoid building non-engineered roads • Coordination between access and planned settlements
▪ *Enhance institutional capacity and undertake reform*	
General	• Building capacity of government institutions (central and local level governments) • Upgrade technical capacity of private firms involved in infrastructure design and construction (consultants and contractors) • Start courses on railway planning, engineering, and management in public engineering campus • Establish railway training institute • Building capacity for transport policy research o Establish in-house think-tank within government agencies o Establish long-run collaboration for transport policy research with some research center of public university • Maintain data-base of basic transport data • Restructure transport regulatory institutions and reform regulatory provisions for transport services.

	• Establish linkage/partnership/collaboration with concern agencies /institutions/stakeholders national and international levels.
Intercity Transport	• Improve/enforce regulation for axle loads of heavy vehicles plying on the national highways
Urban Transport	• Regulate use of motorcycle on some busiest routes (as a pilot project) • Conduct periodic personal trip survey for Kathmandu valley • Design public transport routes and franchising policy based on scientific analysis

8. CONCLUSION

This document is a final draft of National Sustainable Transport Strategy (NSTS) for Nepal produced as the compilation of first draft of EST strategy and two other background documents, namely green freight and climate and disaster resilience. In fact, 'sustainability' aspect has already been a subject of policy priority as reflected in various policy documents from Ministry of Physical Infrastructure and Transport, and other related government agencies. Various initiatives have also been taken at the policy, planning and project level to improve sustainability of transport system. National ST Strategy would basically build on the past and on-going initiatives, and make attempt to complement and bridging the gaps. A broad review of past trends and current initiatives has been under taken and issues, challenges and opportunities are identified. Major strategic components and actions, which meant to support in achieving the objectives and the vision of NSTS, have been proposed. They are subject to critical review by major stakeholders and further refinement.

Recently, respective agencies of the Government of Nepal have formulated strategies and guidelines, which address some key elements of Sustainable Transport System. These include road safety strategies, transport management strategies, and electric vehicle promotion strategies. This demonstrates that government of Nepal has given a high priority to the agenda of sustainable transport. However, there are some challenges in getting these strategies and guidelines implemented. In particular, the most identified measures demand a system approach of implementation in terms of thematic coordination (such as land-use transport coordination) and institutional coordination (among different agencies related to transport). This strategy would therefore make best effort to streamline all the existing straggles or guidelines (irrespective of their status as approved or in the process of approval), and to fill up gaps picking up other important elements of environmentally sustainable transport. The actions identified in this document would be will be further examined and refined in consultation with respective government agencies. Government of Nepal has already declared as a policy priority to prepare and adopt a National Sustainable Transport Strategy (NSTS) in this fiscal year. This document came in the right time and would contribute significantly towards facilitating the formulation and adaptation of NSTS for Nepal.

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Annex 1: Stakeholder Consultative Workshop I [30 April 2014]

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5	Indu Sharma Dhakal	Joint Secretary, MOPIT
6	Saroj K. Pradhan	Joint-Secretary,MOPIT
7	Sharad Kumar Shrestha	Joint Secretary, MOPIT
8	Devendra Karki	Director General, DOR
9	Keshab Kumar Sharma	Department of Road (DOR)
10	Tulsi Nath Gautam	Under-Secretary, MOPIT
11	Jeevan K. Shrentha	A. Director General, DoLIDAR
12	Nabin K. Pokharel	Senior Divisional Engineer, MOPIT
13	Niraj Sharma	Deputy Project Director, KSUTP/PMCO
14	Lal K. KC	President, SOTEN
15	Madan Maleku	Former Director General DoR/INTDRC
16	Yogeshwor Parajuli	Development Commissioner,KVDU
17	Basant Pant	Superintendent of Police, MTPD
18	Padma Sundu Joshi	Programme Manager, UN-HABITAT
19	Robindra Nath Shrestha	Department of Road
20	Kamal Kumar Sah	Department of Road
21	Surakshya Kafle	IOE, Pulchask Campus
22	Monish Man Shakya	Engineer, MOPIT
23	Megha Raj Pooudyal	Nepal Automobile Sports Association
24	Keshav Adhikari	Nepal Automobile Sports Association
25	Ganga Bahadur Thapa	Traffic Division

