Journal of Engineering and Technology for Industrial Applications

ISSN ONLINE: 2447-0228

ITEGAM-JETIA

Manaus, v.7 n.27, p. 20-40. Jan/Feb, 2021

DOI: https://doi.org/10.5935/jetia.v7i27.713

RESEARCH ARTICLE OPEN ACCESS

ROAD SAFETY STATUS AND SOME INITIATIVES IN NEPAL

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ARTICLE INFO

Article History
Received: October 27th, 2020
Accepted: February 04th, 2021
Published: February 15th, 2021

Keywords:
Highways,
Traffic Safety,
Road Traffic Accidents,
Road fatality,
Law enforcement.

ABSTRACT

Global number of deaths due to road accident recorded is 1.35 million people each year and became the 8th leading cause of death globally and 3 times higher deaths rate in low income than in high income countries. Also 1st cause of death among children aged 5-14 and among young adults aged 15-29 with an average rate of 27.5 deaths per 100,000 populations and in every 24 seconds someone dies on the road. Nepal recorded 13,366 road-traffic accidents in the fiscal year 2018/19 resulting 2,789 fatalities, 4376 serious injuries and 10,360 minor injuries. Road Safety became a critical theme and number of deaths on the roads remains unacceptably high. Road Traffic Accident (RTA) related fatalities and injuries continue to be an important morbidity and mortality problem. Human factors, Road conditions, Vehicle conditions became the major causes of road crashes. Within SASEC countries, the accident rate is in increasing trend except a little improvement in Maldives. Education, Engineering and Enforcement are the major sectors to reduce the rate of accident. With due priority we should focus on them and for this several activities/action plan need to be implemented by allocating sufficient dedicated budget on road safety and strict implementation of road safety legislations/activities. The government policy in Nepal for transportation sector is to develop a self-sustainable, reliable, economic and safe transportation system for the social and economic advancement of the country. The road safety strategy is Safe road-infrastructures and services backed with effective post-crash response and conducive environment resulting in little or no casualties from the Road Traffic Accidents (RTAs). In a country where the annual loss due to road crashes is US$ 55 million approx. improvement of safety standards on its roads should be highly prioritized. Nepal has committed to reduce road fatality by 50% in a decade. Instead the rate was found to be accelerating. The rate has not flattened even after the country renewed the commitment by adopting SDG Goal 3.6 of achieving 50% reduction in road fatality by 2020. Following declaration of Global Action Plan for the Decade on Road Safety, Nepal drafted a Road Safety Action Plan 2013/20 to mobilize efforts of relevant agencies in reducing crashes and is being updated. Considering the death data 2789 in 2018/19, we have to reduce about 2000 fatality from road crashes to achieve the 50% reduction target. So, in Nepal it is urgent to carry out enormous actions on all the five pillars of the Decade Action Plan to achieve the targeted reduction in road fatalities and SDG goals in road safety sector. Substantial improvements of expected number of accidents are to be quantified when the road section parameters improved and up keeping the city's infrastructure is important in reducing accidents as well as the severity level of the accidents that do occur. Attention to the inclusion of dedicated lanes that separate slow moving vehicles and high-speed vehicles and from pedestrians will have a positive effect on the frequency and severity of vehicle related collisions. The first horizontal curve after a long tangent may be the most critical curve and the risk will be 1.5 times greater than that of the tangent section and accident frequencies reduced due to improvement in land and shoulder width. A reduction in overloaded trucks is also conducive to a reduction in crashes.

I. INTRODUCTION

I.1 IN GLOBAL CONTEXT

Road Safety is a critical theme and number of deaths on the world's roads remains unacceptably high, with an estimated 1.35 million people dying each year. Road accident became the 8th leading cause of death globally and 3 times higher deaths rate in low income than in high income countries. 1st cause of death among children aged 5-14 and among young adults aged 15-29. With an average rate of 27.5 deaths per 100,000 populations, the risk of a road traffic death is more than three times higher in low-income countries than in high-income countries where the average rate is 8.3 deaths per 100,000 populations. Low-income countries 1% vehicles of worlds vehicles but 13 % of all death. high-income countries bears 40% of the world's vehicles but 7 % of all death. Low- and middle-income countries bear a disproportionate burden of road traffic deaths. 54% of deaths are pedestrians, cyclists and motorcyclists and every 24 seconds someone dies on the road. Road traffic deaths decreased in 48 countries, Road traffic deaths increased in 104 countries, Road traffic deaths remained the same in 23 countries. No low-income country has reduced the number of road traffic deaths, Road traffic deaths have decreased in 23 middle-income countries and 25 High-income countries have decreased the number of road traffic deaths. The report suggests that the price paid for mobility is too high, especially because proven measures exist. Drastic action is needed to put these measures in place to meet any future global target that might be set and save lives [1-2].

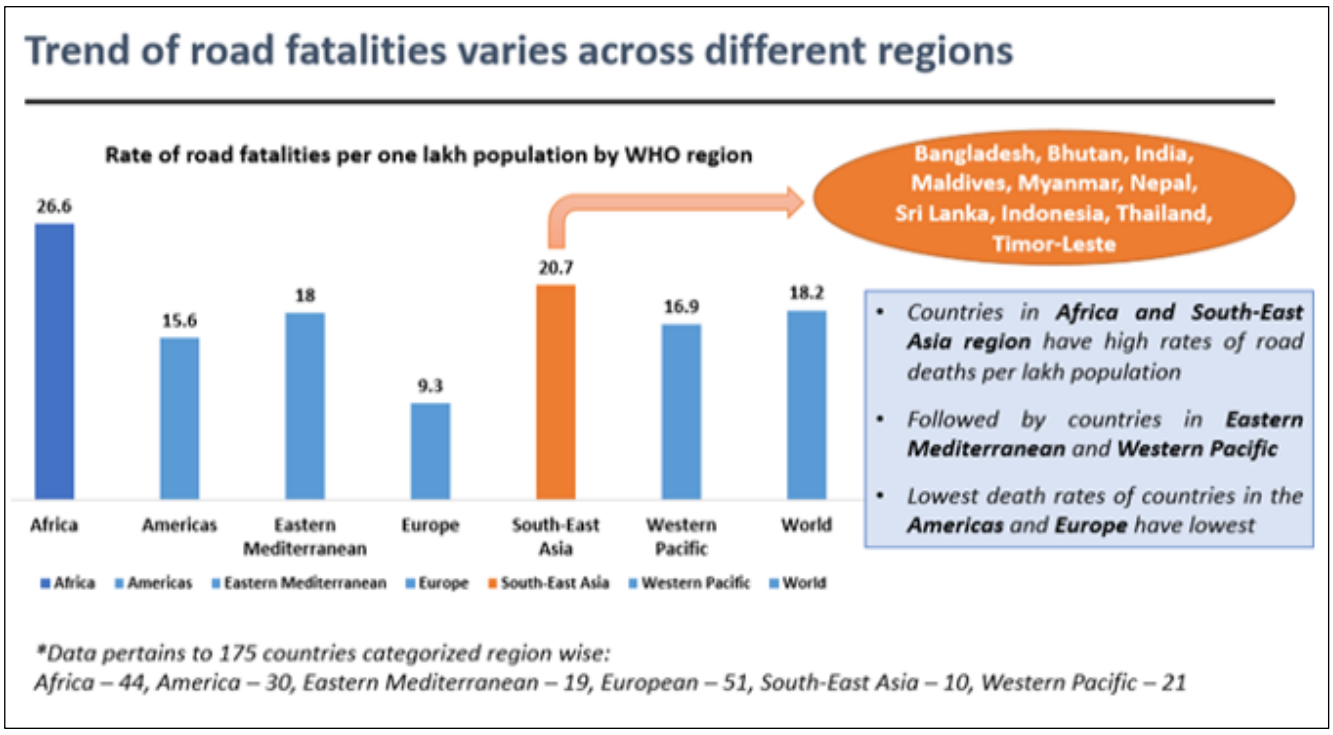

Figure 1: Rate of road fatalities per 0.1 million population by WHO region.
Source: [1-2].

I.2 IN GLOBAL CONTEXT

As per the Nepal police statistics, there were 13,366 road-traffic accidents in the fiscal year 2018/19 resulting 2,789 fatalities, 4376 serious injuries and 10,360 minor injuries [3]. However, these figures may not truly reflect the actual number of casualties occurring in Nepal as past researches have indicated that RTAs are under-reported, particularly, the minor injuries. Comparing the road traffic fatalities with the cumulative number of vehicles registered in the country up to 2018/19 (i.e. 3,503,077) [4], Nepal's fatality rate in this fiscal year was 7.96 per 10,000 registered vehicles and 9.84 per 100,000 populations, which, is still the higher rate in both Asia and the world. The fatality rate is actually higher than 7.96 if the number of vehicles phased out or scrapped and under-reporting are taken into consideration. Safety Issues in Nepalese hill roads (which form a substantial portion of the road network) are poor visibility at blind corners; poor shoulders; unforgiving side-drains, inadequate safety barriers at steep vertical drops; unscientific location of passing bays in single lane roads; lack of climbing lanes; very steep gradients at numerous sections, narrow sections at built-up areas, etc. Along the roads in the plains (Terai), unforgiving drains, inadequate pedestrian provisions, inadequate delineation at bridge/culvert crossings, narrow carriageway at build-up areas, etc., are the predominant safety issues.

Decade of Action on road safety has been endorsed by the UNRSC and a wide range of public figures. As a result, the UNRSC released the Global Plan for the Decade of Action for road-safety 2011 to 2020 in May 2011. Nepal is also a signatory on the decade action plan for road-safety 2011 to 2020and drafted the Nepal Road Safety Action Plan 3013-2020. The UN Global Action mandates member countries to develop their individual national plans for the decade (2011 to 2020) incorporating interventions under the following five pillars to road-safety [5].

1. Road safety management:
2. Safer roads and mobility:
3. Safer vehicles:
4. Safer road users:
5. Post-crash response:

II. THEORETICAL REFERENCE

II.1 ROAD TRAFFIC ACCIDENTS IN GHANA

Road Traffic Accident (RTA) related fatalities and injuries continue to be an important morbidity and mortality problem, as well as a health finance problem in Ghana requiring urgent attention and containment as has been done in some countries with developed economies. The problem of RTAs' in Ghana though must not be seen and managed through the lens of "RTAs' are just a safety issue", and hence being tackled as such; as has been reflected in the public domain in the past. The problem of RTA containment should primarily focus on prevention by utilizing a multifaceted public health approach. This approach draws on all the relevant public health disciplines of epidemiology, statistics, environmental sciences, behavioral sciences, safety and injury prevention, health services administration and others, as well as the incorporation of emergency and advanced trauma support services, to guide and formulate policies towards containing the scourge of the RTA problem currently confronting the country. The problem of RTAs in Ghana is not typical of Ghana only, but a problem in the sub-region and Sub-Saharan Africa in general. The urgency for containment of the RTA situation in Ghana (and the Sub-Saharan region) is especially important now; more so as the United Nations considers the problem of RTA containment a global public health priority, and has declared the decade 2011 to 2020 as the "decade of action for road safety" [6].

II.2 ROAD TRAFFIC CRASH DATA SOURCES, PROBLEMS, AND COLLECTION

Road traffic crash data are useful tools to support highway safety programs that tend to reduce road traffic crashes. They can be used by many authorities such as: law enforcements to identify persons at fault in road traffic crashes; insurers seeking facts about traffic crash claims; road safety researchers to access crash reliable database; decision makers to develop long-term, statewide strategic plans for traffic and highway safety; and highway safety administrators to help educate the public. Given such trends, study showed that a general overview of the sources, collection methods, and problems associated with crash data to better gaining an understanding of road traffic operational problems, locating hazardous road sections, identifying risk factors, developing accurate diagnosis and remedial measures, and evaluating the effectiveness of road safety programs [7].

