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Value of Risk Reduction of Fatal Road Crashes: A Case Study of Long- and Medium-Route Public Vehicle Passengers Traveling To and From Kathmandu

by

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A THESIS

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The undersigned certify that they have read and recommended to Institute of Engineering for acceptance, a thesis entitled **"Value of Risk Reduction of Fatal Road Crashes: A Case Study of Long- and Medium-Route Public Vehicle Passengers Traveling To and From Kathmandu"** submitted by Puspa Sukubhattu in partial fulfillment of the requirement for degree of Master of Science in Transportation Engineering.

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ABSTRACT

Studies on public attitudes toward road safety and their Willingness To Pay (WTP) for reducing crash risks are limited in Nepal, leaving little evidence to guide decision-makers in prioritizing road safety investments. This research aims to determine Value of Risk Reduction (VRR) for Nepal in road safety through their WTP for reducing fatalities considering trade-offs with travel time and cost. Discrete choice questionnaire survey was conducted among long and medium-route public vehicle passengers to 38 different locations in Nepal with public vehicle access to and from Kathmandu. The study considered three key attributes: annual number of fatalities, travel time, and fare. By using actual baseline values for travel time and travel fare, and realistic values of base fatalities, eight practical combinations were generated, enabling respondents to make informed and meaningful choices. This approach distinguished the study by enhancing the realism and reliability of the responses. WTP value was estimated using binomial logistic regression with clustered standard error techniques and the value was found to be $0.119 per person per trip. Using WTP value, annual average daily passenger and fatal crash risk reduction of 37.5%, VRR was calculated to be US$ 0.11 million per fatality reduction. (exchange rate:US1=NRs139, 2024).

Keywords: Willingness to Pay, Discrete Choice, trade-offs

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LIST OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
ACBC	Adaptive Choice Based Conjoint Analysis
BT	Bituminous Treatment
CM	Choice Modelling
CV	Contingent Valuation
DC	Discrete Choice
DOR	Department of Roads
GDP	Gross Domestic Product
HC	Human Capital
HCA	Human Capital Approach
IATSS	International Association of Traffic and Safety Sciences
IRAP	International Road Assessment Program
JICA	Japan International Cooperation Agency
MIROS	Malaysian Institute of Road Safety Research
OECD	Organization for Economic Cooperation and Development
QGIS	Quantum Geographic Information System
RAIMS	Road Accident Information Management System
RTI	Road Traffic Injuries
SP	Stated Preference
SPSS	Statistical Package for Social Sciences
TRL	Transport Research Laboratory
UK	United Kingdom
US	United States
USD	United States Dollar
VOSL	Value of Statistical Life
VRR	Value of Risk Reduction
VSL	Value of Statistical Life
WB	World Bank
WHO	World Health Organization
WTP	Willingness to Pay

CHAPTER 1: INTRODUCTION

1.1 Background

The role of road transport in improving mobility and accessibility is very crucial but at the same time, the higher risk to human life due to road traffic crashes is noteworthy. As per global status report on road safety 2023 (WHO, 2023), road traffic crashes claim 1.19 million lives and 20 to 50 million people suffer non- fatal injuries each year & the burden is disproportionately high with 92% coverage in low and middle-income countries representing a major public health and economic burden. RTIs have a high cost in terms of health and socio-economic outcomes with the greatest share of mortality and long-term disability among the working-age population (Mitra, 2023).

An alarming state of road crashes in Nepal since last one and half decades is shown in Figure 1.1. The official record of Nepal Police shows that 2369 people lost their lives and 6160 were seriously injured in fiscal year 2022/23. The trend of road construction intensified especially after the implementation of federalism, increase in vehicle ownership and diversity of motorized and non-motorized modes of varying size and speed will even exacerbate the crisis. Road crashes will continue to climb unless urgently required measures are implemented. With nearly all districts and municipalities now connected to the national road network, the focus should be on addressing existing safety issues and upgrading infrastructure. Moreover, the most impactful safety measures are often the most fundamental.

Nepal Road Safety Action Plan (2013-2020) highlights problems like blind road corners, poor shoulders, unforgiving side-drains, inadequate safety barriers at steep vertical drops, and lack of climbing lanes whilst also stating activities for each five pillars viz. road safety management, safer roads and mobility, safer vehicles, safer road users and post-crash response. Similarly, Nepal Road Safety Action Plan (2021-2030) presents the strategies like nationwide roll-out of RAIMS, network level safety assessment of all roads, establish trauma centers etc. to improve the road safety status of the country. To ensure the successful and effective implementation of these activities, securing sufficient financial resources is essential. WB (2020) estimates that Nepal will require an additional investment of US$879 million over the coming decades, if it is to achieve the sustainable development goal 3.6,

target of 50% reduction in national road crash fatalities. This will take long-term commitment and sustained vision from the Government of Nepal for this investment to be effective and bring road safety performance under control on a sustainable basis (World Bank**,** 2020).

Capital allocation in road safety require justification from economic gain of traffic crash risk reduction. To achieve this, it is essential to determine the monetary value of road crash risk reduction. Estimating cost of crashes is an approach for this. There are various methods well documented by Transport Research Laboratory (TRL) for determining cost of road crashes such as human capital approach (HCA), willingness to pay approach (WTP), gross output method and insurance-based costing. HCA estimates costs based on lost productivity, medical expenses, and other direct economic losses resulting from crashes. Gross output method extends the HCA by including both lost productivity and the value of non-market activities (e.g., household work, leisure). WTP measures how much individuals are willing to pay to reduce the risk of crashes or injuries. TRL recommends use of HCA for developing countries to determine crash cost because WTP is based on complex survey which may be unfamiliar to ordinary people. However, most of the developed countries adopt WTP approach which assumes that individuals' preferences are the basis for economic welfare.

Also, the required resources must be primarily generated through contributions from the general public. However, it is yet to be ascertained whether the public is willing to contribute. A comprehensive evaluation of the public's willingness to pay is imperative to ascertain the scope of safety improvements that can be implemented with the allocated funds. So, this study aims to estimate value of road crash risk reduction in Nepal by WTP approach.

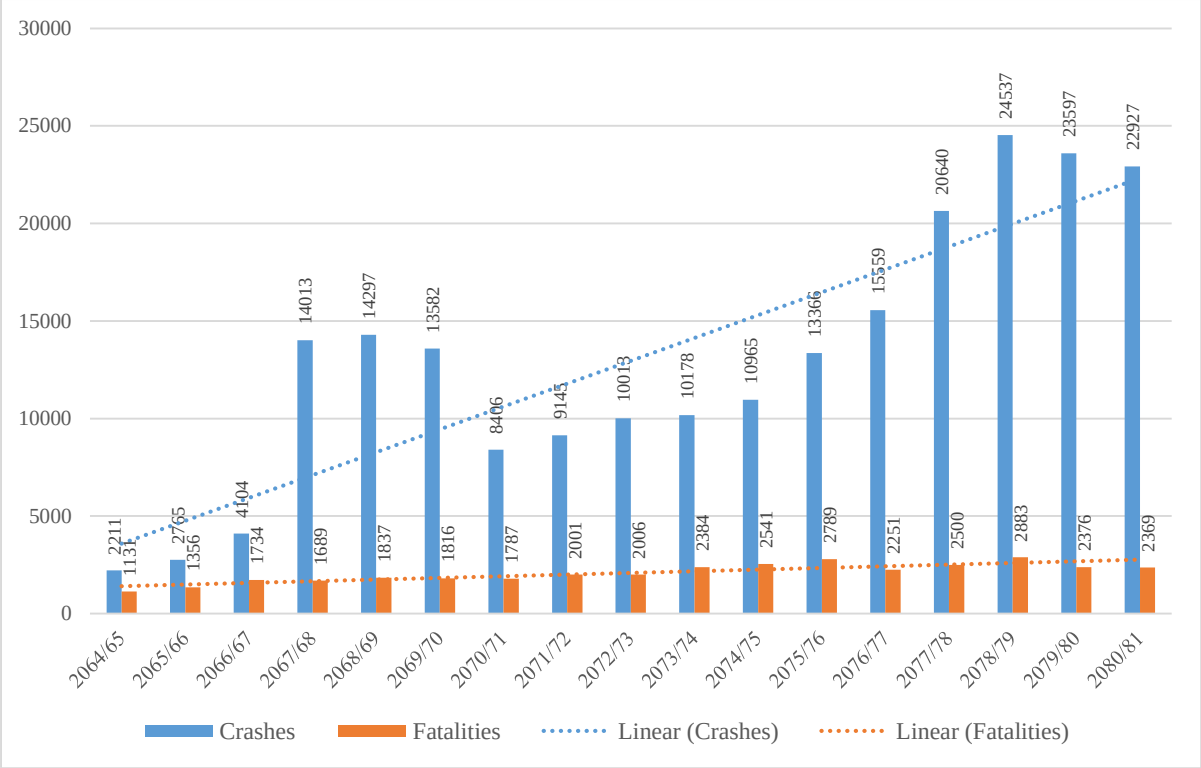

Figure 1.1 Increasing Road Crashes and Fatalities in Nepal (Source: Nepal Police, 2025)

1.2 Problem Statement

Despite frequent fatal crashes on Nepal's highways, road safety has not received the attention it deserves. Road safety issues in national highways are a major concern with mass fatalities of bus passengers. Bus crashes on long-distance routes account for 13 percent of fatalities and 31 percent of serious injuries in Nepal (World Bank 2020). The passengers, who bear no responsibility for errors made by drivers or road agencies, often become helpless victims of preventable crashes. No study has yet assessed public vehicle passengers' willingness to pay for enhanced road safety leaving a key question unanswered—are people actually willing to bear the financial burden for safer roads? This is a critical gap for the economic analysis of road safety improvement projects.

