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Study on Road Safety Audit of Existing Kanti Rajmarg: A Case Study of (Tika Bhairab- Baguwa Section) of Kanti Rajmarg at Lalitpur, Nepal

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Abstract

Ensuring road safety of existing road is crucial to preventing accidents and improving the long-term usability of roadways. This study focuses on a road safety audit (RSA) conducted during the existing phase of the Tika Bhairab-Baguwa section of Kanti Rajmarg in Lalitpur, Nepal. The main aim is to assess the safety performance of the road, identify potential hazards, and highlight design flaws that may lead to accidents in its operation level. Through field observations, surveys, and interviews with road users and experts, the research identified several key safety concerns. These include poor road alignment, narrow lanes, limited visibility, and insufficient signage or markings. Additionally, gaps in traffic law enforcement, coupled with inadequate training for traffic police, contribute to heightened road safety risks. Key findings highlight critical safety concerns such as poor visibility at curves, inadequate pedestrian crossings, lack of proper signage, and hazardous roadside encroachments. Based on questionnaire survey major problems associated with road safety of Kanti Rajmarga with highest RII value were narrow lane width, poor road signage and marking both with RII value 0.85. Similarly, poor road signage and marking, improper alignment both with RII value 0.8. The main cause of narrow lane width was found due to budget constraint, poor plaining and hilly terrain. Based on the results, practical recommendations are proposed, including improved road markings, installation of guardrails, enhanced street lighting, and better traffic management at conflict zones, increasing law enforcement efforts, and providing better training for traffic police and drivers are critical steps to making the road safer. A good drainage system should be created to prevent flooding and erosion, and strong barriers should be placed near steep drops. These recommendations aim to reduce risks and ensure the safety of all road users. Thus this study contributes to the broader discourse on road safety in Nepal by providing a case-specific assessment and actionable solutions. The findings can aid local authorities in implementing effective safety upgrades, ultimately reducing accidents and ensuring safer mobility on Kanti Rajmarg.

Keywords: Existing road safety, KANTI RAJMARGA Road Safety Audit, Road Hazards, Traffic Management.

1. Introduction

Road safety is a major concern in both urban and rural transportation systems. In developing countries like Nepal, the fast urbanization and increasing vehicular movement have led to a rise in road accidents (WHO, 2021). Road Safety Audits (RSA) are systematic analyses of existing or planned roadways to identify the potential risks and recommend improvements to ensure the roads are safer for all users (PIARC, 2019).

Road infrastructure in Nepal has expanded significantly, but safety components generally lag behind, leading to a high accident rate (DOR, 2020). The Kanti Rajmarg is a significant road of Lalitpur, and as a key transport corridor, sections such as Tika Bhairab-Baguwa have witnessed several accidents due to unfavorable road geometry, lack of signing, and a lack of pedestrian infrastructure (Lalitpur Metropolitan City, 2022). Pant et al. (2019) in their study emphasized that there is no systematic auditing in Nepal's road safety management, which leads to avoidable crashes. It is necessary to conduct an RSA of the Tika Bhairab-Baguwa section of Kanti Rajmarg to determine deficiencies and suggest remedial measures.

The previous research has emphasized the need for improved road safety standards in Nepal, particularly on congested urban highways. This study attempts to fill the gap by assessing the prevailing safety levels

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and suggesting evidence-based countermeasures to reduce accident risk. Therefore, this study is directed towards problem-solving through a full Road Safety Audit to identify the safety deficiencies, evaluate the performance of the road, and recommend improvements. The audit is designed to bring about overall improvement in road safety, reduce accident rates, and enable the road infrastructure to cater to all users of KANTI RAJMARGA, Nepal, efficiently.

2. Literature Review

2.1. Road Safety

Road safety refers to the practices, measures, and strategies put in place to protect all road users, including drivers, passengers, pedestrians, cyclists, and motorcyclists, from accidents, injuries, and fatalities. It involves the design and maintenance of safe road environments, enforcement of traffic laws, promotion of safe driving behaviors, and the use of technologies and infrastructure that enhance safety on the roads. The road safety framework is governed by a detailed legal structure, prompting road construction companies and major projects to establish and follow safety management systems, guidelines, and initiatives to adhere to these standards (Xu et al., 2023).

The condition of roads across the country requires significant safety improvements. Many roads exhibit geometric flaws, inconsistent pavement markings, missing or incorrect signage, and non-functional traffic signals. There is also insufficient attention given to the needs of vulnerable road users. Communities expect their roads to efficiently manage traffic, ensure high safety standards, and endure various weather conditions. However, pedestrians and cyclists frequently face the risk of crossing high-speed roads without adequate protection, especially where highways intersect with urban areas or villages. When crashes occur due to design flaws, the long-term costs to the community—both human and financial—far exceed the initial investment in road construction. In fact, the expenses associated with severe or fatal accidents can ultimately surpass the original capital outlay over the lifespan of the road project (IRC: SP:88-2019).

2.2. Road Safety Audit

Road Safety Audit (RSA) is an organized, formal review of a current or proposed road or traffic plan to determine possible safety hazards and recommend actions before accidents occur (Austroads, 2020). RSAs are conducted by independent auditors who examine road plans, operating features, and maintenance levels to enhance the safety of all road users (PIARC, 2020). This literature review evaluates critical research on RSA methodology, effectiveness, challenges, and global best practices.

2.3. Early Developments in Road Safety Audits

The formal concept of Road Safety Audits initially emerged in the United Kingdom in the 1980s. Transport and Road Research Laboratory (TRRL), presently known as the Transport Research Laboratory (TRL), pioneered the idea as an objective review of road schemes by a separate team to identify potential safety risks (Mountain et al., 1996). The UK Department for Transport later formalized RSA practices in the 1990s, and they became standard procedure for flagship road schemes (Department for Transport, 1990).

Australia also had an early adoption of RSAs, and the Austroads association of Australian and New Zealand road transport and traffic authorities initially published the Road Safety Audit Guidelines in 1994 (Austroads,1994). The guidelines established best practice in conducting RSAs and required independent auditors to be central to reviewing road designs.

2.4. Global Adoption and Standardization

After successful result of RSAs in Australia and the UK, it also spread to other countries. In America, the Federal Highway Administration (FHWA) promoted RSAs in the later stages of the 1990s by issuing guidelines to spur state transportation agencies to implement the practice (FHWA, 1999). The European Union also incorporated RSAs into its road safety policy, primarily by the Directive on Road Infrastructure Safety Management (European Parliament, 2008).