II.2.1 Causal Exploration of Bike Accidents in the Bay Area

Accidents that occurred closest to an intersection would be more likely to end in injury or fatality. In general, the distance from an intersection was not found to be a significant factor in predicting the severity of a bicycle-related accident. The relative risk for injury in a bicycle-related accident was 27.5% higher when the accident occurred due to the fault of the driver. The relative risk for injury in a bicycle-related accident where the pedestrian was at fault was much higher than when the bicyclist was at fault. A cyclist involved in a solo accident, such as one where a pothole or crack in the road causes the accident, is roughly five times more likely to suffer an injury relative to an accident where the cyclist is clearly at fault. This suggests that upkeep of the city's infrastructure is important in reducing accidents as well as the severity level of the accidents that do occur. On the other hand, solo accidents, which are likely to end in injury, are very unlikely to end in a fatality for the cyclist involved. When the accident took place in an area where it was dark outside but the streetlight was not functioning, the relative probability of the accident ending in an injury was much higher. This is another area that is easy to improve on. The risk of an accident resulting in an injury at night with the street light functioning was almost the same as the risk of an accident resulting in an injury during the daytime. This result suggests that perhaps commuting at night is not as dangerous as commuting during the day- time. A wet road surface did not have a significant result on the risk of an accident resulting in an injury. This may have to do with the fact that cyclists are not often found riding their bikes outside during inclement weather. However, a slippery road surface contributed to a higher relative risk of injury in a bike-related accident, compared to a dry road surface. The risk of fatality was not significantly affected by the condition of the road surface. While one can look at all the numbers and make inferences on what causes an accident and what contributes to its severity, the most important thing to consider is that a good amount of these accidents can be prevented. Better bicycle education and training can keep a cyclist from making mistakes that may put him or her in conflict with a pedestrian, parked car, or moving vehicle. Likewise, if an automobile driver has respect for the cyclist, they are sharing the road with the occurrence of these accidents resulting in an injury can be reduced. Additionally, continued attention to the inclusion of bike lanes that separate cyclists from drivers and pedestrians will have a positive effect on the frequency and severity of bicycle- related collisions [8].

II.2.2 Road Traffic Accidents (RTAs) Trends on Kathmandu-Bhaktapur

There is an increase in accident immediately after completion of the widening of road and decrease in the successive years. This is because of unfamiliarity among drivers with the increased design speed and unchanged behavior of pedestrians. The rate of accident is decreasing after passage of sometime as a result of awareness program conducted by the project office and media partners focusing safety of school children, bike riders, drivers and pedestrians. Main contributing factors of road accidents are: carelessness, over speeding, defective vehicle, drink driving and overtaking. Age is another major cause of accidents; 25 - 34 years' age group is found to be the vulnerable group (41%). Accidents corresponding afternoon hours (12:00-15:59) are the highest (35%). Motorbikes major mode of transportation is involved in accidents (45.5%). The reason being motorcycles consists of more than half number of total vehicles plying in this section and major violation of traffic rule being made by them. Males' involvement in road accidents is higher than females corresponds to the higher males who are involvement in outdoor works along with their more aggressive nature. Following recommendations are made to ensure the traffic safety along the Kathmandu-Bhaktapur road [9].

1. Stringent enforcement of the provisions of the VTMA for traffic rule violators. Continue and promote drunken driving testing drive.

2. Priorities for behavioral changes by immediate actions such as road campaigns and visual demonstrations. Conduct awareness and training program for drivers to raise the level of understanding and skills.

3. Installation of traffic signs in each section and grade separated intersections at Jadibuti and Sallaghari intersection.

II.3 FATALITY FROM ROAD TRAFFIC ACCIDENT IN GUINEA

Most of the deaths were among occupants, motorcyclists, pedestrians, and the productive workforce aged 25 - 49 years. It

was found that majority of the death happened in Upper Guinea followed by Forest Guinea. Improvement of roads design, strict enforcement of road safety laws and raising the awareness of general public about the causes and risks factors of road traffic accident through various channels are highly required which will promote economic growth in the local communities and then help people escape the poverty trap [10].

II.4 INJURY PATTERN AMONG ROAD TRAFFIC ACCIDENTS' VICTIMS

Young male drivers in Najran recorded the highest frequency of RTAs' victims with 58% of the RTAs happened in the evening. Amongst road traffic injuries (RTI), head injury represented 36% of cases, followed by lower limb and spinal injury (23% for each) with neurological deficits occurred in 8% of cases. Since RTI are a major health problem in Saudi Arabia which negatively impact national economy, studying pattern of road traffic injuries is a useful tool to focus on and identify the causes of RTAs. Although study did not focus on the causes of RTAs, it is important to minimize them by enhancing law enforcement of traffic policies. Regulations regarding driving license release as well as license renewal should be promoted with adoption of psychophysiological tests along with initiation of road safety education and expansion of Saher system (road camera surveillance) deployment [11].

II.5 QUANTIFYING THE INFLUENCE OF ROAD GEOMETRIC PARAMETERS ON ROAD SAFETY

The analysis showed that short and sharp (i.e., $R \leq 450$ m) horizontal curves were associated with higher crash frequencies. For wider curves (i.e., $R > 750$ m), the effect of horizontal curve elements on road safety is found to be not consistent and hence it may be highly affected by the availability of other risk indicating road parameters rather than horizontal curves elements. Generally, the frequencies of average accidents decreased as the radius of the curve, transition curve length and super-elevation of horizontal curves jointly and/or alone increased. The numbers of horizontal and vertical curves per 1.5 km road segments were positively correlated with the average accident frequencies. Furthermore, it was also found that the first horizontal curve after a long tangent was the most critical curve and the risk was 1.5 times greater than that of the tangent section. Grade of the road was positively correlated with average number of accidents per segments. Furthermore, an increase of around 69% and 11% in number of accidents identified when the road section transformed from flat to mild grade and from mild to steep grades respectively. Wider lane and/or shoulder width produces fewer numbers of average accidents. In average, 22% and 29% of accident frequencies have been reduced due to 0.15 and 0.2 m land and shoulder width improvement respectively. Finally, even though traffic police report underestimated the influence of road geometry on road safety in Ethiopia, substantial improvements of expected number of accidents have been quantified when the road section parameters improved [12].

II.6 DETERMINING THE CRASH-REDUCTION

The crashes on high-risk rural roads should be identified on improving roads' safety by providing more information and tools for the FHWA High-Risk Rural Road Program (HRRRP). Fatal and incapacitating-injury crashes on Kansas' rural major collectors, rural minor collectors, and rural local roads were analyzed for five- year crash data, and the predominant crashes types that were identified were fixed-object crash, run-off-road crash, overturned crash, rear-end crash, and head-on crash. Various possible countermeasures and the CRFs for each predominant crash type were gathered from the literature, and the CRF values were validated for high-risk rural-road usage by conducting interviews with Kansas county engineers/officials [13].

II.6.1 Road Safety Management Systems in the European Countries

The analyses revealed that all the countries are different when the RSM systems are considered as a whole, making it impossible to identify typical RSM structures or a single best working model at a national level. However, it is possible to compare countries when the RSM areas are considered separately, where the clusters of countries recognized the patterns common for the European countries. A further indication of a correlation between a higher level of the RSM system and better safety performance of the country was also provided. Among the countries, a higher availability level was observed for the presence of a strong lead agency, a national medium-term road safety program, quantitative targets, NGOs or government agencies actively advocating for taking road safety action, "benchmarking" progress related to other countries, systematic data collection, using research results and a media coverage of the road safety issues. Clearly, these "good practice" features are common today for the RSM of the developed countries. On the other hand, low availability was found for most policy implementation and funding components, including a lack of dedicated budget, insufficiency of human resources, etc. The additional weak points of the RSM systems were: distribution and coordination of responsibilities between various management levels, and (un)availability of sustainable and results-focused structures which would enable effective implementation, funding, monitoring and evaluation of the road safety activities [14].

II.6.2 Overloading a Vehicle and Road Safety

Due to overloading the vehicle will be less stable, difficult to steer and take longer to stop. Overloaded vehicles can cause the tyres to overheat and wear rapidly which increases the chance of premature, dangerous and expensive failure or blow-outs. The driver's control and operating space in the overloaded vehicle are diminished, escalating the chances of an accident. Brakes have to work harder due to 'the riding of brakes' and because the vehicle is heavier due to overloading. Brakes overheat and lose their effectiveness to stop the vehicle [15]. Overloaded trucks pose serious threats to road transport operations, with increased risks for road users, deterioration of road safety, severe impacts on the durability of infrastructure (pavements and bridges), and unfair competition between transport modes and operators. A reduction in overloaded trucks is also conducive to a reduction in crashes [16].

II.6.3 Accident Caused by Overloaded Trailers

When a semi-truck is overloaded, or the load is improperly loaded, even the most experienced drivers can experience a dangerous accident. Overloaded trailers are difficult to safely transport and drivers may be unaware that they are carrying a dangerous trailer. When they take a turn on the highway, turn sharply to navigate city streets, or try and safely stop in traffic, the

unpredictable trailer load may turn over, cause the vehicle to jackknife, or prevent the driver from safely coming to a stop [17].

II.6.4 Trucking-Accidents Due to Overloading

It is important to understand the various ways in which overloaded vehicles can be involved in accidents. There is never a reason for a driver or trucking company to overload a truck. There are several common causes of overload accidents, the breaking distance increases for overloaded vehicles. As a result, the ability to stop quickly decreases when a vehicle is overloaded, improperly secured cargo can shift position in a truck, leading to a rollover, Jackknifing can occur when vehicles are overloaded. When a vehicle jackknifes, other people in the immediate area are at risk of being seriously injured or killed, tires can be blown out because a vehicle is carrying too much weight, too much weight can put a tremendous strain on vehicle's mechanical systems, resulting in many different types of structural failures, Vehicles with too much weight can experience difficulty in maneuvering corners, which can easily result in rollovers [18].

II.7 ROAD SAFETY STATUS IN SASEC COUNTRIES

SASEC is contributing in three sectors, with substantial progress as Transport, Trade Facilitation, and Energy. SASEC's achievements on the ground are shown in terms of the three priority land transport corridors, which are especially improving Bhutan's and Nepal's access to key markets and gateway ports and their prospects for participating in regional and global value chains. SASEC document concludes with a reminder that increased connectivity and mobility, with rising numbers of vehicles plying longer routes, bring with them a higher risk of road accidents, in the absence of adequate safety measures. Most of the SASEC sub-region has experienced a worsening accident trend since 2010, stressing the need for a more concerted action for safe mobility. Rising Risk of Accidents/Burden of Accidents is high for low- and middle-income countries. So, South Asia Need for Better Safety Record for its Roads.

II.7.1 Road Safety Status in Bangladesh

Road safety is a challenging issue in Bangladesh. On average, 2410 lives claims death every year during last five years. Number of Road Traffic Accident (RTA) deaths is 6.93 per 10,000 motor vehicles and 16.32 per 100,000 populations in 2018. Number of Road Traffic Accident (RTA) deaths per 10,000 motor vehicles dropped from 10 in 2014 to around 7 in 2018. Vulnerable Road Users (VRUs) account for 80% of road traffic accidents fatalities. Government is concerned about the growing road safety problems to combat against such trauma. Some pragmatic programs have been taken to ensure safer transportation. Efforts are underway for integrating different public and private organizations civil societies, communities and individuals developing effective measures to address road safety problems [19].

Factors leading to the road accidents and resultant fatalities:

- Link to Driver: Unauthorized overtaking, over speeding, over loading, Lack of professional knowledge, Violation of traffic law, Using Mobile Phone while driving, driving without taking adequate rest, Having Drug and others.
- Linked to Vehicle Owners: Irregular Maintenance of vehicles, recruiting unlicensed, unqualified and unskilled drivers on day basis, inadequate number of drivers for the fleet.
- Linked to Pedestrians: Careless and inattentive movement/road crossing, using mobile phone while crossing road, Habit of not using the Pedestrian crossing/ foot over bridge/ underpass.
- Linked to Infrastructure: Lack of Proper Maintenance with safety features like road marking & sign signal on roads, Encroachment, Unplanned intersections.
- Linked to Vehicle: Improvised and unfit Vehicles, Unauthorized changes in size & design, mixed traffic (motorized & non-motorized) Analysis of National Data (contd.).

Measures Taken to reduce road accidents:

Enactment of "Road Transport Act, 2018, Covers the common reasons of accidents with severe penalty and high punishment in National Road Safety Strategic Action Plan 2017-2020, Improve the quality of sign and marking on national and regional highways, Establish Axle Load Control station for controlling overloading, Remove unauthorized speed breakers, obstructions, encroachments on highways, Grade separation on Major-Major intersections, Railway overpass at level crossings, Safety issues addressed in all road designs, 473 kilometer road upgraded to 4-lane divided carriageway. 500kms road safety audit conducted, 394 kilometer SMVT lane being constructed, banning more than 20 years old vehicles on road, banning three Wheeler & NMT on National Highways, Strengthening Driver Training Programme, Rehabilitation, Operation & Maintenance, Steps have been taken to establish Motor Driving Testing and Training Centre in each division and greater district, Vehicle inspection manual prepared, District administration also conducting mobile courts in district level.