1.3 Objective of Study

The main objective of the study is to determine how people value road safety through their WTP for reducing road crash fatalities, considering trade-offs with travel time. The specific objectives are enlisted as below:

1) To estimate willingness to pay per person per trip of long- and medium-distance public vehicle passengers for reducing fatalities.
2) To estimate the value of risk reduction of fatal road crashes based on WTP.

1.4 Scope of Study

The following scope of the study has been planned:

- To study risk perception and determine willingness to pay of passengers of long and medium-distance public vehicles traveling to and from Kathmandu to various places in Nepal.
- To study the impact of demographic and socio-economic factors such as age, gender, and income in willingness to pay
- To determine the value of fatal road crash risk reduction based on WTP of passengers

1.5 Limitation of Study

The study has following limitations:

- Considered destinations are limited to the most common destinations from Kathmandu designated by various bus operators with counter numbers displayed at the Gongabu bus park. Besides, six locations to the central eastern parts of Nepal were added.
- Travel time and fare were taken from website of Bus Sewa that may vary with real time and fare of some respondents.
- Since road crash data based on highway or route followed by public vehicle was not available, the base scenario of crash at different highways were created based on crash data of particular districts through which the public vehicles pass

assuming all recorded fatal crashes are on the roads enlisted by Department of Roads.

1.6 Organization of Report

The study consists of four chapters as follows:

Chapter 1: The introduction includes background describing overall status of road crashes in a global context and Nepal focusing on the need for financial resources for road safety improvement. It introduces problem statement on why public attitude is essential to consider and outlines the objectives, scope, and limitations of the research.

Chapter 2: Literature review discusses the available literature in the study related area regarding the historical background on valuing risk reduction, different methods for valuing risk reduction, their suitability, methods for WTP approach, steps for designing experiment, and survey techniques.

Chapter 3: Research methodology describes the methodology adopted for the study including secondary data collection, questionnaire design, field survey, mathematical formulation for analysis and data analysis using software.

Chapter 4: Result and discussion discusses the results of the study with descriptive statistics of socio-economic characteristics of respondents, parameter estimates of binary logit model and their interpretation.

Chapter 5: Conclusion and recommendation include main findings with its practical implications and recommendations for future research.

CHAPTER 2: LITERATURE REVIEW

2.1 Historical Background on the Value of Risk Reduction

The need for valuing safety or risk reduction emerges from two inescapable facts, first, safety is typically not a free good, second, society's resources are not limitless (Jones-Lee *et al*., 1995). Since Adam Smith's time (1776), economists have noted that workers demand a compensating differential—a wage premium—for jobs involving higher risks. These wage premiums provide a basis for evaluating risk-money tradeoffs and estimating the value of life. As economists sought to quantify individuals' lives based on their earnings and productivity, Human capital approach (HCA) emerged and was formalized in the 1950s and 1960s.

HCA quantifies discounted present value of the victim's future output (or income) extinguished as a result of his or her premature demise. An allowance is then added for various other economic effects such as vehicle damage, police and medical costs and so on. Further, allowance for the "pain, grief and sufferings" are also added arbitrarily which is called modified HCA or gross output approach. Thus, the gross output approach can be viewed as an attempt to measure the impact of death or injury on current and future levels of national output, broadly construed to include various non-marketed services. It was widely used in road safety and public health economics, particularly in cost-benefit analyses by organizations like the World Bank and OECD till 1980s. Many low and middle-income countries, including Nepal, still rely on this method for appraisal of projects.

Previous studies in Nepal have primarily focused on estimating the economic losses from road crashes, relying on the Human Capital (HC) approach. ND LEA Inc. et al. (2008) estimated fatal crash cost for Nepal to be Rs 609236 while Rizal et al. (2020) estimated Rs 7459501 for fatal road crash in Kathmandu valley. Though this method seems straight forward Robinson (1986) points out, an individual’s WTP to reduce mortality risks has no direct correlation with their discounted lifetime earnings, making HC-based estimates inadequate for capturing the true value of life.

The main objection to HCA as given by earlier authors was that people value safety because they want to avoid death and injury for themselves and others, not just for economic reasons and to maintain productivity. So, focus should be on people's genuine preferences for safety, how much they are willing to pay for safety. Department of Transport in the UK formally initiated the WTP approach and used in valuing road crash fatalities in 1988.

2.2 The Appraisal Framework for Decision

Putting money values on unpriced assets like the safety of life is objected by some commentators but this may risk that the things which people care about will be not given adequate recognition when decisions are made. If these issues are omitted from decision-making, there is a strong risk that non-marketed goods will be under-supplied in the economy, and that non-marketed bad will be over-supplied. Deciding how much of a good to supply, or how much of a bad to tolerate or abate, requires that the value of those good and bad be brought into balance with the costs of providing the good (or the cost of reducing the bad). In this regard at least, 'money counts' because prices provide an indicator of preferences (Pearce, 2002).

Appraisals which are undertaken to support decision making (apart from the purely financial) fall into three broad categories (Pearce, 2002):

- Cost benefit analysis: where all the significant pros and cons of a range of alternative solutions are compared, ideally in money terms;
- Cost effectiveness analysis: where alternative ways to meet a defined result are compared, again generally in terms of money value costs;
- Multi-criteria approaches: which compare alternative options based on attributes that are measured but not necessarily valued.

Money values are central to the first two of these approaches. The third approach inevitably involves some element of weighting, even if only implicitly, so valuations should still be an important component where possible. So, whether using HC or WTP approach, valuation of non-marketed goods like road safety remains essential.

2.3 Willingness To Pay Approach

It is a method used for valuing any non-marketable goods in which people are asked for their willingness to pay to avoid a small risk of becoming a fatal victim or suffering an injury. Since the concern is with small probabilities, not the certainty of death, these values are referred to as the Value of Statistical Life (VSL). For example, suppose that the amount people are willing to pay to eliminate a risk of death of 1/10,000 is $700. If we divide the willingness to pay amount of $700 by the risk probability of one in ten thousand, then one obtains the value per unit risk as value per statistical life which is $7 million (Andersson *et al.,* 2008).

2.4 Methods for WTP

Literatures reviewed for this study reveals that there are two methods for WTP approach.

2.4.1 Revealed Preference Method

It is a method used in economics to infer individuals' preferences based on their actual behavior and choices. It assumes that people reveal their Willingness To Pay (WTP) for goods, services, or risk reductions through market decisions, such as wage premiums for hazardous jobs, or travel costs incurred to access public goods. Unlike stated preference methods, which rely on surveys, RP is based on observed real-world decisions, making it more grounded in actual economic behavior**.** But it suffers from several limitations that can bias estimates. Measurement errors arise from inaccurate or incomplete data, while unobserved factors (e.g., job satisfaction, employer benefits) can distort risk-money trade-offs. People often misperceive risks, overestimating rare dangers like plane crash while underestimating common ones like car crash, leading to unreliable estimates. Due to these limitations, economists increasingly combine RP with Stated Preference methods like surveys to improve accuracy in valuing safety and risk reductions. As per Pearce (2002) without surveys, the motives for preferences cannot be discerned.

2.4.2 Stated Preference Method

This approach employs hypothetical or constructed markets, typically through questionnaires, to reveal economic values. By carefully defining hypothetical payment scenarios, it helps estimate people's willingness to pay for specific aspects or the entirety of a good, service, or other relevant factors in decision-making. It relies on what people say rather than what they do, making them more flexible than revealed preference methods. SP techniques are being used to an increasing extent with long history of use in the health and safety field, where willingness to pay studies of changes to risk of illness, injury or death have informed many policy and investment decisions. Indeed, they are the only kind of technique suitable in many circumstances (Pearce, 2002). Within the class of SP methods, there are two alternative groups of techniques: choice modelling and contingent valuation.

2.4.2.1 Contingent Valuation (CV)

This technique seeks measures of willingness to pay through direct questions such as ‘What are you willing to pay?’. This question is called open ended type and is adopted by Maharjan. B, 2012 in estimating willingness to pay by motorcycle users in Kathmandu valley. Another question looks like ‘Are you willing to pay £X?' which is called bounded type. Another type is called double bound dichotomous choices (DBDC) questions in which respondent is asked like ' Are you willing to pay £50 to reduce road fatalities by 50% annually?'. If respondent says 'yes', they will be asked follow up questions 'Are you willing to pay £100 to reduce road fatalities by 50% annually? This method is applied in a WTP study by Mekonnen, *et al.* (2022).

2.4.2.2 Choice Modelling (CM)

This technique seeks to secure rankings, ratings of alternatives or a choice among alternatives from which WTP can be inferred. Basically, there are four forms of choice modelling. First is choice experiment which asks respondent to choose between alternatives

and status quo. Second is contingent ranking which asks to rank series of alternatives from best to worst ot vice-versa. Third is contingent rating which asks to give rating to each alternative on a scale of 1 to 10 or similarly. Last one is paired comparison which asks to score pairs of scenarios in similar scale. Among these all, only choice experiment, also called conjoint analysis is consistent with theory of welfare economics (Pearce, 2002).