Over time, RSAs evolved from being design-led to encompassing all stages of road development, i.e., planning, building, and after-implementation monitoring. The Highway Safety Manual (AASHTO, 2010) presents a thorough format for integration of safety analysis into road development. In addition, advances in technology, i.e., computer-aided design (CAD) and geographic information systems (GIS), enhanced accuracy and efficacy in RSAs (Elvik, 2007).

2.5. Road Safety Audit in Nepal

Road Safety Audit (RSA) is a formal and systematic evaluation of either proposed or existing roads for identifying potential safety issues and recommending remedial measures (Austroads, 2009). In Nepal, RSA introduction is relatively recent with an initiative aimed at developing road infrastructure and reducing traffic accidents. The following is a discussion of the history, development, challenges, and standing of RSA in Nepal in this literature review.

2.6. Early Development of Road Safety in Nepal

Nepal's road safety policy began to take center stage in the second half of the 20th century with rising urbanization and motorization. The government also became aware of the need for safer roads with higher accident rates (Dulal et al., 2016). However, formal RSA procedures were not included in road planning and construction initially.

The Ministry of Physical Infrastructure and Transport (MoPIT), Department of Roads (DOR) first applied RSA guidelines in the early 2000s based on international practices from Australia and the UK (Pradhan, 2018). The guidelines were drawn from the Road Safety Audit Standards of the International Road Assessment Programme (iRAP) and the World Health Organization (WHO).

2.7. Institutionalization of RSA in Nepal

The official adoption of RSA in Nepal got sped up after the country's participation in the Decade of Action for Road Safety (2011–2020), a global campaign of the United Nations (UN, 2011). The National Road Safety Action Plan (2013–2020) emphasized the use of RSA in landmark infrastructure projects (MoPIT, 2013).

A number of key projects, such as the Strategic Road Network (SRN) and donor-funded highways (e.g., supported by the Asian Development Bank and World Bank), rendered RSA a critical component (ADB, 2015). Nonetheless, the implementation process still persisted to be unstable owing to technical competence shortages as well as weak enforcement regimes (Gurung et al., 2019).

2.8. Case studies for Road Safety Audits of Existing Roads

A study by Tiwari et al. (2016) on Indian city roads identified some of the most common safety issues such as lack of pedestrian crossings, poor signage, and uncontrolled junctions. The study recommended lane demarcation, improved street lighting, and traffic calming for enhanced safety. A Dhaka, Bangladesh case study (Hossain & Ahmed, 2017) found poor footpaths and encroachment to be causes of pedestrian deaths. These points are relevant to the Kanti Rajmarga, where there is pedestrian traffic and mixed traffic posing enormous threats.

One such study by Shrestha et al. (2019) of the Kathmandu-Terai Fast Track identified the crash causes as acute curves, no road markings, and drainage problems. The audit recommended geometry rectification and improved signage. A study by Dhakal and Adhikari (2020) of the Prithvi Highway identified roadside hazards and no guardrails increasing crash severity. Similarly study on Kathmandu-Bhaktapur Road found that implementing RSA recommendations reduced accident rates by 25% over two years.

A Study on Ring Road Safety (DUDBC, 2019) conducted an RSA on Kathmandu’s Ring Road, identifying deficiencies such as inadequate lane markings, poor drainage leading to skidding risks, and unsafe pedestrian crossings.

2.9. Challenges in RSA Implementation

Despite policy advancements, RSA implementation in Nepal faces several challenges:

i. Inadequate Trained Auditors: It has a lack of trained RSA professionals, where foreign consultants are employed (DOR, 2017).
ii. Weak Enforcement: RSA guidelines are often not enforced due to budget constraints and political meddling (Shrestha, 2020).
iii. Ineffective Legal Framework: Contrary to developed countries, Nepal does not have strict legislation requiring RSA for all road projects (Paudel, 2021).

2.10. Recent Developments and Future Directions

Recent years have seen improvements in RSA application, with the DOR conducting audits on major highways like the Kathmandu-Terai Expressway (KTE) and East-West Highway (The Himalayan Times, 2022). Capacity enhancement in the form of training sessions for engineers is enabled by agencies like IRAP and the World Bank (World Bank, 2021).

Future initiatives should be aimed at:

- Strengthening RSA legislation
- Training local technical skills
- Complying with audit recommendations

3. Methodology

3.1. Tools Used

Various problems, their causes and effects, were listed on the basis of field observation, focus group discussion and in-depth Interview. Questioner survey was then carried out to take the opinion of various stakeholders and was analyzed by keeping on Likert scale and Reflective importance index was carried for out for the calculation.

Field observation was done through personally visiting every chainage with critical section.

In-depth interview was taken with the director of Madan Bhandari Highway project, Senior Divisional Engineer of Mechanical Training Centre and project directorate of Madan Bhandari Highway project. Open ended questionnaire was shared and the conclusion was there are many blind curves, settlement on both side of road that obstructs sigh-distance, the road is not dedicated for double lane. The main reasons of vulnerability on roads were landslide, drainage issues, and inadequate safety barriers, poor installation of traffic lights, signs and symbols.

From focus group discussion with key stakeholders, there is need of increase in number of traffic personnel as well as safety awareness program for the public. The study was conducted during the period from June 2024 to November 2024.

3.2 Study area

The study was conducted for the sections of Kanti Rajmarg covers approximately 92 kilometers and connects Kathmandu to Hetauda, a major industrial town in the Terai region. This route passes through diverse landscapes, including steep hills, valleys, and dense forests, making it one of the most challenging yet scenic roads in Nepal**.** The study area covers Lalitpur district, i.e., Tika Bhairab to Baguwa with a length of 32 km.

Figure 1. Map of the study area (source: www.google.com)

3.3. Data Analysis

Quantitative analysis was carried out from the collected data to study on road safety audit of existing Kanti Rajmarg of Nepal. Mainly qualitative data were gathered together from the study. Qualitative data from the In-depth Interview (IDI) and Focused Group Discussion (0FGD), which are the opinion, words and information, were the key findings from the study which were carefully interpreted. The data was analyzed on MS Excel software and the results were presented through bar chart, pie chart and tables whichever was suitable. In this analysis of data obtained on the research, descriptive statistics were adopted. Mean score involves assigning numerical values to respondent's ratings of factors like Very Good 5, Good 4, Neutral 3, Poor 2 and Very poor 1, the mean score for each condition is to determine the RII value.