II.7.2 Road Safety Status in Bhutan

In Bhutan road traffic fatality is in decreasing trend. The target was to reduce 13-15 deaths per 10,000 vehicles to less than 10 deaths per 10,000 vehicles by 2020 and in 2019 it was 8.85 death/10,000 vehicles. Annual road safety education & awareness programs conducted annually and implementation of strategies for use of road safety measuring devices with regular monitoring of drug/alcohol abuse by drivers and Monitoring of driving institutes for road safety standards [20].

Measures Taken to reduce road accidents:

Highway inspection, Vehicle road worthiness inspection, Inspection for use of alcohol and drugs, Passenger bus drivers and taxi drivers on periodic basis, Private vehicle drivers are inspected at random, Road Safety Audit, Fines & penalties for traffic violation. Policy framework for efficient road safety, Ban of import of used cars, adhoc drug/alcohol test, Enforcement of traffic law, right of way for pedestrians, 100% usage of no honking unless necessary, use of helmets (two-wheelers), Road Safety for students, Initiated data collection and analysis, Observation of Zero tolerance day, Introduction of green no. plate (EV), Introduction of green tax to counter environmental impact through emission (focus on eco-friendly EVs).

II.7.3 Road Safety Status in India

India alone accounts for close to 11% of global road deaths with 0.151 million deaths in 2018 and number 1 leading cause of deaths for children & young adults aged between 5-29 years. NH and SH (5% of total road network) account for 55% of road

accidents and 63% of road accident deaths. Road Accident victims are large in age group of 18-45 year. Motorized two wheelers account for highest share of Road Fatalities and over speeding accounted for maximum number of deaths due to traffic rule violations. Objective on road safety is 25% reduction in fatalities by 2024 (in line with overall aim of 50% fatality reduction by 2030) [2].

Some initiatives:

Identification and rectification of accident black spots, Training and capacity building, Road Safety Audits, Installation of crash barriers, Reducing PCU for four Laning NH, Speed Control Standard, Vehicle Tracking System in Public Service Vehicles, Speed limit/ Speed Alert System, ABS system in M1, M2 categories and in Two wheelers, Automatic Head Light On, Air Bags, Weight losses in New Helmet Design, Bus Body code, Electric, Ethanol and Methanol Vehicles exempted from Permits , Truck Body code, Red Beacon Lights, Advisory on Linking of PUC data (emission related data) with the VAHAN database, Crash Tests, Promoting Intelligent Transport System (ITS), Enforcement of Road Safety Laws, Electronic Monitoring and Enforcement of Road Safety, Post-crash response and trauma care – NHARSS, Good Samaritan Guidelines, Incident Management System on NH, National Programme on Trauma Care , Emergency Medical Services for road Accidents, Inspection and Certification Centers, Mass action treatments on high risk crash corridors, Reduce Speed Limits in school zones, Point to Point and mobile speed cameras, Speed warning systems deployed on all vehicles, Mandating detachable seat belt and enforcing child restraint system usage, Standards for helmets & Enforcing use of safety devices, Constitution of Urban Road Design Unit (URD), Undertake traffic signaling studies cities >50K population, Interventions against driving under influence (DUI), Good Samaritan Guidelines, First Responder Trainings, Ambulances with GPS devices, Single emergency /accident reporting number, Penalty / bonus payments for golden hour treatment, Cashless insurance schemes, Optimizing Road Use, Monitoring & Evaluation, Road Safety Advocacy, Road Safety Management, Education and Awareness activities are conducted.

II.7.4 Road Safety Status in Maldives

Road accident fatality in 2015 was 12 persons in 1845 accident cases and in 2018 it was 14 in 1887 accident cases. Road safety is maintained by the road users and road monitors but negligence on road safety is seen in Maldives that leads to traffic congestion and accidents. There are some challenges to change the road user's behavior and some steps are taken to minimize the road accident like improvement in road infrastructure, strengthening the Rules and Regulations and conducting the awareness programs. Major factors noticed are speeding, missing road signs, Overtaking, Distance between two vehicles, Parking techniques, Road Infrastructure, Pedestrians crossing blindly, Mobile phone usage [21].

Some initiatives:

Development of road infrastructure design guideline, driving behavior and Speed management, Speed Regulations have been amended, Traffic Police monitoring System, Compulsory awareness program for new drivers, Revised Regulations, introduce public transport system, introducing certificate of entitlement, Emphasis on environment friendly vehicles, Changing License Number plates to steel plates, Camera readable plates, Upgrading software (vehicles information data base). Road rallies to promote and aware people on road safety, Accidents drama on the road, T-Shirts with messages, message boards and banners, conducting compulsory awareness program for new drivers, amending all related regulations, Awareness Programs like use of Helmet, Social Media Importance of maintaining speed limit, Intensify monitoring and enforcement.

II.7.5 Road Safety Status in Myanmar

There were 16167 road accident cases with 5325 people's death in 2019. Majority of accidents seen in two wheelers with 41% vehicles involved, personal vehicles involvement 13% and truck 14%. Road Safety Action Plan (2021-2030) is being updated in the following 6 sectors: (a) Institutional management, implementation management and management for human resources and finance (b) Provision of traffic rules and regulations for road safety (c) Safer Vehicles (d) Safer Pedestrians (e) Post-crash Care and Emergency Services (f) Education and Enforcement for Road Safety and Data Collection of Road Accidents to research [22].

Some initiatives:

Injury Surveillance System in major hospitals, Trainings for Advocacy on leadership for road safety and strengthening capacity on post-crash response and Initial Emergency care, first aid trainings/Establish Emergency Care Units/Establish emergency call center/Set up hotline number (192) for road accidents and health Current RS Data Collection, collect road accidents data.

II.7.6 Road Safety Status in Sri Lanka

Sri Lanka is a tropical island surrounded by the Indian Ocean and its history dates back to over 2500 years having current population of 21 million. Hilly terrain at center, hot plain beaches along the coast, ancient historic ruins and monuments and varying climate condition are attractive features of Sri Lanka. Rapid motorization from 3,125,794 in 2007 to 6,795,469 (2.17-time increase) in 2016. Increase in road accident fatalities with 2176 in 2008 to 2994 in 2018 (1.37 times increase) with 8-9 deaths per day due to road accidents. Road Development Authority total road network (2019) is about 116682 Km with 12438 km National Roads, 81321 km Local roads and 4000 km other roads [23].

Some initiatives:

Coordinating activities relating to road safety amongst governmental and nongovernmental organizations, paying compensation to persons injured in hit and run accidents, maintaining a database system, maintaining a library on road safety, maintaining relationships with like-minded international institutions and exchange of knowledge, Preparing and implementing projects on road safety, offering advice to the government on policies and projects connected with road safety.

II.7.7 Road Safety Status in Nepal

Total Population of Nepal is about 29 million and Road Traffic Fatalities is 2789 in 2018/19 with approx. 7 people per day. Fatality in road accident is in increasing trend. Total Road Network of Nepal is about 92000 km with 77087 State/Local Roads and 14913 km National Highways. No. of registered vehicles 3.54 million (2018/19) about 72% two wheelers Annual loss due to Road crashes approx. US$ 55 million. Road accident in urban area

is about 48%, in Highways 29% and in rural area is about 23%. Road safety action plan 2013-2020 is in implementation with no improvement in road crashes and is being updated [24].

Factors leading to the road accidents and resultant fatalities:

- Human factors: Driver behavior or fault, over speed, over Load, drunk driving, fatigue, violation of traffic rules, pedestrians (Reckless pedestrian crossing violating regulations, carelessness) etc.

Figure 2: Causes of accidents.
Source: [24].

- Road condition: Poor visibility at blind corners, unsafe side-drains, very steep gradients at numerous sections, insufficient control system, slippery or skidding road surface, pot holes, narrow bridge approaches etc.

Figure 3: Causes of accidents.
Source: [24].

Vehicle condition: engine, brake etc.

- Other causes: Advertisement boards, service stations, parking problems, no proper lighting system in street, less space for non-motorized transport, road encroachment, high beam headlight at night, unauthorized parking of vehicles, confusing traffic signs, back light not in condition, horn not used in curves, road markings not maintained, weather conditions, careless cycling and walking on road.

Some Initiatives:

Formation of Road Safety Council 2017, Road Safety Audit in few new road constructions and upgrading projects, Revision in Nepal Road Standard, Comprehensive Driving License Test, Institutional establishment in concerned agencies, Road safety awareness among all stake holders, In-house trainings, Initiation of dedicated budget head for road safety. Road Safety Action Plan 2013-2020 is in implementation. Road Safety Audit Piloted in large projects funded by ADB/WB, Road Safety inspection done in strategic Roads, Speed limit law/Drink driving law/Helmet law/Seat belt law implementation, Time card system, Trauma center one in Kathmandu capital of country, Vehicle Fitness Testing Center One in Kathmandu.

Guidelines and enforcement:

a) Infrastructure Related
   - Nepal Road Standard 2014
   - Road Maintenance Manual, DoR
   - Standard Specification for road and Bridges 2016
   - Design Manuals, DoR, Traffic Sign and Signals

b) Road Safety related DoR Publications
   - Traffic Sign Manual Volume I & II
   - Road Safety notes
   - Road users Guide

c) Technology based solutio
   - RA-IMS Started from DoTM
   - CCTV Camera Installation Initiated
   - Planned: -Network Based Regulatory System (ITS)
   - Use of Radar Gun to check speed
   - Use of breathalyzer to control drinking drive
   - Weigh Bridges
   - Channelization

Some effective practices in Nepal in Road safety:

Do not drink and drive program: (Enforcement + Education).

- 35-50 thousand drivers are fine per year only in Kathmandu.
- Enforcement: penalty + license punching (after 5 punching licenses cancel).
- Education: need to take one-day class about traffic rules.

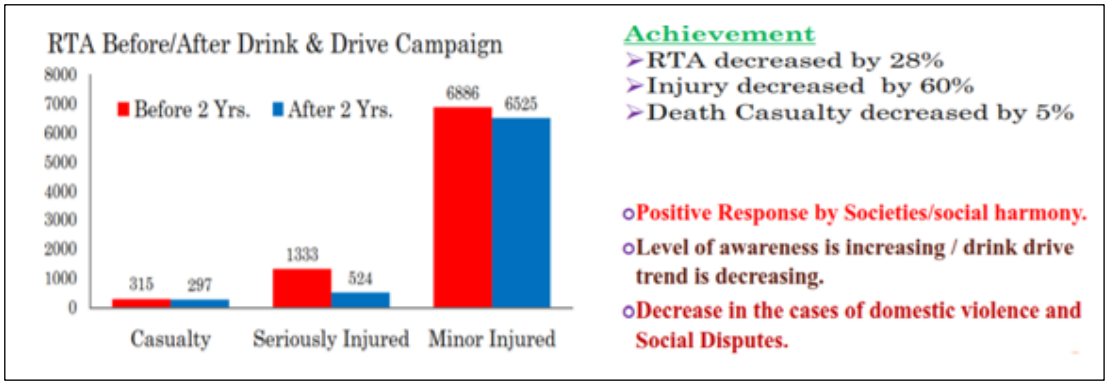

Figure 4: Comparison of two years' data on drink and drive campaign.
Source: [24].

Time card system: For speed Control

- Traffic Police launched this system and distributed the cards to drivers
- Drivers have to reach their destination within the time frame
- A separate time card has been allocated for heavy and small vehicles.

Major activities established within five pillars of Nepal Road Safety Action Plan 2013-2020 [25].

Pillar 1: Road Safety Management

Revive the existing NRSC with necessary acts, higher authority and resume work, Develop the national road-safety action plan, Conduct training on road-safety & traffic rules, Develop and implement a pedestrian planning guideline and regulation, Review and update vehicle insurance policy, Identify amendments required in Existing Laws regarding RTS, Amend VTMR 1994 and LSGR 1999 to harmonize with UN/int'l conventions, Establish sound coordination mechanisms on managing road safety, Develop a national road-safety strategy and process for the government endorsement. Out of 19 actions targeted in road safety management 10 are yet to be implemented.