2.4.2.3 Choosing Between Contingent Valuation and Choice Modelling

The choice depends on how much detail is needed about the good or effect being valued. Since any good consists of multiple characteristics, Choice Modeling (CM) is useful when the goal is to value specific aspects. However, these characteristics should not be correlated, and there should be a clear trade-off between them. On the other hand, if the study aims to value the good as a whole—such as the total economic value of a wetland—Contingent Valuation (CV) may be more appropriate. In some cases, understanding specific characteristics, like recreational amenities or wildlife composition, is more relevant for management decisions rather than broad conservation choices.

Choice modeling can avoid some response difficulties that can be found in contingent valuation questions. For example, people cannot say easily how much they can pay to save one life from a road accident. Further, it reduces response biases found in contingent valuation, such as "yea-saying," where respondents give affirmative but potentially false answers. In dichotomous choice designs, respondents may say "yes" to please the interviewer or accept a higher bid just to express support, knowing they won't actually pay. Choice experiments minimize this issue by offering multiple opportunities to express preferences across different payment levels. While open-ended contingent valuation avoids yea-saying, it can be cognitively challenging for respondents. In contrast, choice experiments simplify the task by asking, "Do I prefer A, B, or neither?".

2.5 Common Design Steps for Choice Modelling

The common steps for choice modelling are shown in figure 2.1 where attributes means key features or characteristics of a product or service such as risk, time, cost of travel etc

that are most likely to be affected by a policy decision. Selection of attributes is usually done through literature reviews, focus group discussions or direct questioning. A monetary cost is usually one of the attributes to allow the estimation of WTP. A rule of thumb is not to choose more than 4 or 5 attributes, including cost. Levels are the specific options within each attribute such as Rs 100, 300, 500 etc. for cost attribute. Levels should be realistic and span the range over levels which respondents can be expected to have preferences. Profile are the combination of different attributes and their levels representing a hypothetical product or service. Statistical design theory is used to combine the levels of the experimental attributes into a number of alternative scenarios or profiles. The profiles identified by the experimental design are then grouped into choice sets to be presented to respondents. Options, i.e. different bundles of attributes, should typically not exceed 8 in number. Participants are shown different profiles and asked to rank, rate, or choose among them.

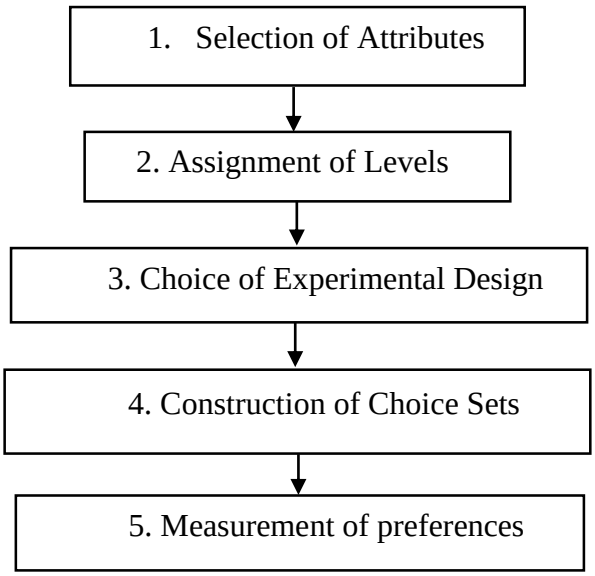

Figure 2.1 Common Steps for Choice Modelling

2.6 Design of Experiment

Choice experiments can be designed as full factorial, fractional factorial, orthogonal or efficient designs (Henser *et al.*, 2009). Time, cost and accident risk are the three major attributes taken in studies (Balakrishnan *et al.*, 2019) though more attributes like route

length, separate risk for fatality, serious injury and minor injury can also be taken as in (Henser *et al.*,2009 & Jazdzik *et al.,* 2021*).*

Balakrishnan (2019) adopted 4 years average annual fatality rate to show real scenario in accident risk while time and cost attribute values were hypothetical. The attribute levels were varied from -25% to +25% for time and cost & up to -50% for accident risk as in (Henser *et al*., 2009). 27 combinations resulting from 3 attributes with 3 levels each were split into 3 blocks eliminating some dominating options which is fractional factorial design. While, Rizzi *et al*. (2003) considered all 9 choices in each block by swapping time in dominant options to make it full factorial orthogonal design. But orthogonality may not be important in estimating logit models, as it is the differences between the attribute levels that count and non-orthogonal designs can yield more reliable parameter estimates (Henser *et al.,* 2009).

In Henser *et.al* (2009), data from the pilot questionnaires were collected and analyzed, with additional comments from respondents collected after the survey was concluded, to confirm the appropriateness of the attributes and their levels. The parameter estimates calculated from pilot survey was used as priori information for calculating D-error so that design can be made efficient. A design is more efficient if the model parameters can be estimated with a greater expected reliability with the same number of respondents (i.e. lower expected standard errors). The lower the D-error, the higher the efficiency of the experimental design. Association of VSL with child restraint system, seat belt and helmet use was also estimated in Musa *et al*. (2023). Similarly, WTP was associated with improvements desired for pedestrian movement like zebra crossing, overhead bridges, pedestrian side walk in contingent valuation study of WTP for pedestrian in Kathmandu valley by Deshar(2015).

Survey techniques applied as seen in literatures also vary. Data were obtained from face-to-face interviews handing over hardcopy (Balakrishnan *et al.,* 2019) or using computer aided personal survey instrument (Henser *et.al*, 2009). Some study also used web based survey technique with Adaptive choice based conjoint analysis (Jazdzik *et al.,* 2021).

Choice survey sections are preceded by detailed explanation of different risk scenarios. Socio-economic and travel related questions are also included. Then respondents are asked to choose among different hypothetical routes.

Blaeij *et.al.* (2003) performed meta-analysis to determine variables that explain the variation in Value of Statistical Life (VSL) estimates reported in the literature. He concluded that magnitude of VSL estimates depends on the value assessment approach (particularly, stated versus revealed preference), and for contingent valuation studies also on the type of payment vehicle (price of private good, tax, donation, toll) and elicitation format (risk level only, risk level + visual presentation, victims in population, risk level + explanation).

2.7 Summary of Literature Review

Literature reviews show that different methods for capturing public preference for road safety have been tried starting from standard gamble chained, following contingent valuation to conjoint analysis. Many studies have been made to make answers from public realistic and reliable. Conjoint analysis or choice modelling has been proved to be most suitable for valuing non marketable goods with many attributes. Existing research exploring public attitudes toward road safety in terms of willingness to pay for crash reduction is limited in Nepal. The few available studies focus on specific types, such as motorcycle and pedestrian and are confined to Kathmandu Valley. No study has focused on long distance public vehicle passengers attitudes towards road safety and their willingness to pay hence creating a gap.

CHAPTER 3: METHODOLOGY

3.1 Research Design

The conceptual plan of this study is shown in Figure 3.1. This research is quantitative as well as qualitative type as it is helpful to analyze peoples' perception towards road safety and their willingness to pay.