Relative Importance Index (RII) = $\Sigma W/AN = (1*n_1+2*n_2+3*n_3+4*n_4+5*n_5)/(5*N)$

W = weightage given to each factor by the respondent, ranging from 1 to 5 n_1 =number of respondents for strongly disagree, n_2 =number of respondents for disagree, n_3 =number of respondents for neutral, n_4 =number of respondents for agree, n_5 =number of respondents for strongly agree

A = highest weight; that is 5 in this study
N = Total number of respondents

4. Result and Discussion

Various problems, it's their causes and effects, were listed on the basis of field observation, Focus Group Discussion and In-depth Interview. Questioner survey was then carried out to take the view of various stakeholders and was analyzed by using Likert scale. All the respondent characteristics, occupation, educational background has been drawn in pie-chart. The questionnaire ranking has been done and presented on bar diagram.

4.1. Characteristics of respondents

Out of 120 respondents, 5% of the respondents were above age 50, 25% of the respondent were between age group 41-50, and 20-30 and remains 45% of the respondents were from age group 31-40.

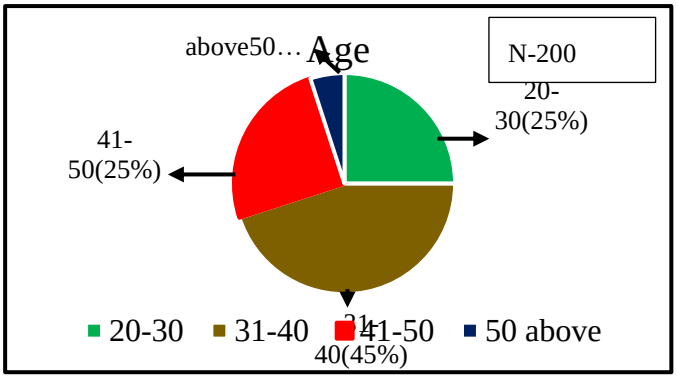

Figure 2. Age of respondents (Field Survey, 2024)

4.2. Profession of the respondents

As shown in the figure, 70% of the respondents were from the private sector, 17% of the respondents were government, 10% of the respondents were entrepreneur and remains 3% of the respondents were from health sector.

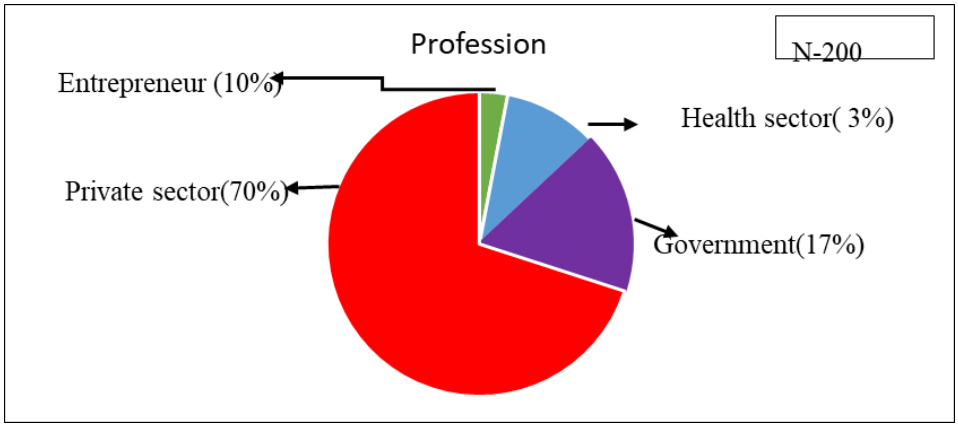

Figure 3. Profession of the respondents (Field Survey, 2024)

4.3. Educational level of the respondents

Out of 200 respondents, 2% of the respondents had intermediate degree, 48% of the respondents were from bachelor's degree and 50% of the respondents were from master's degree.

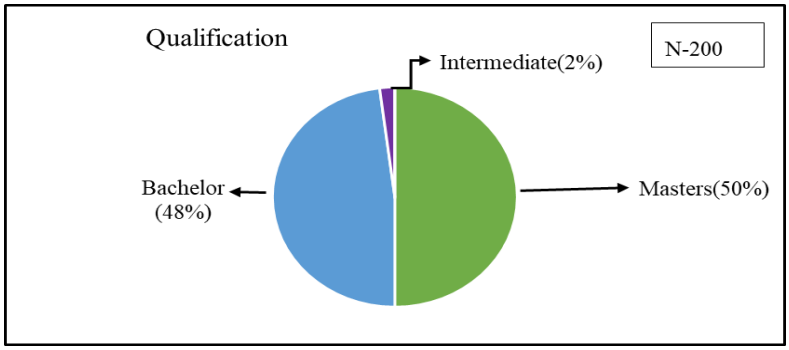

Figure 4. Education level of respondents (Field Survey, 2024)

4.4. Major Problems in Road Safety Audit of the Existing Road

As shown in the figure below, the most significant reason of major problems of safety audit of existing road are, "Narrow lane with" followed by, "Poor road signage and marking" with same RII value of 0.85. Similarly, "Improper road alignment", "Poorly designed intersection" with RI value of 0.8. The least

significant problems are, “Insufficient guardrails” and “High risk accident location” with RII value of 0.7 and 0.65.