Pillar 2: Safer Roads and Mobility

Pilot/Enforce and Implement RSA for all SRN and LRN, Introduce RS impact assessment, Black spot analysis and counter measures, introduce mandatory provisions for work-zone safety planning in the construction contracts, make road authorities legally responsible for reporting annually their progress, findings and remedial works performed for road-safety, Establish road-safety units in Municipalities. Out of 26 actions targeted in safer roads and mobility 15 are yet to be implemented.

Pillar 3: Safer Vehicles

Develop and implement a safe-vehicle guideline, identify amendments required in VTMA 1993 and VTMR 1994 to incorporate the following, Review the route permit procedures, set up a central transport management committee, Upgrade DoTM institutional capacity, ensure all public vehicles are handicap accessible. Out of 22 actions targeted in safer vehicles 16 are yet to be implemented.

Pillar 4: Safer Road Users

Develop a comprehensive code- of-conduct for all road-users (drivers, pedestrians, street-vendors), Conduct road-safety awareness campaigns, Update the existing textbooks on road-safety, publish and introduce in school curriculum, publicize road-safety through TV, radio and print media, introduce regular road-safety education programs for professional drivers, Improve driver license system, Institutional support for Traffic Police. Out of 16 actions targeted in safer road users 7 are yet to be implemented.

Pillar 5: Post-Crash Response

Introduce a toll-free telephone number for medical emergencies, develop a national ambulance policy, provide trauma-care training to medical personnel at all levels (primary, secondary, tertiary), Investigate funding sources to assist rehabilitation of crash victims, conduct medical research on major injuries of crash victims, ensure people with disabilities are not deprived from employment opportunities. There are 6 Regional Hospitals, 11 Zonal Hospitals, 5 Teaching Hospitals, 11 Central Hospitals, 56 District Hospitals, and 13 Small (15 bed) Hospitals under different levels of governments. In addition to plenty of privately owned hospitals. Although the 14th Periodic Plan had provisioned for trauma facilities in all hospitals near SRN roads, this has not been achieved. The 15th Plan has further planned to provide each municipality with a primary hospital equipped for primary trauma care service. Out of 11 actions targeted in post-crash response 6 are yet to be implemented.

The road safety strategy is Safe road-infrastructures and services backed with effective post-crash response and conducive environment resulting in little or no casualties from the RTAs. Horizontal coordination amongst the stakeholders to manage road-safety has been poor, ad-hoc, often hampered with duplication of activities from parallel committees set up under different agencies while interventions been arbitrarily implemented. A National Road Safety Council was set up in Nepal during the nineties but this body has been defunct and road-safety did not receive the due priority it demanded.

Some Activities of law Enforcement to Reduce Accidents by Traffic Police

Traffic police of Nepal is responsible for regular operation of vehicles, traffic management on VVIP movement, traffic management during festivals, rallies and ceremonies, reduce accidents, vehicular traffic related public awareness programs and punishment/impose fines to those violating the traffic rules. Followings are some activities implemented by traffic police within capital city in 2019/20 to fulfill above responsibilities [26]:

- Three months' traffic awareness programs, pedestrian safety awareness/ law enforcement programs, public awareness program by musical programs, traffic police holding play cards about road safety on roads, one hr. awareness program conducted to drink and drive drivers, lane rule violators, road accident case drivers.
- Punishment to high sounded motorbike drivers, unauthorized parked vehicle drivers, door open vehicle drivers, looking glass related drivers, horn related cases, drink and drive cases.
- To minimize the congestion separation of flow of high speed and low speed vehicles on 4/6 lane roads, informative boards about traffic rules erected on roads, use of traffic cones to maintain lane discipline
- Implementation of long term and short-term traffic management action plan, use of volunteers to manage traffic during peak hours.
- Operation of traffic light installed/maintained by Department of Roads in the capital city for the management of vehicular traffic, use of surveillance vehicles, CCTV-Camera, Radar gun, breathalyzer to enforce the rules
- Use of road accident information management system (RAIMS) software developed and supported by Department of Transport Management
- Banning of heavy vehicles to enter in the capital city from 6:00am to 8:00pm., removal of hoot of the buses to reduce fatality during accidents.
- Coordination/Discussion with stakeholders to reduce accident rate and fatalities.

Road Safety related documents in Nepal

National Transport Policy 2058: The construction, improvement and management of the means of transport shall be done in harmony with the traffic-safety and environment. The Constitution of Nepal guarantees under § 51 Policies of the State, it directs for a safe, systematic and disabled friendly transportation sector. The formation order for Road Safety Council is based on Good Governance Act 2064 and not on MVTMA. Hence the focus is rather on management than on prevention of road crashes as is seen in its objectives [5].

Roads Board Act 2058: Under § 25 use of Road Fund, RBN may finance road safety activities. But no mandatory provision.

Local Government Operation Act, 2074: As per § 11.Ta.4, the Rural Municipalities and Urban Municipalities are responsible for road safety management on the roads under their jurisdiction (i.e. non-strategic roads). However, the act does not elaborate further on goal and priority activities towards making the roads safer.

Public Roads Act, 2031: § 3Ka: to impose a 6m setback from road edge for permanent structure; This powerful authority to avoid possible vehicle-pedestrian conflicts has never been exercised.

MVTMA 2049 and MVTMR 2054: Only license bearers are allowed to drive; only license bearers are allowed to serve as conductor, commercial passenger vehicles to obtain route-permit, appointment and authority of Mobile Transport Inspectors; only road-worthy motor vehicles to ply, prohibition on using motor vehicles for non-registered purposes, safe and timely transport of passengers and goods, prohibition against overloading vehicles, rest for the bus driver and change of drivers, drivers are not to be disturbed, proper positioning of stopped vehicles, passengers to be seated, compulsory use of seatbelt by passengers on the front in a car and use of helmets by all riders of motorcycles, vehicles to stop at zebra crossings when being used, pedestrian not to walk on travel lanes, prohibition on straying of domestic animals, prohibition to drive under influence of alcohol or narcotics, crash victims to be helped, prohibition on reckless driving, speed control through traffic signs and standing orders, erection of traffic signs as per international conventions and their enforcement; providing bus laybys and parking yard, delineation of on-road work site, educating the general public.

- Guideline on workshops and repair centers
- Guidelines on bus route allocation
- Guidelines on loading control of goods vehicles
- Guidelines on operation of driver training centers
- Guidelines on vehicle fitness inspection and testing
- Guidelines on vehicular emission test
- Guidelines on bus body building
- Guidelines on school buses

Labor Act 2049: Vehicles on long routes shall have two drivers, Drivers could be fired if found to consume alcohol.

Heavy Vehicle Management Policy 2005: Heavy management Policy 2005 are relevant for road safety and are hardly referred by them in road design and construction. The policy focus is basically on effect of overloaded vehicles on pavement deterioration, nevertheless, it also discusses enhancing road capacity, enhancing road safety by adhering to vehicle manufacturers' specifications and road design standards.

Road Safety Notes from 1996 to 1998: Road safety notes includes following documents which are relevant for road safety and are hardly referred by them in road design and construction. Now these documents are compiled in one volume.

- Road Note 2: Design of Safe Side Drains
- Road Note 4: Road Safety Audit Manual
- Road Note 5: Delineation Measures
- Road Note 6: Safety Barrier
- Road Note 7: Safety at Bridges
- Road Note 8: Identifying and Treating Accident Sites
- Road Users' Guide
- Traffic Sign Manual

Nepal's Commitments to the Global Community

Busan Declaration: Recognizing the urgency to address the issue, in 2007 in Busan, Declaration on Improving Road Safety in Asia and the Pacific, agreed to a goal of saving 600,000 lives and preventing a commensurate number of serious injuries on the roads of the region over 2007-2015, As no significant action followed the signing of the declaration, road fatalities in Nepal jumped from 785 in 2007 to 2004 in 2015. The SDGs, set in 2015 by the UN General Assembly and intended to be achieved by 2030. Target 3.6: By 2020, halve the number of global deaths and injuries from road traffic accidents. Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons, Nepal has set a sub-target of 50% for proportion of population that has convenient access to public transport, and 80% for access to paved road within 30 minutes of walking

1958 Agreement on Vehicle Regulations: defines the minimum requirements that automobiles must satisfy in order to be approved for sale or use in a particular country or region, stop import of substandard accessories such as helmets, brake, tire, and seat-belt, rather than accession of the agreement itself, national standard for the accessories in conformity with the 1958 Agreement need to be developed

1968 Convention on Road Traffic: The Convention on Road Traffic is designed to facilitate international road traffic and to increase road safety by establishing standard traffic rules for motor vehicles and trailers in international traffic. Nepal requires to ratify this treaty, incorporate the provisions fully in MVTMA and MVTMR to make the roads safer. Nepal also needs to update and widely disseminate the Highway Code: including to the international traffic entering the country.

1968 Convention on Road Signs and Signals: The Convention is designed to increase road safety and aid international road traffic by standardizing the signing system for road traffic (road signs, traffic lights and road markings) in use internationally. Nepal should consider to apply for Accession of the treaty.

1975 Agreement on Minimum Requirements for Driving Permits: The 1975 Agreement on minimum requirements for the issue and validity of driving permits elaborate the 1968 Convention on Road Traffic. Nepal requires to ratify this treaty, incorporate the provisions fully in MVTMA and MVTMR to produce qualified drivers for the local traffic as well as to issue International Driving Permits.

1997 Convention on Technical Inspection of Vehicles: Adoption of Uniform Conditions for Periodical Technical Inspections of Wheeled Vehicles and the Reciprocal Recognition of such Inspections. Nepal needs to establish a network of VFTC throughout the country in adequate numbers and use the test parameters including those specified in the treaty.

1998 Convention on Global Vehicle Regulations: As Nepal is neither a vehicle producing nor exporting country, the existing provision in MVTMR banning to change the properties of purchased motor vehicles suffice.

2018 WHO Voluntary Targets for Road Safety: Setting indicators for voluntary global performance targets relating to road safety risk factors and service delivery mechanisms can assist national and global road safety policy efforts. not ratified by the UN General Assembly.

2.14 Star Rating of Highways

The Australian Government and State and Territory governments have agreed on a National Road Safety Strategy 2011-2020 (NRSS) with the goal of reducing the number of deaths and serious injuries from road crashes by at least 30 per cent by 2020. Recent progress has been insufficient and are in danger of not meeting the national road safety targets. Cost effective countermeasures to improve safety have the potential to prevent deaths and injuries for decades after they are implemented. We should strive to create a genuinely safe road system in which improving the safety of drivers, vehicles and roads is of mutual importance. A road system in which we have 5-star drivers in 5-star cars on 5-star roads should involve no deaths. The AusRAP Star Rating process identifies the national highways which lack adequate safety-enhancing design elements. The Star Rating also serves as an information source for motorists wishing to determine the level of safety of roads. The Star Ratings and SRIPs, which are the focus of this report, measure the inherent safety of a road's infrastructure – that is, the degree to which built-in safety features prevent crashes from occurring and reduce the severity of those crashes which do occur. Some Safety Countermeasures adopted are: Roadside barriers, Central median barrier (no duplication), Shoulder rumble strips, Skid resistance (paved road), Protected turned lanes, Additional lane etc. [27]. For the first time the United Nations has included road safety as a Sustainable Development Goal (3.6). The UN Global Road Safety Performance targets are now providing a common standard to benchmark the safety of the world's roads. 3-star or better roads for all road users is a key target for all of our partners to embrace as we work together to create a world free of high-risk roads. Ensuring more than 75% of travel is on 3-star or better roads for all road users by 2030 will save lives on a scale that matters [28].