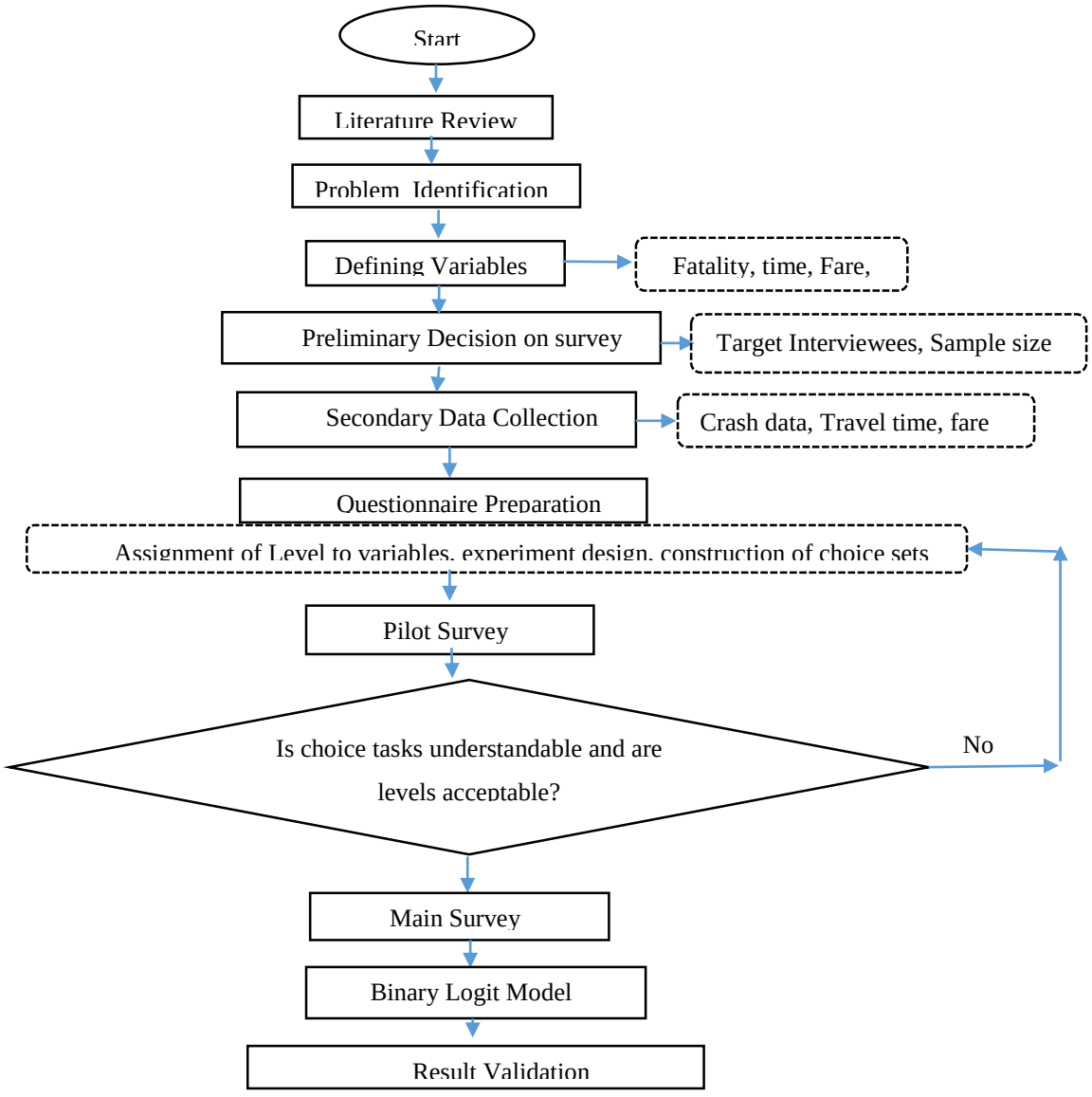

Figure 3.1 Framework of Research

The study initiates with literature review for identification of problems and variables associated with it. After defining variables preliminary ideas are collected through literature

reviews on target interviewees and sample size required. For questionnaire preparation, data are collected from secondary sources and desk study. Most studies on willingness to pay (WTP) for road safety present respondents with hypothetical scenarios involving fatalities, travel time, and cost. While people can easily relate to time and cost based on their daily experiences, they often cannot easily grasp safety risks or the current fatality rate. Although the scenarios are hypothetical, making them as realistic as possible builds trust. Providing respondents with realistic combinations of fatalities, time, and cost helps them engage more meaningfully and make informed decisions. So, in this study each respondent is presented with actual fatality, travel time and fare relevant to their destination. Questionnaire design is followed by pilot survey and testing of questionnaire which is ultimately followed by main survey. Then collected data are analyzed for result and validation.

3.2 Study Area

Details of 32 destinations from Gongabu Bus Park and 6 destinations connecting central eastern parts of Nepal were collected, and the travel routes to each location were identified in QGIS as shown in figure 3.2. The destinations considered for the study are given in Appendix D. The study population includes long and medium distance public vehicle passengers in Nepal travelling to and from Kathmandu.

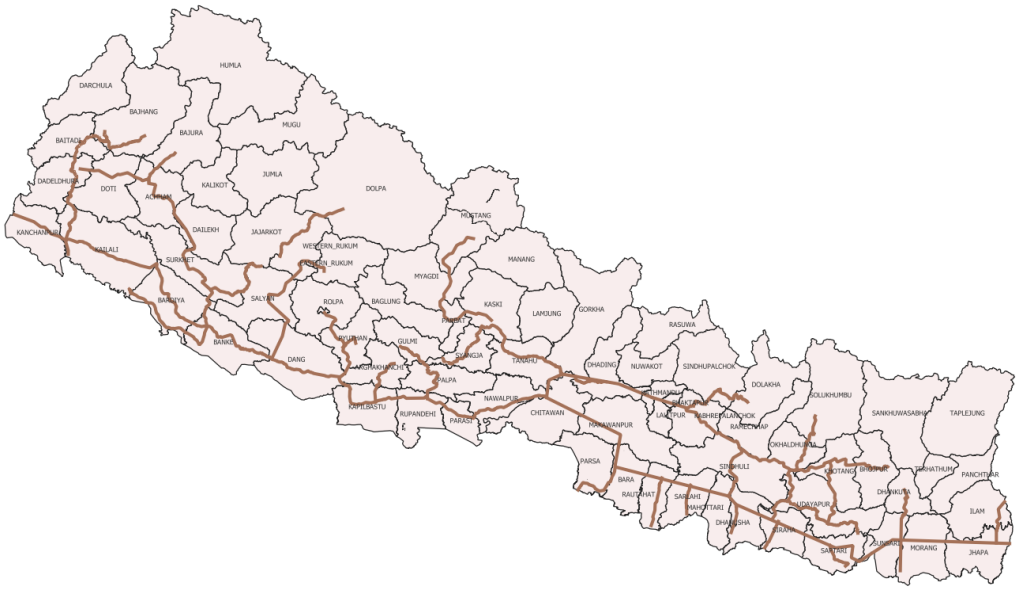

Figure 3.2 Routes Considered for the Study

3.3 WTP survey

3.3.1 Questionnaire Design

The questionnaire was designed consisting three sections. First included demographic information like age, gender, marital status, employment and yearly income. Second includes travel-related questions like frequency of trip per year, risk perception and causes of risks. This session also explained current scenario of road crash fatality, urgent need for improvement, role of financial support and speed reduction in reducing fatality as background information. Third section consisted choice questions. It also asked people's preference for road safety improvement measures like road infrastructure upgrading, safer and comfortable vehicles, safer and professional driving.

Attributes selected for the choice questions were based on literature review. When trade-offs are involved, individuals do not prioritize safety alone; they also consider cost and travel time. So, this study aims to analyze people's preferences by examining different combinations of these three attributes. Levels of the attribute, number of fatalities was defined based on objective of Nepal road safety Action Plan i.e. reducing fatal road crashes to 50% by 2030 which also matches with that used by Balakrishnan, et al. (2019) and Maharjan, (2012). Levels of travel time and fare were chosen so that they matched with the scenario of reduced fatality. Power model of relationship between speed and road safety as proposed by the Swedish road safety researcher Göran Nilsson as shown in Equation 3.1.

$$\frac{Fatalities\ After}{Fatalities\ Before} = \left(\frac{Speed\ After}{Speed\ Before}\right)^4 \quad (3.1),$$

This relation was used to determine increase in travel time required for reducing fatality which results requirement of 16% reduction in speed for 50% reduction in fatality. So, 20% increase in time was adopted for 50% reduction in fatality adopting inverse relation of speed and time.

An open-ended contingent valuation survey for WTP by Maharjan, B. (2012) has findings of individual WTP of Rs 339 for reducing fatality among motorcycle users in Kathmandu. This value is 23% of the average fare presented in this survey and is taken as basis for fare

levels which also matched with cost levels of ±25% adopted by Henser et al. (2009) and Balakrishnan, et al. (2019). So, this study also adopted +15% and +30% increase in fare for reduction of fatality by 25% and 50% respectively. Table 3.1 shows the attributes and their levels. With 3 levels of fatality, 5 levels of time and 6 levels of fare, there are altogether 90 combinations for full factorial design. But all these combinations are not relevant for asking a respondent. So, partial factorial design approach has been adopted here. Only eight realistic combinations are chosen for survey which is give in Table 3.2.

Table 3.1 List of attributes and their levels

Attributes	Fatality	Travel time	Fare
Level 1	Base value	Base value	Base value
Level 2	Reduced 25%	Increased 5%	Increased 8%
Level 3	Reduced 50%	Increased 10%	Increased 15%
Level 4		Increased 20%	Increased 30%
Level 5		Reduced 5%	Increased 27%
Level 6			Increased 42%

Table 3.2 Eight combinations of different levels of attributes

Task	Fatalities	Time	Cost
1	Reduced by 25%	base value	Increased by 15%
2	Reduced by 25%	Increased by 5%	Increased by 8%
3	Reduced by 25%	Increased by 10%	base value
4	Reduced by 50%	base value	Increased by 30%
5	Reduced by 50%	Increased by 10%	Increased by 15%
6	Reduced by 50%	Increased by 20%	base value
7	Reduced by 25%	Reduced by 5%	Increased by 27%
8	Reduced by 50%	Reduced by 5%	Increased by 42%

3.3.2 Testing of Questionnaire Design

Careful questionnaire design is crucial to success of choice modelling (Pearce et al., 2002). The sequence suggested by Pearce et al. (2002) was followed for test of questionnaire design.

3.3.2.1 Focus Group Discussion

A discussion was conducted on 28th January 2025 among a small group of respondents to check whether the questions were understandable and sensible and, the words were clear. The respondents were two students of masters in transportation engineering at Pulchowk campus, two government engineers and a private employee.

3.3.2.2 Pilot Survey

A pilot study was conducted on 1st and 2nd February 2025 among 16 respondents to evaluate the proposed methodology and assess respondent reactions to the questionnaire. Respondents included 7 male and 9 females. 7 respondents were of age group 16 to 35, 4 of them were of age group 36 to 45, 3 of them were 46 to 55 and 2 were of age above 55 years. By profession, respondents included three government employees, three construction sector laborers, four students, three private sector employees, one self-employed and two retired public vehicle users. The pilot survey questionnaire was designed using Sawtooth Software, based on Adaptive Choice-Based Conjoint Analysis. Respondents were surveyed via email and subsequently contacted for feedback through both phone calls and face-to-face meetings. Data from the pilot questionnaires were collected and analyzed, with additional comments gathered from respondents after the survey concluded. The findings from the pilot survey were instrumental in finalizing the Stated Preference (SP) survey. The pilot data were also used to evaluate the suitability of the selected attributes and their levels, as well as to determine whether these attributes were easily understandable to users. Several issues with the existing questionnaire were identified, including:

- The screening section was complex and difficult to comprehend. It was suggested to focus solely on choice-based questions.
- Respondents found it easier to understand when differences between the current and hypothetical scenarios were presented upfront.
- Repetition of options led to respondent fatigue and disengagement.