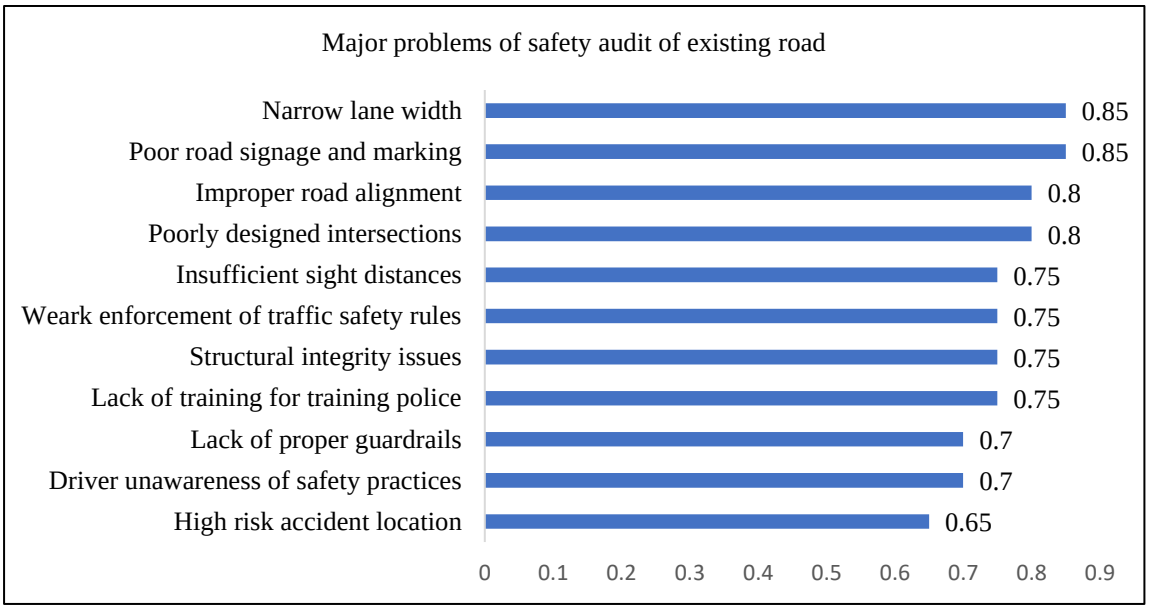

Figure 5. Major problems on road safety audit for existing road (Field Survey, 2024)