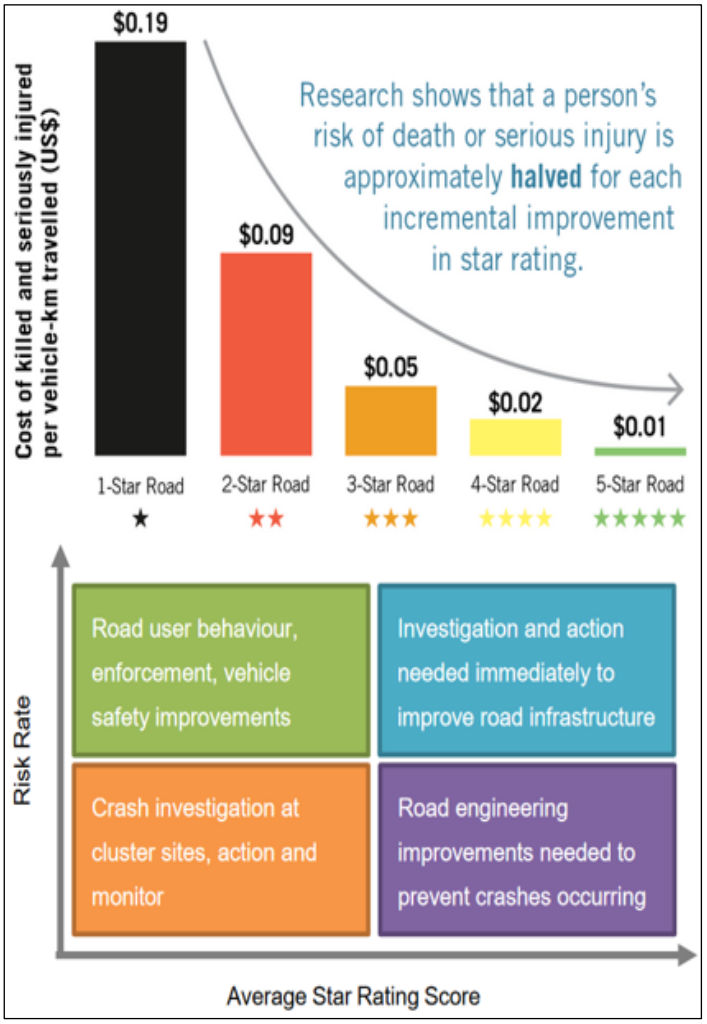

Figure 5: Prioritizing routes using risk rates and Star Rating Scores.
Source: [29].

Table 1: Criteria for Star Rating.

Star Rating	Pedestrian	Bicycle	Motorbike	Cars
★	No side walk, No safe crossing, 60km/hr traffic	No cycle path, No safe crossings, poor road surface, 70km/hr traffic	No motorcycle lane, undivided road, trees close to road, winding alignment, 90km/hr traffic	Undivided road with narrow centerline, trees close to road, winding alignment, 100km/hr traffic
★★★	Side walk present, pedestrian refuge, street lighting, 50km/hr traffic	On-road cycle lane, good road surface, street lighting, 60km/hr traffic	On-road motorcycle lane, undivided road, good road surface, >5m to any roadside hazards, 90km/hr traffic	Wide centerline separating oncoming vehicles >5m to any roadside hazards, 100km/hr traffic
★★★★★	Sidewalk present, signalized crossing with refuge, street lighting, 40km/hr traffic	Of-road dedicated cycle facility, raised platform crossing of major roads, street lighting	Dedicated separated motorcycle lane, central hatching, no roadside hazards, straight alignment, 80km/hr traffic	Safety barrier separating oncoming vehicles and protecting roadside hazards, straight alignment, 100km/hr traffic

Source: [1].

II.7.8 IRAP Star Rating

iRAP star rating is a tool that assesses the safety standard of a road against safe system principles. The star ratings are based on road inspection data and provide a simple and objective measure of the level of safety which is 'built-in' to the road. The higher the star rating, the safer the road. The star rating of a road depends on a variety of factors relating to the nature of the road. As a result, motorways, with fewer merging junctions and more roadside barrier, normally have higher star ratings than non-motorways. Similarly, dual carriageways, with opposing flows of traffic being physically separated, tend to have higher star ratings than single carriageways. iRAP believes that improving the world's roads to a 3-star or better standard is a key way to achieve the SDG target of halving road deaths and injuries by 2020. 3-Star or better roads for all road users presents a realistic target for national and regional governments and road authorities to adopt [30].

III. MATERIAL AND METHODS

III.1 DATA ON ROAD SAFETY – BANGLADESH [19]

Table 2: Time series data on road accidents and fatalities.

Year	Accidents	Death	Injury	Vehicle Registered	Percentage of accident
2014	2027	2067	1535	2,142,083	
2015	2394	2376	1958	2,463,298	
2016	2566	2463	2134	2,879,708	
2017	2562	2513	1898	3,300,106	
2018	2609	2635	1920	3,797,480	
2019				4,301,610	

Source: Authors, (2020).

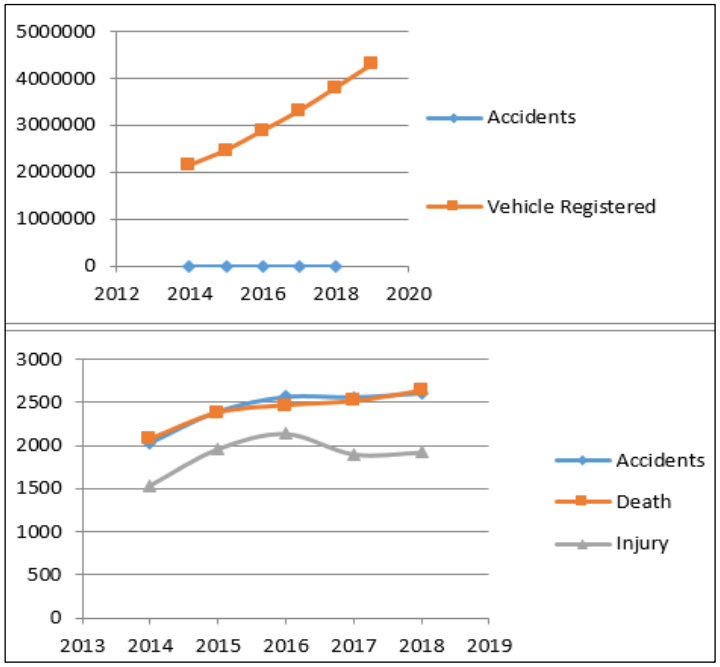

Figure 6: Vehicle, accident and fatality relationship.
Source: Authors, (2020).

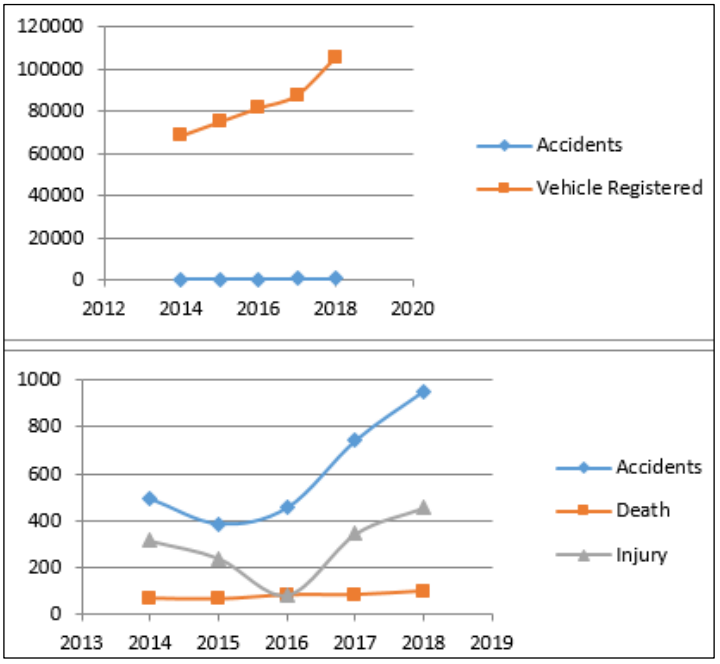

Figure 7: Vehicle, accident and fatality relationship
Source: [19].

Table 3: Vehicle registration is increasing in linear trend but accident trend remains somehow stable in last three years Accidents by Vehicle Category.

Bus	Bikes/Auto	Truck	Car/Microbus	Nosimon
27.40%	34.83%	16.40%	7.82%	3.55%

Source: Authors, (2020).

III.2 DATA ON ROAD SAFETY – BHUTAN [20]

Table 3: Vehicle Population (Approx.) and road crash data by year.

Year	Accidents	Death	Injury	Vehicle Registered
2014	493	70	315	68500 (from Graph)
2015	387	67	240	75000 (from Graph)
2016	456	84	84	81500 (from Graph)
2017	741	85	346	87500 (from Graph)
2018	950	100	457	105000 (from Graph)
2019				

Source: Authors, (2020).

Vehicle registration is approximately increasing in linear trend but accident trend is initially in decreasing trend and from 2016 in increasing trend.

Table 4: Vehicle types involved in accident.

EME	MB	Taxi	HV	MV	TW	LV
2.6%	1.6%	9%	13.9%	3%	1.6%	68.3%

Source: Authors, (2020).

Table 5: Distribution of accident by gender.

Male	Female	Unknown
83%	5.4%	11.6%

Source: Authors, (2020).

Table 6: Gender and age group involved in accidents.

Age Group	25 Yrs	26 Yrs	27 Yrs	28 Yrs	29 Yrs	30 Yrs	31 Yrs	32 Yrs
Male	99	119	108	115	145	110	109	109
Female	13	2	3	0	7	17	11	8

Source: Authors, (2020).

Table 7: Distribution of Accident by Causes with Death and Injuries.

Death / Injuries	Human Factor	Environmental factors	Vehicle factors	Road factors	Unknown
Death	145	39	24	21	39
Injuries	705	94	75	21	87
Total accidents	1304	81	117	78	81

Source: Authors, (2020).

III.3 DATA ON ROAD SAFETY – INDIA [2]

Table 8: Road safety scenario.

Year	Accidents	Death	Injury	Vehicle Registered [31]
2014	489400	139671		190386054
2015	501423	146133		209689528
2016	480652	150785		229650234
2017	464910	147913		253000000
2018	467044	151417		

Source: Authors, (2020).

Table 9: Road death based on Gender and Age in 2018.

Gender/Age	Less than 18	18-25	25-35	35-45	45-60	60 above
Female	2160	3942	5017	4462	3455	1732
Male	7817	28835	34943	28210	19343	7343

Source: Authors, (2020).

Table 10: Road death based on type of vehicle.

Year	Bus	Auto	2 wheelers	Car	Truck
2017	10651	6762	44092	31183	23483
2018	10507	6624	47560	30811	23868

Source: Authors, (2020).

Table 11: Road accident deaths based on traffic rule violation.

Year/Causes	Driving on wrong side	Use of Mobile Phone	Jumping red Light	Drunken Driving	Over-speeding
2017	9527	3172	1826	4776	98613
2018	8764	3707	1545	4188	97588

Source: Authors, (2020).

Table 12: Road Accident based on License Type and Non Use of Safety Devices.

Year	Without License	Learner's License	Valid License	Without Helmet	Without seat Belt
2017	48503			35975	26896
2018	37585	23593	345799	43614	24435

Source: Authors, (2020).

Table 13: Road accident deaths based on type of collision.

Year	Fixed object	Vehicle overturn	Hit from side	Pedestrian	Hit from back	Hit and run	Head on collision	Others
2017	4283	9413	12071	18886	22446	25866	24170	21910
2018	4623	9548	15477	22656	25801	28619	29646	38975

Source: Authors, (2020).

III.4 DATA ON ROAD SAFETY – MALDIVES

Table 14: Data on Accidents and Road Fatalities.

Year	Accidents	Death	Injury	Vehicle Registered
2014	1836			68208
2015	1845	12		
2016	2073	04		71796
2017	1954	12		
2018	1887	14		
2019		09		

Source: [21] and [32].

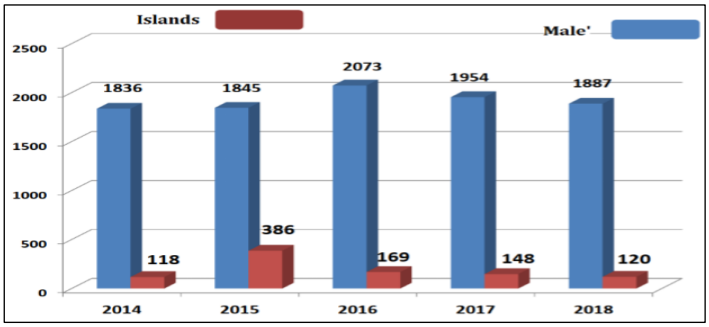

Figure 8: Road Accidents-5 years' data (2014-2018).
Source: Authors, (2020).