Based on this feedback, revisions were made to the questionnaire. The updated version included eight fixed choice questions, each with two options, and eliminated the repetition of the second option. The questionnaire was redesigned using KoBoToolbox, and the screening section was removed entirely. Differences in fatality rates, travel time, and fare were provided as reference information for respondents.

3.3.2.3 Content Validity Test

The prime objective of the questionnaire design was to ensure that respondents deliberate about their true preferences through two aspects:

Scenario Design:

Hypothetical bias was avoided by presenting a scenario consistent with reality like increase in cost or time or both for reducing fatality. For same fatality reduction, the fare-only increment was made higher than the same for both increase in fare and time which is reasonable provision change. To avoid starting point bias, six different levels of cost attributes were presented. All questions were written in both English and Nepali, also instruction was given before choice tasks to make questions understandable.

Elicitation:

Since the target population are public vehicle passengers, fare is the only payment vehicle relevant hence, payment vehicle bias was removed.

3.3.3 Sample Size Determination

For binary variables and proportions, the sample size required depends on variance in the underlying population and required precision. Standard error is given by Equation (3.2)

$$SE = \sqrt{\frac{pq}{n-1}} \tag{3.2}$$

where, p is sample estimate of population in proportion and q =1-p, and n is sample size. For 95% confidence interval, standard error is 1.96 and being conservative for the sample size we assume population proportion as 50%. Hence we get minimum required sample size of 384.

3.4 Logistic Regression

3.4.1 Binary Logit Model

Binary logistic regression was used to determine individuals' willingness to pay for road safety risk reduction. The model takes the form as Equation (3.3)

$$P(y=1) = \frac{e^{\beta_0+\beta_f.f+\beta_t.t+\beta_c.c}}{1+e^{\beta_0+\beta_f.f+\beta_t.t+\beta_c.c}} \tag{3.3}$$

where,

P(y=1): Probability of choosing y

$\beta_0, \beta_f, \beta_t, \beta_c$: Coefficients known as parameter estimates for intercept, fatality, time and cost variables respectively.

This can be written in the form as Equation (3.4) which is simply an utility function.

$$\log\left(\frac{P(y=1)}{1-P(y=1)}\right) = \beta_0 + \beta_f.f + \beta_t.t + \beta_c.c \tag{3.4}$$

The coefficients are estimated using maximum likelihood estimation technique for which likelihood is given by Equation (3.5).

$$L(\beta) = \prod_{i=1}^{N} P(y=1)^{yi} * (1 - P(y=1))^{1-yi} \tag{3.5}$$

where,

N: Total number of observations

This likelihood function is maximized iteratively using Newton Raphson or Fisher scoring methods as Equation (3.6).

$$\beta^{(t+1)} = \beta^{t} - H^{-1}\frac{dL}{d\beta} \tag{3.6}$$

where,

H^{-1} : Second derivative of log likelihood, also called Hessian matrix

$\frac{dL}{d\beta}$: First derivative of log likelihood or gradient

The maximizing process is continued till the change in coefficients are below threshold to obtain the coefficients $\beta_0, \beta_f, \beta_t, \beta_c$. Then, WTP is calculated as Equation (3.7).

$$WTP = \frac{\beta_f}{\beta_c} \tag{3.7}$$

In standard binary logit model, independence of observation is assumed. So, covariance between observation is zero and variance is given by Cameron *et al.* (2005) as Equation (3.8).

$$V(\beta) = [\frac{\delta^2}{\delta\beta^2} logL(\beta)]^{-1} \tag{3.8}$$

But in this study, eight choice questions are asked to each individual due to which each choice cannot be assumed as independent choice as made by different respondents. There is chance of reflection of dependency of answer to one question over another within same respondent. To account this, clustered standard errors technique has been adopted here which treats eight choice questions of an individual as a cluster. This accounts for dependencies within cluster by adjusting variance covariance matrix as given by Cameron *et al.* (2005) as Equation (3.9).

$$V(\beta) = [\sum H^{-1}]^{-1} * [\sum \frac{\delta L}{\delta \beta}.H^{-1}] * [\sum H^{-1}]^{-1} \quad (3.9)$$

3.4.2 Calculation of Value of Risk Reduction

Value of risk reduction can be calculated from WTP as shown in Equation (3.10). Since VRR is for reducing fatality here, it can be called VSL.

$$VRR = \frac{WTP}{\delta_r} \quad (3.10)$$

where, δ_r is change in risk of death due to road crash given by Equation (3.11).

$$\delta_r = \frac{Reduced\ Yearly\ fatalities}{Annual\ Average\ daily\ passengers * 365} \quad (3.11)$$

As questions were asked for 25% and 50% reduction in yearly fatalities, the change adopted is average i.e 37.5%.

Median of fatalities calculated as described in section 3.1.1 being 121 fatalities per year was used for calculating change in risk.

3.5 Data Collection

3.5.1 Crash, Fare and Travel time Data

Since crash data along the specific routes followed by public vehicles was not available from the Nepal Police, district-level road fatality data of the fiscal year 2023/24 was used instead. Based on the road network passing through different districts to reach the particular destination, fatalities in each respective district were added. But all the road crash deaths in every district may not be totally on the routes followed by public vehicles. So, the proportion of public-vehicle route distance relative to the total highway length in the district was calculated for four locations representing all parts of Nepal to determine relative proportion of deaths along the route. The total highway length includes length of all types of pavements that is bituminous, graveled and earthen roads enlisted in "Statistics of National Highways SNH 2022/23" published by HMIS-ICT unit, Department of Roads. Road crash fatality data of 77 districts in Nepal for the year 2080/81 was obtained from central police spokesperson, SSP Bishwa Adhikari, Nepal Police. The proportion obtained as per Appendix E are 0.3 for eastern and western locations traversing through Terai (Taplejung and Dadeldhura), 0.5 for western mid hill locations (Mustang) and 0.4 for eastern mid hill locations (Khotang). For example if destination of respondent is Taplejung which is in the east, the number of fatalities used for him as base attribute level would be sum of all road crash deaths in all 17 districts through which the bus traverses to reach there, multiplied by 0.3 to account for the proportion of total fatality to fatality in the public vehicle route. Travel time and bus fare to each locations were obtained from website of Bus Sewa, Nepal.

3.5.2 Annual Average Daily Traffic Data

Vehicles travelling to 32 out of 38 locations studied pass through Nagdhunga at Kathmandu. So, AADT of vehicle type bus in the year 2022/23 measured at Nagdhunga was used for this purpose which was obtained from DOR. Occupancy for different size buses was adopted from study of JICA 2014. But it is observed that large buses are not utilized fully up to its capacity throughout the year. Large buses are occupied fully in two-way trips only during festive seasons. During regular time, they are almost occupied for

incoming trip while outgoing passengers are minimal. So, passengers count was taken as half of the occupancy for large buses.

Table 3.3 AADT and Vehicle Occupancy of Buses at Nagdhunga

Vehicle type	Big	Mini	Micro	Total
AADT of buses at Nagdhunga, 2022/23	2721	1612	1186	
Occupancy	40.4	25.3	15.2	
Considered occupancy for whole year	50%	100%	100%	
Daily No. of passengers	54964.2	40783.6	18027.2	113775

3.5.3 Passenger Survey for WTP

The survey was conducted at various locations, including households, offices, and waiting areas at Baneshwor, Bijulibazaar, Sundhara and Kalanki. Clustered form of sampling based on locations was adopted for preference survey as at least 10 respondents were included from each location. A total of 408 respondents were surveyed. Of these, 171 respondents were interviewed face-to-face, during which they were asked to select their preferred option using the KoBoToolbox mobile app on the interviewer's phone. The interviewer assisted respondents in answering the questions and provided clarifications as needed. To clearly communicate the hypothetical scenarios—such as increased travel time, lower accident rates, and increased costs—examples were provided, including improved road infrastructure, safety barriers along the route, and well-maintained vehicles, lowering speed. The remaining 237 respondents were surveyed via email but just 228 responses were complete. A description of the survey was given in the mail to make respondents feel that they were providing input for the decision-making process.

CHAPTER 4: RESULT AND DISCUSSION

4.1 Overview

The estimation of willingness to pay, determination of affecting socio-economic factors and calculation of value of risk reduction were done. The parameter estimates for effect of change of socio-economic factors on probability of their choice for safety was estimated using multinomial logistic regression. Willingness to pay was estimated using binary logit model with clustered standard errors. The data collected from Kobotoolbox was downloaded to excel, coded with 0 and 1 for choices. Fatality, time and cost values were set as continuous variable. Data was prepared in wide format with variables respondent ID, choice, present and alternative values of all three variables fatality, time and cost. The .xlsx file was imported to R studio 4.4.2 and converted to long format. The binary logit model was formulated using R, the coefficients of fatality was divided by coefficient of cost to calculate WTP. Value of risk reduction was calculated using willingness to pay and yearly number of passengers in long- and medium-route public vehicles based on AADT at Nagdhunga.