26	Crangabar Thaapa	National Economic Concern Society
27	Hari Pd. Sharma	Autogas Alliance
28	Binad Pd. Sapkota	NECS, Putalisadak
29	Umeah R. Shrestra	EVAN
30	Padma Bahadur Shahi	DOTM
31	Indra kumari Thapaliya	POTM
32	Sharad Adhikary	DOTM
33	Bishnu Shiwakoti	Transport Federation
34	Manish Tamang	Transport Federation
35	Kamal Pande Consultant	Consultant
36	Suman Uolas	CEN/CANN
37	Dhruba Raj Regmi	KSUTP
38	Mithun Pandel	IOE
39	Ramesh Pokherel	SOTEN
40	Kishore Pokheral	SOTEN
41	Surya R. Acharya	SOTEN
42	CRC Mohanty	UNCRD
43	Ganesh Raj Joshi	UNCRD
44	Robert Earley	Transport Program Manager,Clean Air Asia
45	Sharad Chand	Nepal Police
46	Bijaya Man Sharchan	EVMIAN
47	Prashant Khanal	CEN/CANN
48	Mahesh Adhikari	Nepal Automobile Sports Association
49	Anli Marsani	IOT, Pulchask Campus

Annex 2: Stakeholder Consultative Workshop II [30 July 2015]

S No	Name	Organizaiton
1	Sagar Gawali	Roads Boards Nepal
2	Rabindra Nath Shrestha	MOPIT
3	Arju Basnet	Pulchowk Campus
4	Mukti KC	DOTM
5	Dhruba Raj Joshi	DOTM
6	Ramesh Pokharel	IOE
7	Rajendra Bikram Biniya	FTTEN
8	Prasanta Khanal	CEN/CANN
9	Maheswor Ghimire	DOLIDAR
10	Gopi Mainali	NPC
11	Kamal Pandey	Consultant
12	Bijaya Man Serchan	
13	Umesh Jha	DOR
14	Nabin Kumar Pokharel	MOPIT
15	Deepak Adhikari	Nepal Transport Fed
16	PoshRaj Pokharel	Traffic Division
17	Purna Chandra Lal Rajbhandari	UNEP
18	Arjun Kumar Thapa	DOTM
19	Muna Aryal	RSSN
20	Saroj Khanal	RSSN
21	Radha Kanta Deo	MOPIT
22	Krishna Singh Basnet	RBN
23	Dr. Ganesh Raj Joshi	UNCRD
24	Bigya Gawali	Pulchowk Campus
25	Bikash Adhikari	Pulchowk Campus
26	Krishna Kumar Karki	MOPIT
27	Mithun Paudel	IOE
28	Kanak Mani Dikshit	Sajha Yatyat
29	Mahendra Raj Pande	Sajha Yatyat
30	Ganga Bdr Thapa	Rastriya Arthik Samaj Nepal
31	Ramesh Shrestha	MOPIT
32	Pragya Pradhan	KVDA
33	Hisila Manandhar	KVDA
34	Kanika Gola	CAAI/CEN
35	Rassu Manadhar	CAAI/CEN
36	Sanjay Lal Pradhan	DOR
37	Hari Ram Acharya	
38	Depak Shrestha	KSUTP

39	Rupak Rajbhandari	DOR
40	Suman Saliene	MOUD
41	Ganesh Gurung	Metro Traffic PoLice.
42	Prof. Rabindra Nathn	CIDS, IOE, TU
43	Pramod Neupane	Roads Boards Nepal
44	Shova Sharme	IOE Pulchowk