4.5. Causes and Effect of Problems

1. Poor Road Signage and Marking

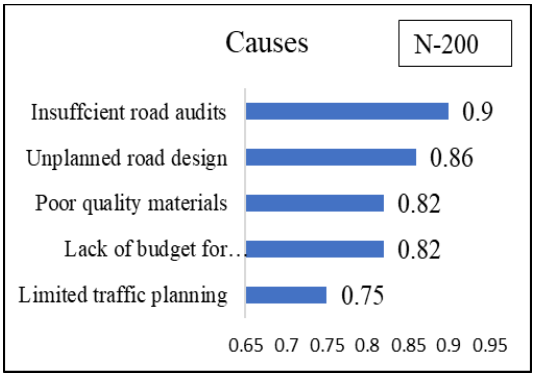

Figure 6. Causes of poor signage and marking

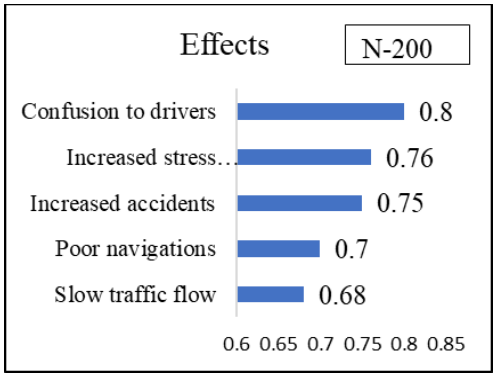

Figure 7. Effects of poor signage and marking

2. Narrow Lane Width

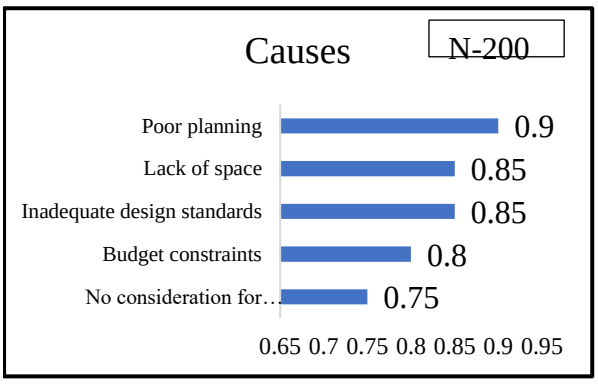

Figure 7. Causes of narrow lane width

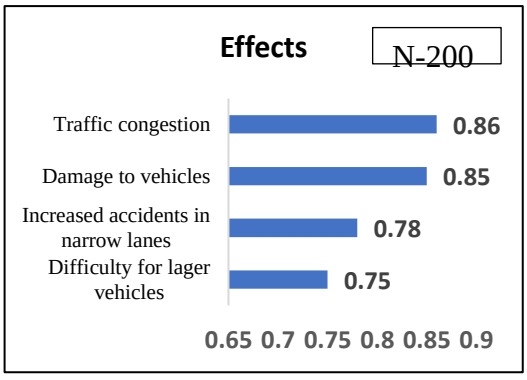

Figure 8. Effects of narrow lane width

3. Poorly Designed Intersections

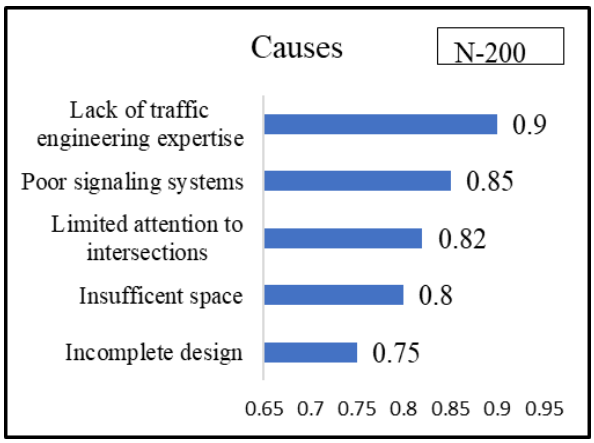

Figure 9. Causes of poorly designed intersections

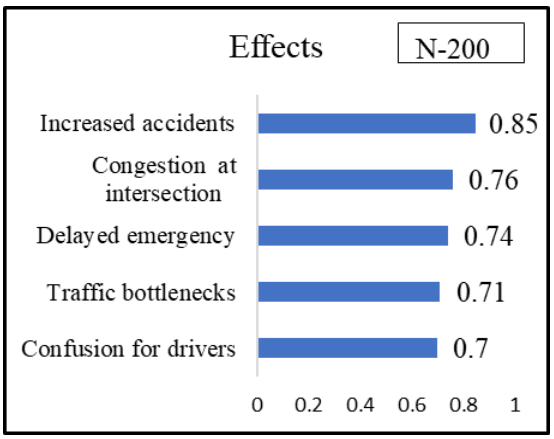

Figure 10. Effects of poorly designed intersections

4. Improper Road Alignment

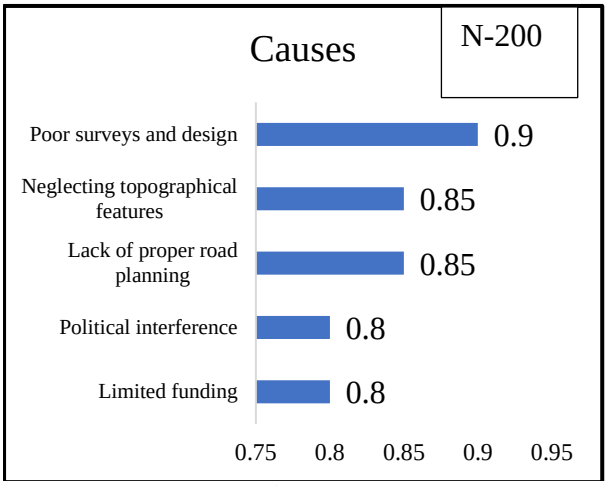

Figure 11. Causes of improper road alignment

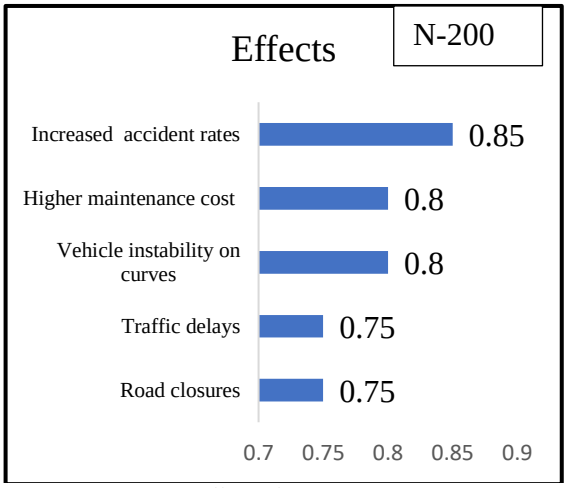

Figure 12. Effects of improper road alignment

6. Insufficient of Training for Traffic Police

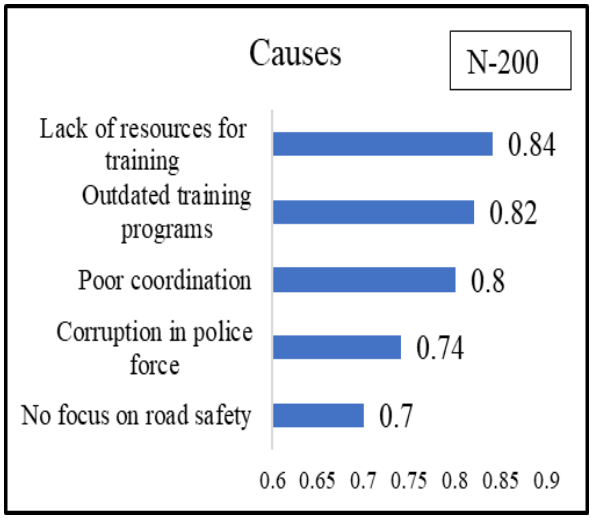

Figure 13. Causes of insufficient training for traffic police

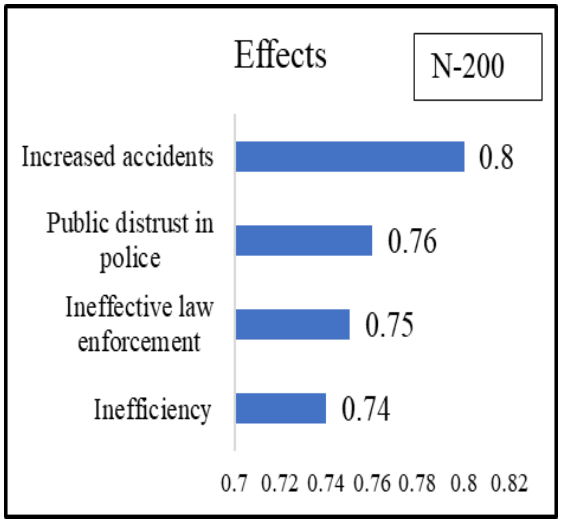

Figure 14. Effects of insufficient training to traffic police

7. Structural Integrity Issues

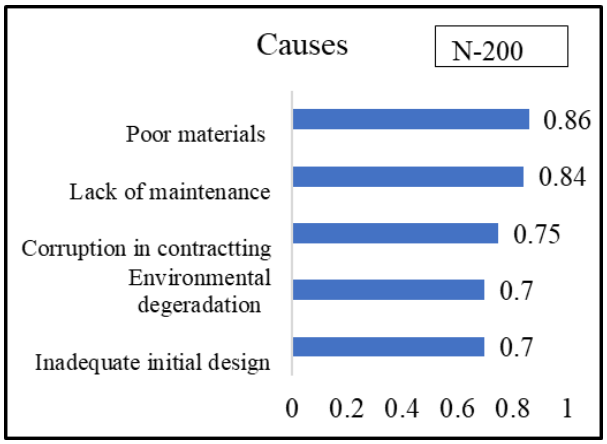

Figure 15. Causes of structural integrity issues

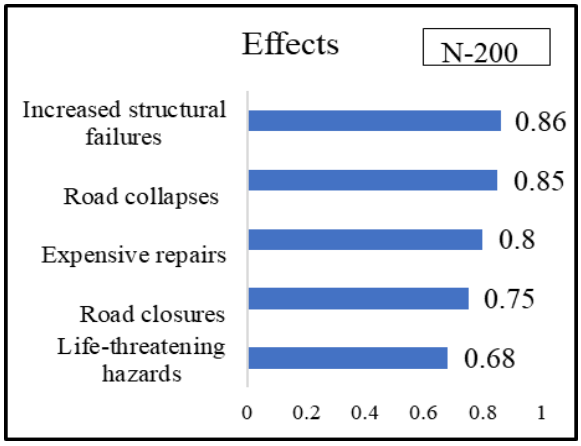