4.2 Descriptive Statistics

Analysis of socio-economic and travel related data was done using multinomial logistic regression in SPSS. At first, each variable was assigned as 'factor' individually with choice as dependent variable and significance of each level of variable was examined. Then, variables which were significant individually were collectively assigned as covariates for multinomial logistic regression.

The socio-economic factors examined include gender, age, marital status, occupation, and annual personal income. Descriptive statistics for these variables are summarized in the Figure 4.1.

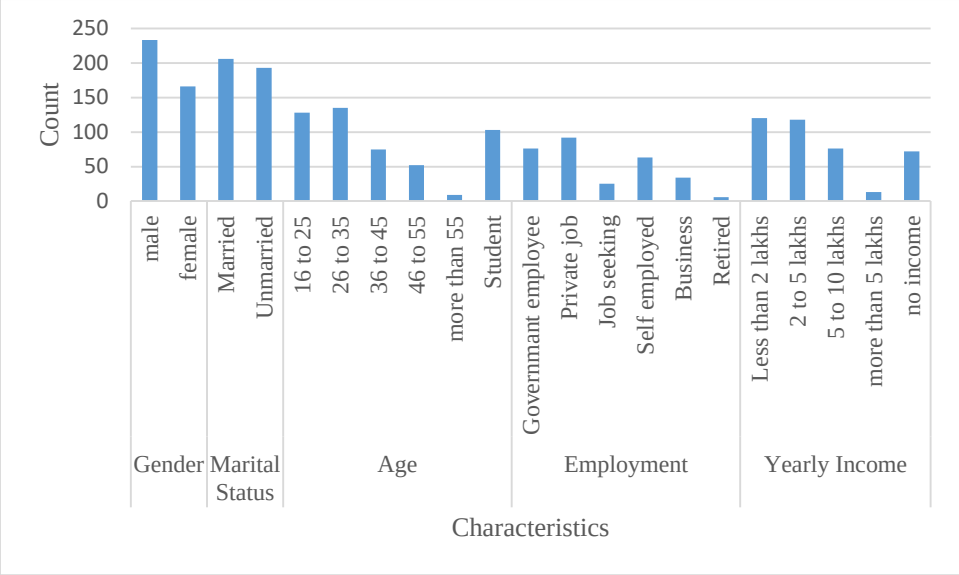

Figure 4.1 Socio-economic Characteristics of Respondents

The findings reveal that the largest proportion of passenger respondents (68%) fall within the 16 to 35 age range, indicating a predominantly younger demographic. Approximately 52% of respondents are married. In terms of income, around 30% report a yearly personal income less than Rs. 200,000, people with income from 2 to 5 lakhs also constitute 29.5% whereas only 3% earn more than Rs. 10 lakh per year. Students constitute the largest group (26%) among respondents followed by private sector employees (23%). This demographic closely represents the group of people mostly using public vehicle for medium and long-distance travel.

Travel related characteristics are shown in Table 4.1. It shows that most trips (59%) are for family and social visits and this was expected since people mostly reside in Kathmandu valley for works and studies while, they move to their parent locations is often for family visits which fall during festive seasons. So, people travelling just 2 to 6 times a year is highest (46%). A key insight from the analysis is that, despite fluctuations in annual road accident rates across various routes, an overwhelming 93% of respondents do not feel entirely safe during their travels and most of them (43%) feel risk due to road condition. However, only 88% are willing to contribute financially to road safety improvement programs that could lower their risk of being involved in crash.

Table 4.1 Travel related characteristics of respondents

Travel related characteristics		No.	%
Trip Purpose	Business and Trade	65	13%
	Government and administrative works	83	17%
	Education	51	10%
	Health	4	1%
	Family and Social Visits	289	59%
Frequency of trip	twice a year	163	41%
	2 to 6 times a year	185	46%
	6 to 12 times a year	29	7%
	more than 12 times	22	6%
Near miss	No	171	43%
	1 to 2 times	192	48%
	more than 2 times	36	9%
Safety Perception	100% safe	29	7%
	80% safe	185	46%
	60% safe	122	31%
	Less than 60% safe	63	16%
Cause of not feeling safe	Road Condition	327	43%
	Traffic Volume	173	23%
	Vehicle Condition	161	21%
	Drivers driving behaviour	95	13%
Willing to pay	Yes	353	88%
	No	46	12%

Respondents choosing alternatives in any one of the tasks were asked what are they willing to pay more for and the result is summarized in Table 4.2 which shows that though there is broad support (55%) for all improvements, the top priority is for road improvement (65%). Safe driving is a second but notable concern. In contrast to our expectations, safe and comfortable vehicles seem to be the least priority.

Table 4.2 Results on road safety improvement preferences

	Improvement measures asked	count	%
Preference for road safety improvement	road improvement	43	24%
	safe and comfortable vehicles	9	5%
	safe driving	5	3%
	all of above	99	55%
Most preferred improvement out of all	road improvement	64	65%
	safe and comfortable vehicles	12	12%
	safe driving	23	23%

4.3 Logistic Regression Model

To determine the socio-economic factors that affect peoples' willingness to pay for reducing risk of fatal road crashes, logistic regression model has been developed. The significant variables contributing to choice of alternative are given in Table 4.3.

Table 4.3 Parameter estimates of socio-economic characteristics

	B	Stn. Error	Wald	df	sig.	Exp(B)
Intercept	-.131	.435	.091	1	.763	
Employment	.219	.073	8.959	1	.003	1.245
Income	-.306	.093	10.913	1	.001	.737
Frequency	-.625	.183	11.705	1	.001	.535
Improvement sought	.044	.008	33.973	1	.000	1.045

For 95% confidence, critical wald statistic is 1.96 and p-value is 0.05. Variables with wald statistics value greater than 1.96 and p-value less than 0.05 are significant. Thus employment, income, frequency and improvement sought or willing to pay for are significant. The signs of the parameters are also meaningful. Negative sign indicates that as income increases, people tend to seek for alternative. Similarly, people travelling more frequently are more concern of safety choosing alternative rather than present condition.

4.4 Binary Logit Model

Binary logit model has been used to estimate the amount of money an individual is willing to pay to reduce the risk of injury or death in a road crash. In Table 4.4, P-values show that all fatality, time and fare are significant with confidence of 99%. Negative sign of price and fatality indicate that probability of choice decreases with increasing price and fatality. But one interesting observation here is peoples' choice probability has positive relation with increasing time. This was expected since the time of face-to-face interview because people were more concern of safety and cost rather than time, they were more willing to sacrifice travel time for reducing fatality than to increase fare. As this study is for long and medium route public vehicle users predominantly travelling for social purposes, this may contrast

with value of travel time for work trips in urban area. Using Equation (3.7), WTP was found to be NRs 16.54 per person per trip with confidence interval of NRs11.3 to NRs28.22 at 95% confidence.

Table 4.4 Parameter estimates of binary logit model

	Estimate	Std. Erro	z value	Pr(>|z|)
(Intercept)	-2.54E-02	5.67E-02	-0.448	0.653885
price	-1.88E-04	4.98E-05	-3.785	0.000154 ***
fatality	-3.11E-03	4.50E-04	-6.912	4.79e-12 ***
time	8.22E-04	1.18E-04	6.959	3.43e-12 ***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
Mcfadden R2		0.01		
Cronbach's Alpha		0.624		
WTP		16.54		
95% CI		[11.3, 28.22]		

4.5 Value of Risk Reduction

Calculation of value of risk reduction is shown in table 4.5. Median value of number of fatalities obtained from study at base condition is 121. Number of daily passengers trips as obtained from table 3.3 is 113775. Willingness to pay value as obtained in section 4.4 is is Rs 16.54 per person trip per (fatality/year). With WTP value of Rs 16.54 per person per trip, daily number of passengers trips of 113775, yearly fatality number 121 and 37.5% reduction in fatality number, VRR was found to NRs 15137654 per fatality reduction using Equation (3.10) and (3.11).

Table 4.5 Calculation of VRR

Number of fatalities in a year (Median Value) [1]	121	No.
Number of daily passenger trips in public vehicles at Nagdhunga [2]	113775	No.
Number of Yearly Passenger trip [2]*365	41527875	No.

Probability of fatality in a year [4] ([1]/[3])	2.9137E-06	1 in 343206
Reduction in probability of fatality [5]	37.50%	
Change in risk, δr [6] ([4]*[5])	1.0926E-06	1 in 915215
Fatality coefficient β_f [7]	0.00311	
Cost coefficient β_c [8]	0.000188	
WTP [9] ([7]/[8])	16.54	per person trip
VRR [9]/[6]	15137654	Rs per fatality avoided

4.6 Validation

Stated Preference survey requires more indirect means for validation. Two means of validation: the content validity and construct validity as given by Pearce *et al.* (2002) were used in this study. The clarity, interpretability and plausibility of questions required for content validity were tested during questionnaire preparation. Construct validity checks if the results are consistent with expectations. It is done through two measures, convergent validity and expectations-based validity.