III.5 DATA ON ROAD SAFETY – MYANMAR

Table 15: Trend of Road Accidents Data (2010~11/2019).

Year	Accidents	Death	Injury	Vehicle Registered
2010	7985	2264	14130	2300696
2011	8568	2495	15316	2356286
2012	9339	2653	15720	3616268

Source: [33].

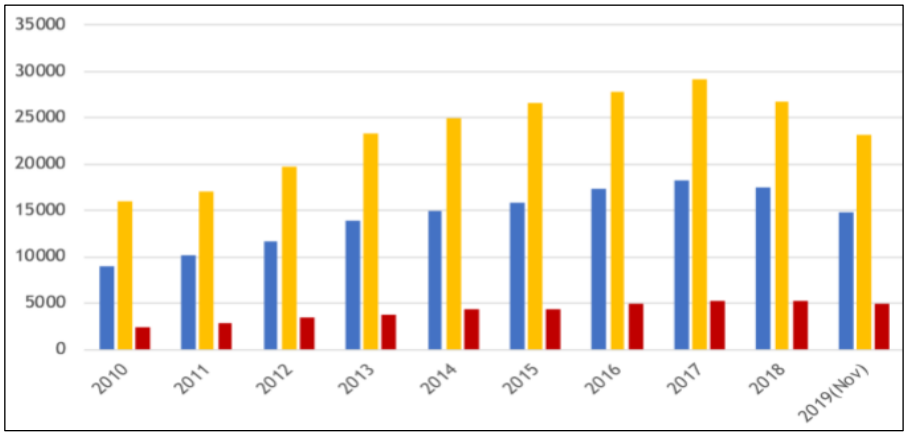

Figure 9: Trend of accident data 2010-11/2019.
Source: [33].

Table 16: Cases with respect to Impacting vehicles by Types (1/2019~6/2019).

Type of vehicle	Personal Vehicle	Truck	Bus	SPV	Two wheelers	Three Wheelers	Farm Truck	Machinery	Other
Percentage	13	14	9	9	41	2	4	1	7

Source: Authors, (2020).

Table 17: Cases with respect to Causes of Road Accidents (1/2019~6/2019).

Causes	Driver's error	Pedestrian's error	Vehicle's error	Road's error	Weather	Total
Nos. of cases	8208	309	203	5	3	8728

Source: Authors, (2020).

Table 18: Accidents by Types of Driving License, Age and Gender (1/2019~6/2019).

Types of License	Under 16 yrs		16 to 20 yrs		20 to 30 yrs		30 to 40		Over 40 yrs		Total	
	M	F	M	F	M	F	M	F	M	F	**M**	**F**
A-1	1	-	48	1	81	7	74	3	67	3	**271**	**14**
A	-	-	351	13	606	46	402	40	439	30	**1798**	**129**
B	-	-	121	1	495	9	417	13	349	11	**1392**	**34**
C	-	-	1	-	49	1	68	1	59	-	**177**	**2**
D	-	-	-	-	87	-	133	6	107	10	**327**	**16**
E	-	-	-	-	140	2	414	3	308	2	**862**	**7**
F	-	-	3	-	23	-	25	-	17	-	**68**	**-**
G	-	-	9	-	19	-	21	-	13	-	**62**	**-**
T	-	-	111	-	24	-	9	-	1	-	**145**	**-**

Source: Authors, (2020).

III.6 DATA ON ROAD SAFETY - SRI LANKA [22]

Table 19: Time series data on road accidents.

Year	Accidents	Death	Injury	Vehicle Registered
2014		2439		3125794 in 2007
2015		2816		
2016		3017		6795469 in 2016
2017		3147		
2018		2994		
2019				

Source: Authors, (2020).

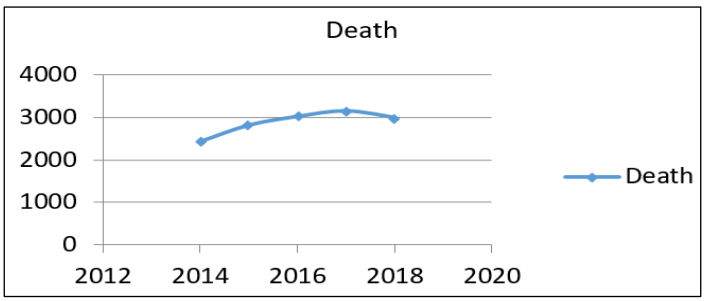

Figure 10: Road fatality over last 5 years Year.
Source: Authors, (2020).

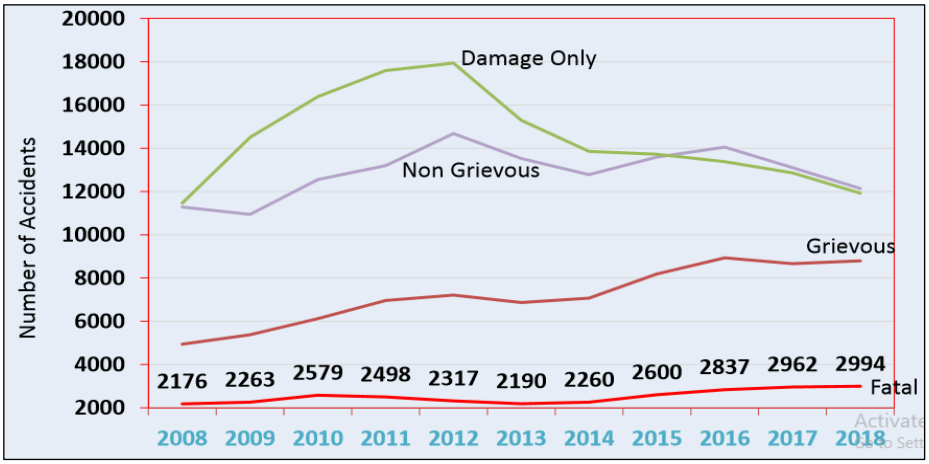

Figure 11: Variation of accidents over the last ten years.
Source: Authors, (2020).

Table 20: Percentage of deaths by road user category.

User/Year	2014	2015	2016	2017	2018
Passenger	23	25	22	20	
Pedestrian	29	29	30	30	
Others	47	46	49	49	

Source: Authors, (2020).

Table 21: Road accident deaths based on type of collision.

Head on collision	Rear end	Crash with pedestrian	Others
19%	20%	17%	44%

Source: Authors, (2020).

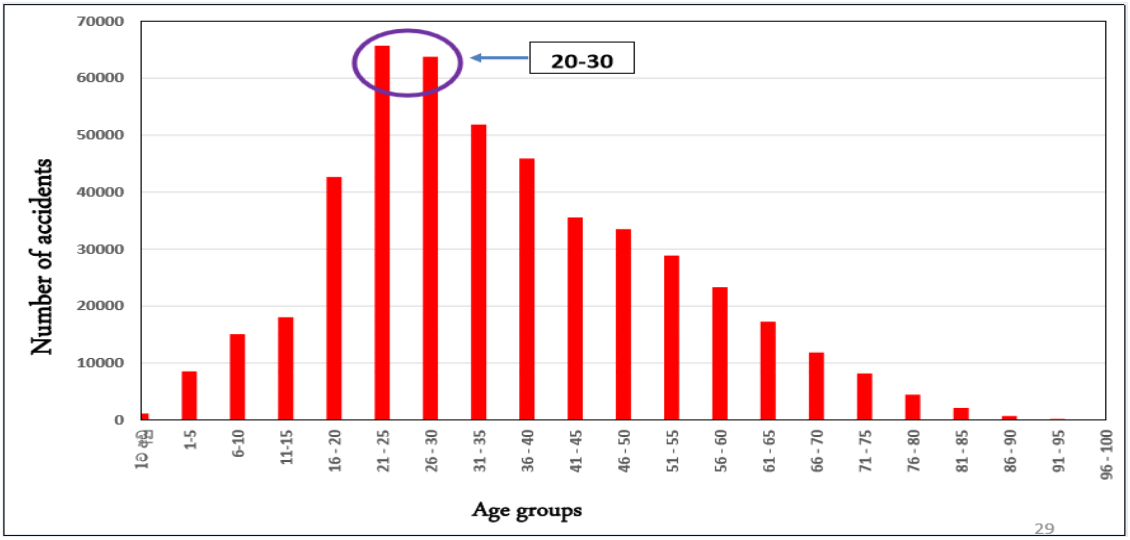

Figure. 12: Variation of number of accidents by age of victim.
Source: Authors, (2020).

III.7 DATA ON ROAD SAFETY - NEPAL [24]

Table 22: Road Crashes and Injuries data.

Year	No. of Accidents	Death			Severe Injury			Normal Injury		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
2015/16	10013	1603	403	2006	3161	1021	4182	6025	2188	8213
2016/17	10178	1914	470	2384	3275	975	4250	5978	2312	8290
2017/18	10965	2044	497	2541	3183	961	4144	6033	2214	8247
2018/19	13366	2218	571	2789	3343	1033	4376	7352	3008	10360
2019/20*	15554	1827	428	2255	3674	951	4617	7982	3243	11225

* Data affected due to Covid-19 Lockdown for 3.5 months of Fiscal year 2019/2020.
Source: Authors, (2020).

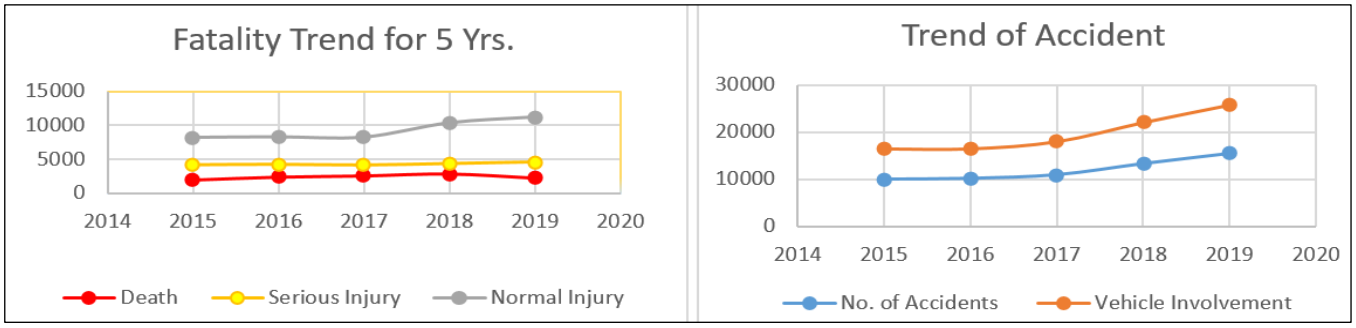

Figure 13: Accident, Vehicle Involvement and road fatality relationship.
Source: Authors, (2020).

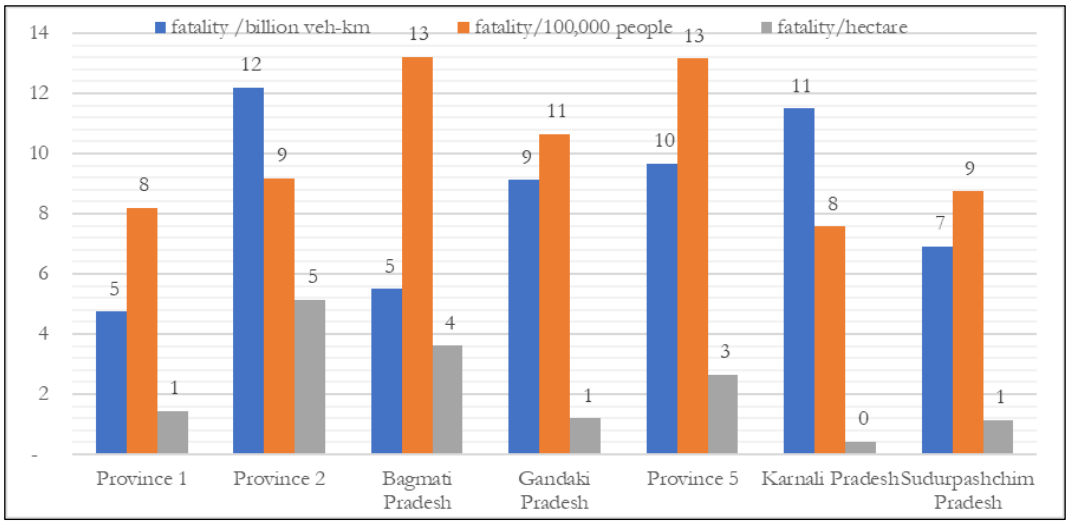

Figure 14: Exposure of risk against road fatality.
Source: [5].