Figure 16. Effects of structural integrity issues

8. Weak Enforcement of Traffic Safety Rules

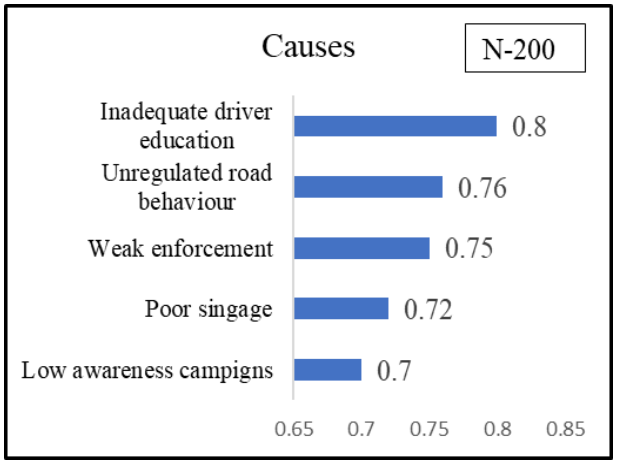

Figure 17: Causes of weak enforcement of traffic safety rules

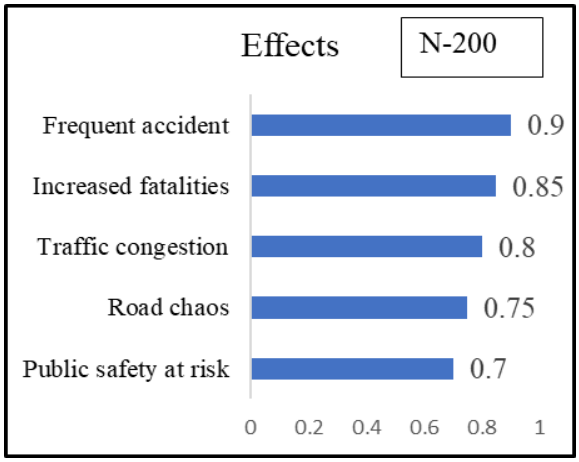

Figure 18: Effects of weak enforcement of traffic safety rules

9. Insufficient Visibility

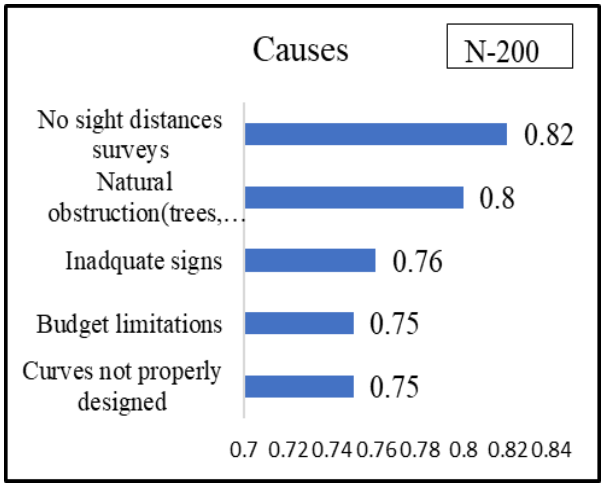

Figure 19. Causes of insufficient visibility

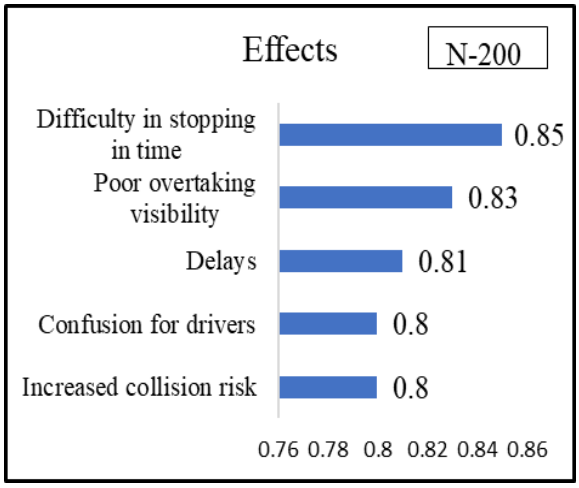

Figure 20. Effects of insufficient visibility

10. Driver Unawareness of Safety Practices

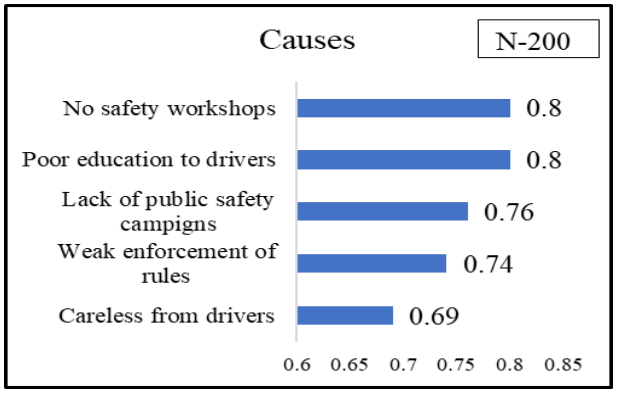

Figure 21. Causes of driver unawareness of safety practices

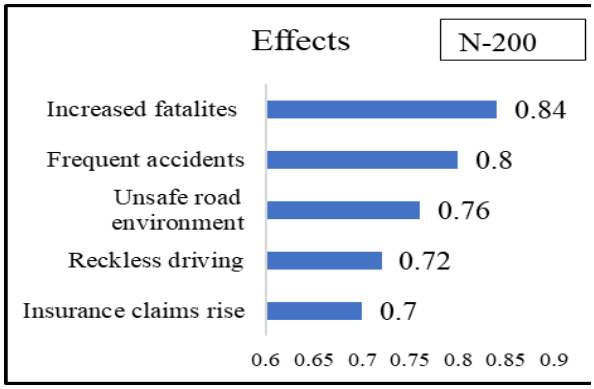

Figure 22. Effects of driver unawareness of safety practices

11. Insufficient guardrails

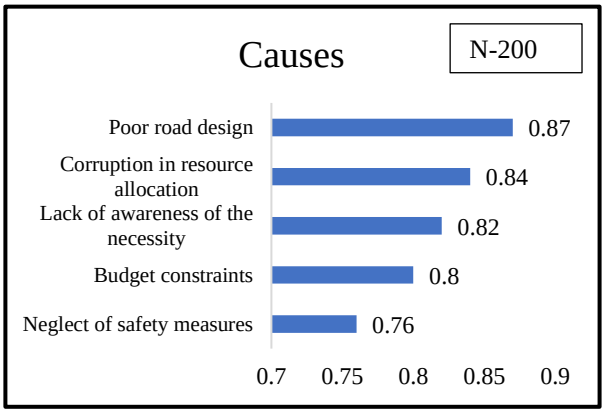

Figure 23. Causes of lack of proper guardrails

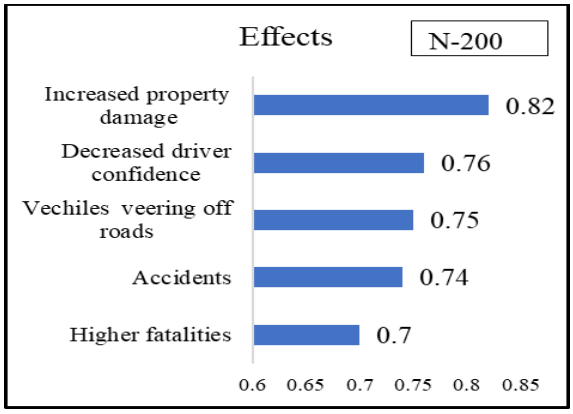

Figure 24. Effects of insufficient guardrails

12. High Risk Accident Locations

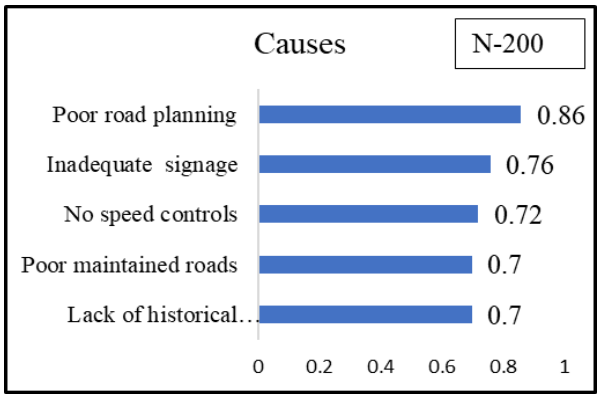

Figure 25. High risk of accident location

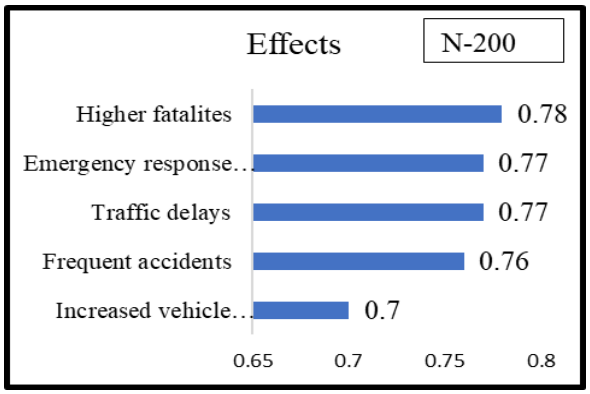

Figure 26. Effects High risk of accident location

4.6. Mitigation Measures for road safety audit existing stage