The parameter estimates check shows that for one unit increase in fatality, log odds of choice decrease by 0.31% indicating people's high preference for reducing risk of fatality but one unit increase in price decreases the log odds of choice just by 0.2%. Mcfadden R^2 is low with value 0.01 while significance of estimate is very high nearly 99% which indicate that though the effect of covariates is small in choice decision, the effect is highly reliable. Increase in income and frequency of travel shows decrease in log odds of choice for present condition indicating as people's income grows, they seek for safer alternatives. Also, people travelling frequently realize risks and hence seek more safety which is in line with prior intuition, hence ensuring expectation-based validity.

For convergent validity, the results obtained here are compared to results from other similar studies. Maharjan. (2012) estimated VSL for motorcyclists in Kathmandu Valley to be NRs 5,652,283.79. Accounting for inflation rate since 2012 to 2023 which is 6.73%, the value amounts to NRs 12,231,821.8. IRAP has given a thumb rule for VSL in transport safety for

low and middle income countries as 70 times GDP per capita of respective country which results NRs 13,071,006.5 in 2023. Hence the result obtained as VRR (2024) as NRs 15137654 is consistent with both.

To compare result with that of international studies, VRR (2024) was converted to VRR (2014) then to international price in 2005 based on purchasing power parity using Equation (4.1) given by world bank group (2017) in a study "Macro-economic and welfare benefits of reducing road traffic injuries in low-and middle-income countries".

$$gdpcap\ (2005\ international\ prices) = gdpcap(current\ prices)(PPP)^{-1}\left(\frac{GDP\ deflator(2005)}{GDP\ deflator(year\ considered)}\right) \quad (4.1)$$

Thus, the obtained VRR (2014) is 0.126817 million international prices in 2005 price. Comparison of values obtained from iRAP and Milligan *et al.* (2014) for different countries as given by the World Bank group is shown in Figure 4.2. The table clearly shows that VRR of Nepal is low as compared to VRR of India as given by iRAP but more than that given by Milligan (2014) and far below China.

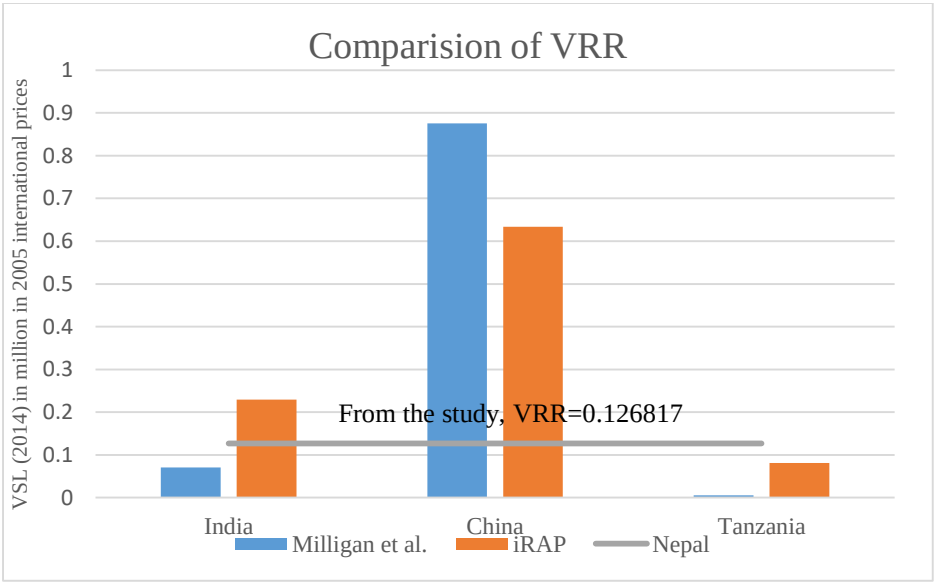

Figure 4.2 Comparative chart of VRR of different countries

The value per fatal road injury avoided obtained using human capital approach and adopted in the cost-benefit analysis of road sector development projects is quite low as compared to result obtained in this study as given in Table 4.6. A draft report on "Feasibility study report for upgrading of Birgunj to Narayanghat section (2011)" has adopted value of $28000 (2010) when exchange rate was 75. Considering average inflation rate of 7% since 2010, the value amounts to Rs 5414922. A study by Rizal et al. (2020) gives the cost of a fatality as Rs 8308894 which is comparable to result of this study but still less because medical cost for fatal case is considered zero and vehicle damage cost is not in detail in the study. Result of fatality cost by ND LEA Inc. et al. (2008), which is approved for Nepal is very low because lost output considered in the study was less than average annual income of people in 2008.

Table 4.6 Road crash fatality cost from studies in Nepal

Reports / Study	VRR or Cost per fatality (in study year)	VRR or Cost per fatality (in 2024)
ND LEA Inc. et al. (2008)	234322	754418
Rizal et al. (2023)	6601328	8308894
DOR, feasibility report (2011)	2100000	5414922

CHAPTER 5: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This study estimates value of fatal road crash risk reduction by estimating willingness-to-pay (WTP) by public vehicle users for reducing fatalities. Using a stated preference (SP) survey, WTP values for accident costs were derived from responses collected among passengers traveling on long- and medium-distance public transport routes in Nepal. Presenting actual values of fatality, fare and travel time even for hypothetical situations of choice tasks makes this study unique from other willingness to pay study. Following are some major conclusion drawn from the analysis:

- Binary logistic regression shows that all three attributes fare, fatality and time are highly significant in determining WTP.
- Among socio-economic parameters income, and frequency of trip are more significant for peoples' willingness to pay. With increase in income and frequency of trip, people seek for safer alternatives being more willing to pay.
- The WTP per person per trip for reduction of a fatal crash per year was estimated Rs 16.54 with 95% confidence interval of [11.3, 28.1].
- Value of risk reduction (VRR) in case of road safety was computed to be Rs 15137654. The value is quite higher than the value given by studies adopting human capital approach but this is usually expected. Comparison of the VRR to that of other countries India, China and Tanzania shows that the obtained VRR for Nepal is comparatively less than that of India and China while higher than that of Tanzania.
- Results show that people are more willing to pay for road improvement measures followed by measures for safe driving.

5.2 Recommendation

The estimated WTP and VSL values determined in this study can serve as valuable inputs for cost benefit analysis during feasibility study of any road improvement projects or

implementing road safety programs. But comparison of willingness to pay values with that based on revealed preference is recommended.

Due to large variation in peoples' choices, the effect of variables considered only in this study seems to be quite low because there may be many other factors people may consider while making trade-offs such as reliability, comfort etc. People's perception on other effects of road crashes such as serious injuries, minor injuries and property damages could not be considered because asking tradeoff for each of these in a single study would not give independent value for them as they compare the serious injuries with fatalities. Separate independent studies considering these factors and using advanced statistical models dedicated to choice modelling are recommended.

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APPENDIX A: Sample Questionnaire for Pilot Survey

your destination is Butwal, bhairahawa, sunauli. Here is the fact regarding trip from Kathmandu to your destination :

Yearly Fatalities (एक वर्षमा सडक दुर्घटनामा ज्यान गुमाउनेको संख्या) : 89

Travel time (काठमाडौँबाट त्यहाँ पुग्न लाग्ने समय) : 10 घण्टा

Current fare (गाडी भाडा) : रू 1150

अहिलेको भन्दा सुरक्षित यात्राको लागि बाढी शुल्क तिर्नु परेमा तिर्नुहुन्छ

- (●) तिर्छु
- ( ) तिर्दिन

Back Next

Present: Yearly Fatalities : 89; Travel time : 10; Current fare : 1150

Here are a few travel options you might like. For each one, indicate whether it is a possibility or not.

Fatalities in a year from Kathmandu to the Destination	111	89	111
Travel Time (in Hours)	12	9	10
Travel Fare (in Rs)	1300	1500	1000
	( ) A possibility (●) Won't work for me	(●) A possibility ( ) Won't work for me	(●) A possibility ( ) Won't work for me

(1 of 3)

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Present: Yearly Fatalities : 89; Travel time : 10; Current fare : 1150

Here are a few travel options you might like. For each one, indicate whether it is a possibility or not.

Fatalities in a year from Kathmandu to the Destination	45	89	111
Travel Time (in Hours)	12	13	10
Travel Fare (in Rs)	1150	1000	1300
	◉ A possibility ○ Won't work for me	◉ A possibility ○ Won't work for me	○ A possibility ◉ Won't work for me

(2 of 3)

Back Next

Present: Yearly Fatalities : 89; Travel time : 10; Current fare : 1150

Here are a few travel options you might like. For each one, indicate whether it is a possibility or not.

Fatalities in a year from Kathmandu to the Destination	111	67	45
Travel Time (in Hours)	12	13	10
Travel Fare (in Rs)	1500	1300	1150
	○ A possibility ◉ Won't work for me	○ A possibility ◉ Won't work for me	◉ A possibility ○ Won't work for me

(3 of 3)

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तपाइले तलको feature हरू एकचोटी पनि select गर्नुभएन, के तपाइलाई यी feature totally unacceptable हो ?

- (●) Fatalities in a year from Kathmandu to the Destination - 111
- ( ) None of these is totally unacceptable.