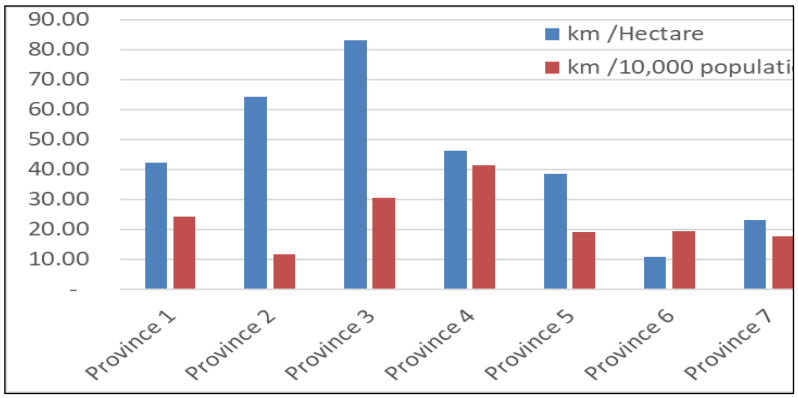

Figure 15: Road densities.
Source: [5].

Table 23: National accident data by road category.

Urban (valley)	Highways	Rural
48%	29%	23%

Source: Authors, (2020).

Table 24: Involvement of vehicle in accident.

Year	Heavy	Bus	Car, Jeep	Tractor	Tampoo	Motorcycle	Sha.sa	Other	Total
2015/16	1921	1970	4528	690	200	6365	757	71	16502
2016/17	2230	2043	4608	645	220	6152	510	107	16515
2017/18	2430	2005	5212	602	237	6874	563	111	18034
2018/19	2685	3224	6079	628	338	8553	465	115	22087
2019/20	2679	2936	7563	606	405	10869	604	127	25789
Average%	**12.07**	**12.31**	**28.29**	**3.21**	**1.42**	**39.23**	**2.93**	**0.54**	**100.00**

Source: Authors, (2020).

Table 25: Accidents with respect to time.

Year	06:00-12:00	12:00-18:00	18:00-24:00	0:00-06:00
2017/18	3179	4450	2812	524
2018/19	3699	5372	3645	670
Dec, 2019- half year	2626	3623	2509	484

Source: Authors, (2020).

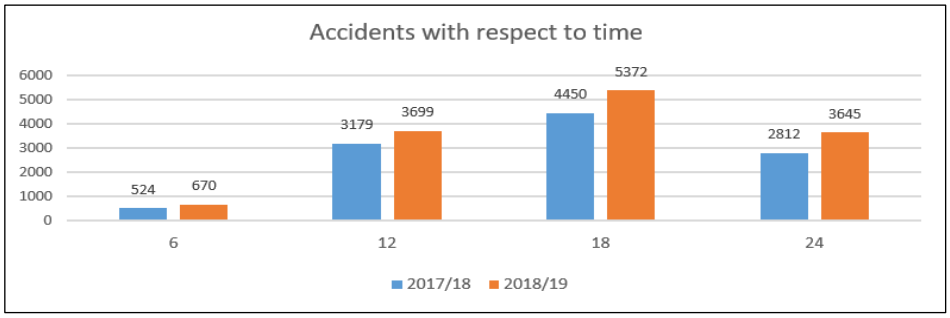

Figure 16: Accidents with respect to time.
Source: [5].

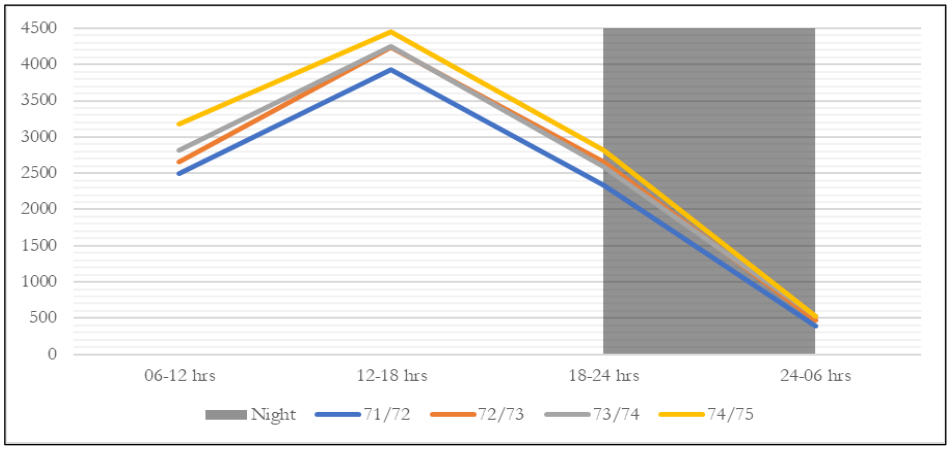

Figure 17: Accidents with respect to time.
Source: [5].

Table 26: Accidents with respect to cause of accident.

Year	Driver's negligence	Passenger	Over take	High Speed	Drink Drive	Vehicle condition	Over load	Animals	Road condition	Weather	Total
2017/18	8461	272	136	1395	311	204	39	15	117	15	10965
2018/19	9136	198	263	2171	416	206	27	8	114	27	13366
2019/20 Half year	6899	92	140	1455	384	141	20	27	83	18	9244

Source: Authors, (2020).

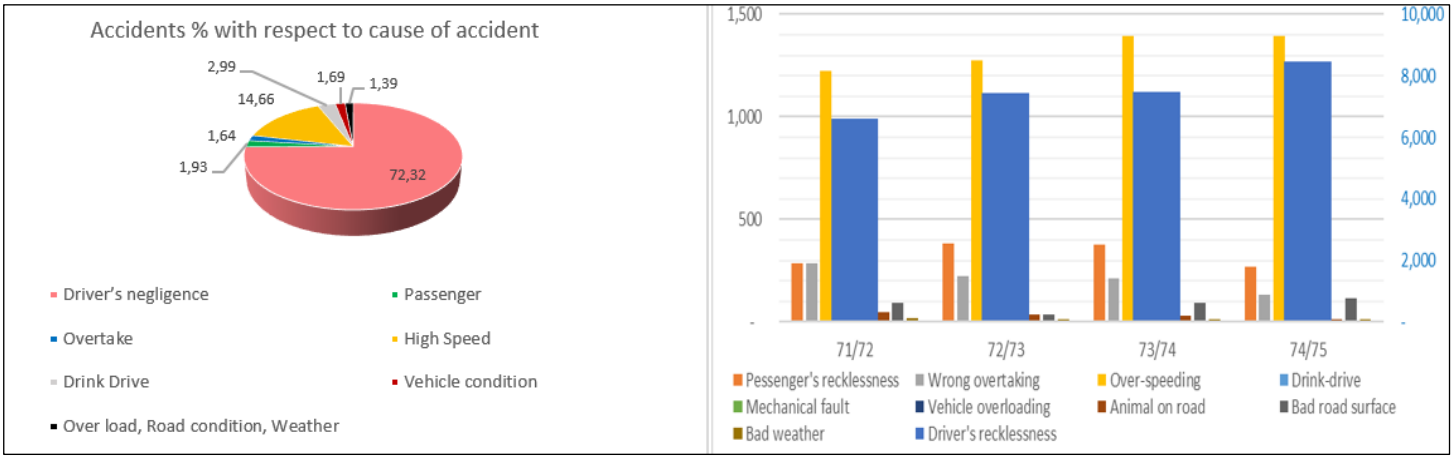

Figure18: Causes and Accident (Thickness of bar considered) from FY (2014/15).
Source: [5].

Table 27: Analysis of national data by age of victim, 2019.

Below 6 yrs				6-16 Yrs				16-25 Yrs				>25 Yrs			
Male		Female		Male		Female		Male		Female		Male		Female	
Death	Injured	Death	Injured	Death	Injured	Death	Injured	Death	Injured	Death	Injured	Death	Injured	Death	Injured
54	256	48	172	91	585	46	382	647	4575	92	1401	1210	4172	344	1693

Source: Authors, (2020).

Table 28: Death rate in road accident estimated per 10000 motorized vehicles (excluding 2 and 3 wheelers), 2019.

Age group of Population	Percentage of Casualties	Death rate per 10000 motorized vehicles
Children under 5 Yrs.	9%	4.45
Children from 5-15 Yrs.	21%	10.38
Young people 15-40 Yrs.	44%	21.74
Elder people 40- 55 Yrs.	12%	5.59
Elder people 55 Yrs.	14%	6.92
Total	**100%**	**49.42**

Source: Authors, (2020).

Table 29: Vehicle Composition: Registration Data.

Year	Bus	Mini bus	Heavy	Car	Pickup	Micro	Tempoo	Motorbike	Tractor	Others	Total
Up to 2013	30560	12968	43023	132154	16852	1383	4742	1121625	83406	309108	1755821
2014/15	3737	2270	4236	13560	6957	932	1541	196383	10524	343	239240
2015/16	4353	4625	8328	28361	5060	1137	2613	267439	9786	12063	331702
2016/17	5342	2008	12712	21292	10675	841	17782	354071	17085	2451	441808
2017/18	2972	1973	12154	24338	10342	1934	16209	341623	13396	12673	424941
2018/19	2354	1751	9958	17953	6987	1431	9785	249581	9765	8912	309565
Total	49318	25595	90411	237658	55973	7658	52672	2530722	143962	345550	3503077
Percentage	1.41	0.73	2.58	6.78	1.6	0.22	1.5	72.24	4.11	9.86	100.00

Source: [4].

III.8 AWARENESS/LAW ENFORCEMENT/FINE/PENALTY DATA WITHIN KATHMANDU VALLEY IN 2019/20 [26]

Table 30: Data of law enforcement by traffic police.

SN	Activities/Enforcement	Number	Remarks
1	Lane Discipline awareness program	1,34,043	Total vehicle running in Kathmandu valley is 15,08,537 In FY 2019/20 and violation of rules recorded 4,11,512 vehicles with total fine/revenue of NPR 26,21,72,000 was collected.
2	Haphazard crossing pedestrian's awareness	19,998	
3	Traffic police Musical team mobilized awareness	7,700	
4	Penalty to drink drive	24,350	
5	Lane rule violators	28,449	
6	Road accident involved drivers	289	
7	Number plate rule violators	1,542	
8	High sound motorbike riders and wrong driving	197	
9	Unauthorized parked vehicles	40,637	
10	Vehicle operation with door opening	21,412	
11	Looking glass not in condition	15,191	
12	No horn rule violators	14,327	

From above data percentage of road traffic rule violators is 27.28 i.e. about one third drivers did not obey the traffic rules in the valley.

Source: Authors, (2020).

Table 31: Analysis of fatality with respect to Vehicle and population.

Year	Total Death	Total Vehicle	Vehicle in 10000	Death per 10000 vehicles	Death Per day (average)	Population in 100000 [34]	Death Per 100000 Population
2015/16	2006	2326763	232.68	8.62	5.50	27.26	7.36
2016/17	2384	2768571	276.86	8.61	6.53	27.63	8.63
2017/18	2541	3193512	319.35	7.96	6.96	28.09	9.05
2018/19	2789	3503077	350.31	7.96	7.64	28.34	9.84
2019/20	2255*	3713262[1]	371.33	6.07	6.18	28.60	7.88

*Data affected due to Covid-19 Lockdown for 3.5 months of Fiscal year 2019/2020.

Source: Authors, (2020).