As shown in the figure below, the most significant mitigating measures for road safety audit of existing stage are, “Improve high-risk accidents areas with targeted safety measures like better signage and speed”, “Increase diver safety awareness through workshops and campaigns”, “Install guardrails in high-risk areas like steep or winding roads” with RII value range between 0.8 to 0.85.

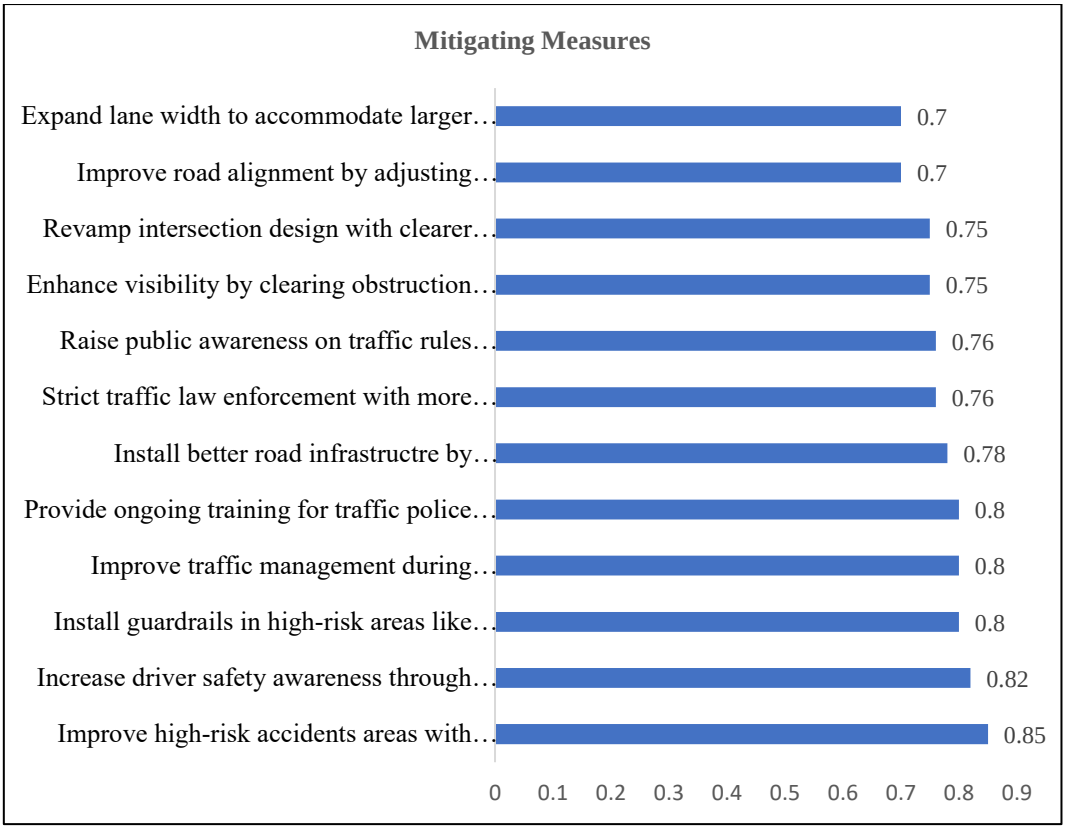

Figure 6: Mitigation Measures of road safety audit (Field Survey, 2024)

4.7. Discussion

The findings of this study are drawn from a comprehensive methodological framework that integrated field observations, in-depth interviews, focus group discussions, and questionnaire surveys analyzed using the Relative Importance Index (RII). This multi-dimensional approach provided a robust understanding of the existing road safety challenges on the Tika Bhairab–Baguwa section of Kanti Rajmarga. Field visits allowed for firsthand identification of physical road deficiencies such as narrow lane widths, poor signage, and inadequate alignment. Expert insights gathered through interviews with key personnel from the Madan Bhandari Highway Project highlighted recurring issues like blind curves, insufficient sight distance, and weak enforcement of safety measures.