[1]Data not available and calculated considering 6% growth rate

Trends in Reported Road Deaths (WHO estimates per 100,000 people)		
Country	2010	2016
Developed Countries		
Australia	6.0	5.6
France	6.5	5.5
Canada	6.5	5.8
United States	14.2	12.4
East Asia		
Japan	4.6	4.1
PR China	22.5	18.2
South Asia		
Bangladesh	18.4	15.3
Bhutan	11.5	17.4
India	21.7	22.6
Maldives	2.5	.9
Myanmar	8.2	19.9
Nepal	14.5	15.9
Sri Lanka	13.4	14.9

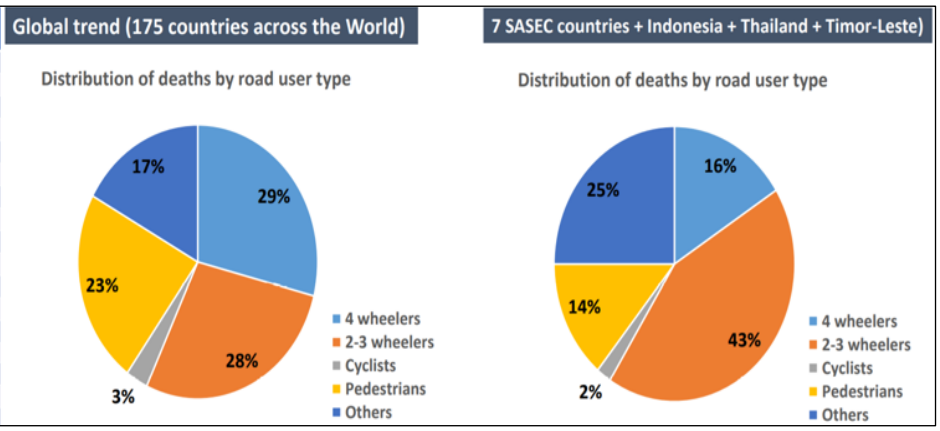

Figure 18: WHO 2018 Global Status Report on Road Safety.
Source: [1].

III.9 GAP IDENTIFICATION BETWEEN TARGETED AND ACTUAL FATALITY DATA

The number of road deaths should come down to 810 in 2020 if Nepal would have responsibly followed the SDG Goals, or to 810 by 2030 if the grace period provided by the Stockholm Conference 2020 is considered. However, it is likely to hit 3,000 in 2020 and 5,000 in 2030 if the effort to lower the road deaths remain at the present level.

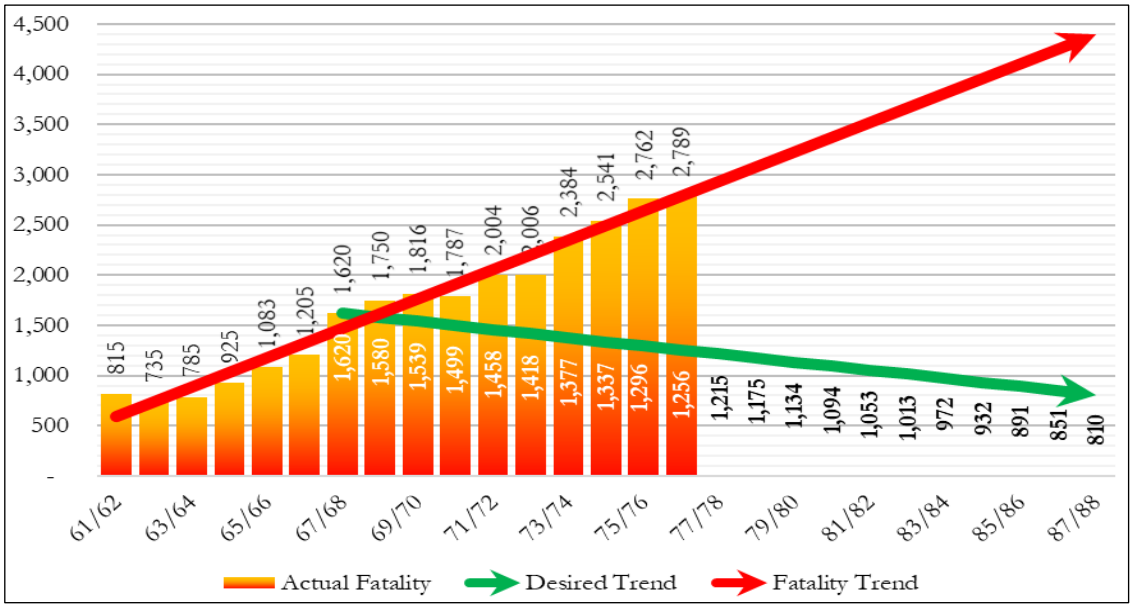

Figure 19: Gap Identification on targeted and actual fatality (BS 61/62 is equivalent to 2004/05 AD and BS 87/88 equivalent to 2030/31AD).
Source: [5].

III.10 GAP IDENTIFICATION BETWEEN TARGETED AND ACTUAL FATALITY DATA

Table 32: Comparison of Road Safety Status.

Country	Total Death	Vehicle in 10000	Death in 10000 Vehicle	Death Rate per 100000 Population
Nepal	2789	319.35	7.96	9.05, Population = 28.09 million
India	151417	25300.00	13.00	11.67, Population = 1.353 billion
Bhutan	100	10.50	9.52	13.20, Population = 754,394 Nos.
Bangladesh	2635	379.75	6.93	16.32, Population = 16.14 million [35]
Maldives	14	8.80	1.59	2.71, Population = 515,696 Nos.
Myanmar	5325			
Sri Lanka	2994	679.55	4.40	13.90, Population = 21,413,249 Nos.

Source: Authors, (2020).

From the table India bears the highest death rate per 10000 motor vehicles and Bangladesh bears the highest death rate per 100000 populations in 2018. Death rate due to road crashes in Nepal seen to be 7.96 per 10000 motor vehicle and 9.05 per 100000 populations. Death rate in Maldives seems to be as low as 1.59 per 10000 motor vehicles and 2.71 per 100000 populations. Some of the above data are calculated from unofficial data sources like presentations or websites. So, may not represent the real figure because WHO presented the different figures on the same matter.

IV. RESULTS AND DISCUSSION

- Road Safety is a critical theme globally with about 1.35 million deaths annually.
- Road accident became the 8th leading cause of death globally and 3 times higher deaths rate in low income than in high income countries.
- Considering the registered vehicles in SASEC countries, India bears the highest death rate due to road traffic accident (13 per 10000 vehicle) in 2018.
- Considering the population in SASEC countries, Bangladesh bears the highest death rate of 16.32 persons per 100000 populations in 2018.
- Road traffic fatalities in Nepal is 7.96 persons per 10000 vehicles and 9.05 persons per 100000 populations in 2018/19 and is in increasing trend i.e. no improvement in road traffic safety.
- In Nepal, major portion of vehicle composition is of two wheelers (72.24%) and involvement of two wheelers in accident is the highest 39.23% on average, heavy vehicles (Trucks and Buses) about 12/12% and that of car is 28.29% on average with highest rate in an urban área.
- Peak traffic hours in Nepal is from 9:00AM to 7:00PM and accident rate at that time is also high. Also, driver's negligence is the major cause (72.32%) of accident followed by over speed (14.66%).
- Road Traffic Accident (RTA) related fatalities and injuries continue to be an important morbidity and mortality problem, as well as a health finance problem.
- Road traffic crash data are useful tools to support highway safety programs.
- Accidents that occurred closest to an intersection would be more likely to end in injury or fatality.
- There will be increase in accident immediately after completion of the widening of road and decrease in the successive years if safety measures are not installed as per set guidelines.
- Age is another major cause of accidents; 15 - 45 years' age group is found to be the vulnerable group and most of the deaths were among occupants, motorcyclists, pedestrians, and the productive workforce.
- Young male drivers recorded the highest frequency of RTAs' victims happened in the evening.
- The analysis showed that short and sharp horizontal curves were associated with higher crash frequencies and the crashes on high-risk rural roads should be identified on improving roads.
- Due to overloading the vehicle will be less stable, difficult to steer and take longer distance to stop. Overloaded trucks pose serious threats to road transport operations, with increased risks for road users, deterioration of road safety, severe impacts. When a semi-truck is overloaded, or the load is improperly loaded, even the most experienced drivers can experience a severe accident.
- 5 of 7 SASEC countries reported higher death rates between 2010 and 2016 so there is need for SASEC countries to better deal with safety record.
- Improving the world's roads to a 3-star or better standard is a key way to achieve the SDG target of halving road deaths and injuries.
- From law enforcement data of Kathmandu valley percentage of road traffic rule violators is 27.28 i.e. about one third drivers did not obey the traffic rules in the valley.

V. CONCLUSION AND RECOMMENDATIONS

Education, Engineering and Enforcement are the major sectors to reduce the rate of accident. With due priority we should focus on them and for this several activities may be implemented by allocating sufficient dedicated budget on road safety. Some recommendations can be listed as:

- Update the Nepal Road Safety Action Plan 2013-2020 to be realistic, implementable from all concerned agencies by harmonizing the vehicle management acts/regulation/guidelines/policies with the UN conventions, international agreements on road-safety and strict implementation of them.
- Establish realistic and long-term national targets for improving road-safety. Develop the network-based accident data recording/ dissemination system and conduct researches on road safety countermeasures on all roads and implement the suggestions.
- Install coordinated self-actuated traffic control system (Intelligent Traffic Signal System) with sufficient bus bays to stop the local public transport in major cities, remote monitoring of speed and traffic volume and remote controlling of traffic flow, SMS/email delivery of traffic violation tickets, and so on.
- Ensure the road safety measures during design of roads by introducing mandatory provision of safety audit and implementation of the recommendations. Introduce road-safety impact assessment and controls in all land developments projects.
- Explore for mass passenger transportation system. Provide access control in high speed highways through grade separated crossings, prohibit right turn where possible and barriers with proper and timely maintenance of the roads confirming to the standards. Introduce mandatory provisions for work zone safety planning in the construction contracts.
- Conduct Skill Development Training in safe-roads and awareness programs regularly and adopt Scientific licensing and route permits techniques. Include road safety in the next revision of formal and informal education curricula, teachers' guide and standard reference material.
- Adopt the policy of importing safer vehicles. Strictly enforce restrictions on vehicle modifications and introduce modern, scientific vehicle testing with strict enforcements by establishing sufficient responsible vehicle fitness centers (Testing information linking to centralized database system and proof in bluebook).
- Set up a network of ambulance services along the major highways, urban and rural roads providing trauma-care training to medical personnel at all levels with expertise

on treatment of road accident victims. Develop and maintain a comprehensive injury surveillance system in hospitals and health centers. Introduce a nationwide toll-free number and an empowered dispatch center at each district/local level hospital to call ambulance.

- Adopt mandatory provision of minimum parking area requirement in all residential/public/commercial buildings, control door/shutter opening for commercial propose to the roadside and control street venders.
- Include road safety and a safe system approach as an integral element of land use planning, road design, transport system planning, education and governance and develop methodology to prioritize investment in road safety projects considering technical, economic and social issues as parameters.
- Establish sustainable source of funding for managing road. Tie requirement for RSA at Feasibility, DPR, Pre-Opening and Operation stage for both the SRN and CRN roads with budget allocation for subsequent phase.

Control overloading of freight trucks through installation of weighing stations at border crossing points and along major trade corridors with network based overloading detection and information system.

VI. ABBREVIATION

ADB/WB	: Asian Development Bank/Word Bank
BRT	: Bus Rapid Transit
DOR	: Department of Roads
DPR	: Detail Project Report
GDP	: Gross Development Product
GPS	: Global Positioning System
ITS	: Intelligent Transportation System
LRN	: Local Road Network
LSGR	: Local Self Governance Regulation
MVTMA	: Motor Vehicle Transport Management Act
MVTMR	: Motor Vehicle Transport Management Regulation
NH	: National Highway
NMT	: Non-Motorized Transport
NRSC	: Nepal Road Safety Council
PCU	: Passenger Car Unit
RS	: Road Safety
RSA	: Road Safety Audit
RSM	: Road Safety Management
RTS	: Road Traffic Safety
SASEC	: South Asia Sub-Regional Economic Cooperation
SDG	: Sustainable Development Goal
SH	: State Highway
SRN	: Strategic Road Network
UN	: United Nations
UNRSC	: United Nations Road Safety Council
VFTC	: Vehicle Fitness Testing Center
WHO	: Word Health Organization

VII. AUTHOR'S CONTRIBUTION

Conceptualization: Krishna Nath Ojha.
Methodology: Krishna Nath Ojha.
Investigation: Krishna Nath Ojha.
Discussion of results: Krishna Nath Ojha.
Writing – Original Draft: Krishna Nath Ojha.
Writing – Review and Editing: Krishna Nath Ojha.
Resources: Krishna Nath Ojha.
Supervision: Krishna Nath Ojha.
Approval of the final text: Krishna Nath Ojha.

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