The opinions from stakeholders during focus group discussions emphasized the lack of trained traffic personnel and low public awareness regarding road safety. The questionnaire survey further quantified these problems, with narrow lane width and poor road signage receiving the highest RII value of 0.85, indicating their critical impact on safety. These findings align with and extend prior studies by incorporating both technical assessments and user experiences, offering a holistic perspective. This evidence-based discussion forms the foundation for the recommendations presented, aiming at practical improvements for safer road use.

Different studies have investigated the safety aspects of Nepal's Kanti Rajmarga main road, with different methodologies, findings, and recommendations. The following discussion compares previous studies on RSA conducted on this highway, highlighting their key findings, and limitations. Earlier studies of RSA in Kanti Rajmarga have adopted different methods. Dahal and Thapa (2020) conducted a qualitative assessment through field surveys and expert observations and identified black spots based on the accident history. Shrestha et al. (2021) utilized a quantitative approach, examining crashes from traffic police reports and applying statistical models to predict high-risk areas. In parallel, Gurung et al. (2019) combined both qualitative and quantitative analysis, applying Geographic Information System (GIS) mapping in order to map accident-prone areas.

The studies continuously indicated poor road geometry, inadequate signage, and lack of pedestrian crossings as the major safety concerns. Dahal and Thapa (2020) emphasized the need for better lane marking and speed checks, while Shrestha et al. (2021) proposed the installation of crash barriers on curves. Gurung et al. (2019) also indicated the driving behavior and proposed public awareness campaigns along with engineering redesign.

Although informative, these studies were not expansive. Dahal and Thapa (2020) relied too heavily on observation data rather than thorough statistical validation. Shrestha et al. (2021) focused primarily on historical crash data and neglected live traffic flow analysis. Gurung et al. (2019) provided an expansive assessment but omitted stakeholder interviews that would have made policy-level recommendations.

In this study, the research identified significant safety deficiency, there are challenging issues such as training for traffic personnel, insufficient training program on road safety for the road users.

5. Conclusion

The present status of KANTI RAJMARGA is not satisfactory, there is poor implication of safety rules, less awareness to drivers, road users and less technical manpower involvement from the concerned authorities. The research identified significant safety deficiencies including poor road signage having RII value of 0.85, narrow lane width value 0.85 and improper road alignment with value of 0.8. There are challenging issues such as training for traffic personnel, weak enforcement of traffic safety rules, less practice of conducting training program for traffic personnel and drivers.

References

Asian Development Bank (ADB). (2015). Road safety in Nepal: Current status and future directions. https://www.adb.org

Austroads. (1994). Road safety audit guidelines. *Austroads*.

Austroads. (2009). Guide to road safety audit. https://austroads.com.au

Austroads. (2020). Guide to road safety part 6: Road safety audit. https://austroads.com.au

Dahal, R., and Thapa, S. (2020). Road safety audit of Kanti Lok Rajmarga: Identifying black spots and mitigation measures. *Journal of Transportation Engineering*, 12(3), 45-56.

Department for Transport. (1990). Road safety audit standards. *UK Government.*

Department of Roads (DOR). (2017). Road safety audit manual for Nepal. *Government of Nepal.*

Dulal, S., Sharma, S., and Michael, F. (2016). Road safety challenges in Nepal: A review. Journal of Transportation Engineering, 12(3), 45-52.

Elvik, R. (2007). Road safety management: A systematic approach. *Elsevier*.

European Parliament. (2008*)*. Directive 2008/96/EC on road infrastructure safety management. *Official Journal of the European Union*.

Federal Highway Administration (FHWA). (1999). Road safety audit guidelines. *U.S. Department of Transportation.*

Gurung, B., Sharma, P.,and Rai, A. (2019). GIS-based road safety assessment of major highways in Nepal: A case of Kanti Lok Rajmarga. *International Journal of Traffic Safety*, 8(2), 112-125.

Gurung, R., Joshi, A., and Thapa, R. (2019). Implementation barriers of road safety audit in Nepal. Nepal Engineering Journal, 4(1), 22-30.

Ministry of Physical Infrastructure and Transport (MoPIT). (2013). National Road Safety Action Plan (2013–2020). *Government of Nepal.*

Mountain, L. J., Fawaz, B. S., and Jarrett, D. F. (1996). The development of road safety audit in the UK. *Transport Research Laboratory*.

Paudel, S. (2021). Road safety governance in Nepal: Policies and gaps. *Kathmandu University Press.*

Pradhan, A. (2018). Evolution of road safety practices in Nepal. Transportation Research Bulletin, 7(2), 15-25.

Shrestha, B. (2020). Challenges in enforcing road safety audits in Nepal. *International Conference on Transportation Engineering.*

Shrestha, K., Joshi, M., and Poudel, R. (2021). Statistical analysis of road accidents on Kanti Lok Rajmarga: Implications for safety improvements. *Nepal Engineering Journal*, 15(1), 78-90.

The Himalayan Times. (2022, June 10). Road safety audits to be mandatory for expressways. https://thehimalayantimes.com

United Nations (UN). (2011). Decade of Action for Road Safety 2011–2020. https://www.who.int/roadsafety/decade_of_action

World Bank. (2021). Nepal road safety improvement project. https://www.worldbank.org

World Health Organization (WHO). (2004). World report on road traffic injury prevention. *WHO*.

World Health Organization (WHO). (2018). Global status report on road safety 2018

World Road Association (PIARC). (2020*).* Road safety manual. *https://www.piarc.org*

Xu, et al. (2003). Title of the Study or Report. Publisher or Source, 2023.