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यी प्रश्नहरूमा सुरक्षा, समय र भाडाको बीचमा समायोजन (Trade off) गरेर तपाइको लागि best option छानुहोस (Same features are grayed)

Present : Yearly Fatalities - 89; Travel time - 10; Current fare - 1150

Fatalities in a year from Kathmandu to the Destination	67	89
Travel Time (in Hours)	13	13
Travel Fare (in Rs)	1300	1000
	( )	( )

(2 of 5)

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यी प्रश्नहरूमा सुरक्षा, समय र भाडाको बीचमा समायोजन (Trade off) गरेर तपाइको लागि best option छानुहोस (Same features are grayed)

Present : Yearly Fatalities - 89; Travel time - 10; Current fare - 1150

Fatalities in a year from Kathmandu to the Destination	45	89
Travel Time (in Hours)	12	9
Travel Fare (in Rs)	1150	1500
	◉	○

(3 of 5)

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यी प्रश्नहरूमा सुरक्षा, समय र भाडाको बीचमा समायोजन (Trade off) गरेर तपाइको लागि best option छानुहोस (Same features are grayed)

Present : Yearly Fatalities - 89; Travel time - 10; Current fare - 1150

Fatalities in a year from Kathmandu to the Destination	45	67
Travel Time (in Hours)	10	13
Travel Fare (in Rs)	1150	1300
	◉	○

(4 of 5)

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APPENDIX B: Sample Questionnaire for Main Survey

Select your Gender (लिंग)

- ○ Male (पुरुष)
- ◉ Female (महिला)

Age (उमेर)

- ○ 16 to 25 (१६ देखि २५)
- ○ 26 to 35 (२६ देखि ३५)
- ○ 36 to 45 (३६ देखि ४५)
- ◉ 46 to 55 (४६ देखि ५५)
- ○ more than 55 (५५ भन्दा माथि)

Marital status (वैवाहिक स्थिति)

- ○ Married (विवाहित)
- ◉ Unmarried अविवाहित)

Do you have children (तपाइको सन्तान छ ?)

- ○ Yes (छ)
- ○ No (छैन)

Employment type (रोजगारीको किसिम)

- ○ Business (व्यापार व्यवसाय)
- ○ Self employed (स्व-रोजगार)
- ○ Government Job (सरकारी जागिर)
- ○ Private Job निजीको जागिर
- ◉ Student (विद्यार्थी)
- ○ Retired (अवकाश प्राप्त)
- ○ Job seeking (खोजीमा)

Yearly income (वार्षिक आम्दानी)

- ○ less than 2 lakh (२ लाख सम्म)
- ◉ 2 lakhs to 5 lakhs (२ देखि ५ लाख सम्म)
- ○ 5 to 10 lakhs (५ देखि १० लाख सम्म)
- ○ more than 10 lakhs (१० लाख भन्दा बढी)

Where is your most common destination to and from Kathmandu
तपाई काठमाडौँ बाट धेरै जसो गइरहने ठाउँ

- ◯ Achham अछाम
- ◯ Arghakhanchi, Sandhikharka अर्घाखाँची, सन्धिखर्क
- ◉ Baitadi बैतडी
- ◯ Bajhang बझाङ
- ◯ Bajura बाजुरा
- ◯ Bardiya, Basgadhi, Bhurigau, Thakurdwara बर्दिया, बासगढी, भुरीगाउँ, ठाकुरद्वारा
- ◯ Birgunj, kalaiya वीरगञ्ज, कलैया
- ◯ Butwal, bhairahawa, sunauli बुटवल, भैरहवा, सुनौली
- ◯ Chhinchu, surkhet छिन्चु, सुर्खेत
- ◯ Chitwan, Narayangarh चितवन, नारायणगढ
- ◯ Dadeldhura डडेल्धुरा
- ◯ Dang, Bhaluwang, Lamahi, ghorahi दाङ, भालुवाङ, लमही, घोराही
- ◯ Dhading धादिङ
- ◯ Dhankuta धनकुटा
- ◯ Dolakha दोलखा
- ◯ Gulmi, tamghas गुल्मी, तम्घास
- ◯ Jajarkot,tallu जाजरकोट, तल्लु
- ◯ Janakpur जनकपुर
- ◯ Jhapa झापा
- ◯ Kailali, Dhangadi, rajapur, gulariya कैलाली, धनगढी, राजापुर, गुलरिया
- ◯ Khotang खोटाङ
- ◯ Lumbini, taulihawa लुम्बिनी, तौलिहवा
- ◯ Mahendranagar महेन्द्रनगर
- ◯ Mustang मुस्ताङ
- ◯ Nepalgunj, kohalpur नेपालगञ्ज, कोहलपुर
- ◯ Nuwakot नुवाकोट
- ◯ Okhaldhunga ओखलढुंगा
- ◯ Palpa पाल्पा
- ◯ Pokhara पोखरा
- ◯ Pyuthan, Bagdulla, Khalanga प्युठान, बगडुल्ला, खलंगा
- ◯ Ramechhap रामेछाप
- ◯ Rautahat, Gaur रौतहट, गौर

- ◯ Rolpa, Liwang रोल्पा, लिवाङ
- ◯ Rukum East ,Rukumkot रुकुम पूर्व, रुकुमकोट
- ◯ Rukum West, chaurjahari रुकुम पश्चिम, चौरजहारी
- ◯ Sarlahi, Malangawa सर्लाही, मलङ्गवा
- ◯ Sindhuli सिन्धुली
- ◯ Syangja, Mirmi स्याङ्जा, मिर्मी
- ◯ Taplejung ताप्लेजुङ
- ◯ Udaypur, Gaighat उदयपुर, गाईघाट

How often do you travel to this destination in a year
वर्षमा कति चोटी त्यहाँ जानुहुन्छ

- ◯ 2 (२ पटक)
- ◉ 2 to 6 (२ देखि ६)
- ◯ 6 to 12 (६ देखि १२)
- ◯ more than 12 (१२ चोटी भन्दा बढी)

Purpose for your trip (तपाइको यात्राको उद्देश्य)

- ☑ Business and trade (व्यापार व्यवसाय)
- ☐ Government and administrative works (सरकारी कामकाज)
- ☐ Education (पढाई)
- ☐ Healthcare (स्वास्थ्य उपचार)
- ☐ Family and social visits (पारिवारिक तथा सामाजिक कामकाज)

Have you ever faced near miss to accident
(के तपाई कहिल्यै दुर्घटना हुनै लाग्दा जोगिनुभएको छ?)

- ◉ no (छैन)
- ◯ 1 to 2 times (१ देखि २ चोटी)
- ◯ more than 2 times (२ चोटी भन्दा बाढी)

How safe do you feel while traveling to or from Kathmandu to your destination?
(काठमाडौंबाट आफ्नो गन्तव्य जाँदा वा फर्किदा तपाई कत्तिको सुरक्षित महसुस गर्नुहुन्छ?)

- ◉ 100% (पूर्ण सुरक्षित)
- ◯ 80% (८० %)
- ◯ 60% (६० %)
- ◯ less than 60% (६०% भन्दा कम)

Reasons for you not to feel 100% safe
(तपाई पूर्ण रुपमा सुरक्षित महसुस नगर्नुको कारण)

(Multiple selection allowed)

- [ ] road condtion (सडक अवस्था)
- [ ] traffic volume (सवारी चाप)
- [ ] vehicle condition (सवारी साधनको अवस्था)
- [ ] drivers driving behaviour (चालकको गाडी चलाउने तरिका)

Present facts regarding your travel (अहिले तपाइको यात्राको अवस्था) :
Yearly fatalities (वर्षमा मृत्यु हुनेको संख्या) - 58
Travel time (यात्रा समय) - 9 घण्टा
Travel Fare (गाडी भाडा) - रू 1000

यसपछि आउने हरेक Task मा हाल सडक दुर्घटनामा ज्यान गुमाउनेको संख्या , हाल लागिरहेको समय र भाडा पहिलो line मा देखाउछ । अहिलेको अवस्था सुधारी मृत्यु संख्या कम गराउन दुईवटा उपाय छन्, एक) सडकको अवस्था सुधार, सवारी साधनमा जडित सुरक्षा उपाय, दुर्घटना भइहलेमा पनि मानवीय क्षेति कम गर्ने सुरक्षा संयन्त्र , र यी सबैको लागि पैसा आवश्यक हुन्छ , दुइ) यी सबैको लागि लगानी गर्न नसके पनि सजिलो उपाए हो speed घटाउने ताकी दुर्घटना कम हओस र भइहाले मा पनि क्षेति कम हओस , यसले गन्तव्यमा पुग्ने समय बढाउछ , त्येसैले दुर्घटना बाट कतिजनाको ज्यान जोगाउन कति समय वा पैसा वा दुवै बढाउनु पर्छ भन्ने समायोजन दोस्रो line मा दिइएको छ, हरेक Task मा दुइ वटा बिचको सम्झौता हेंरेर अहिलेको अवस्था नै ठिक लाग्छ भने 'Present' छान्नुहोस्, मानिसको ज्यान जोगाउन पैसा बढी तिर्न वा समय बढी दिन चाहनुहुन्छ भने 'Alternative' छान्नुहोस्

हरेक Alternative फरक फरक छन्, हरेकमा मृत्यु संख्या, समय र पैसा हेंरेर तपाई यात्रा गर्दा जे गर्नुहुन्छ वा जे ठिक लाग्छ त्येही छान्नुहोस्

Task 1

- ◯ Present condition (अहिलेको अवस्था:सडक दुर्घटनाबाट एक वर्षमा भएको मृत्यु / fatalities-58 जना ; time-9 hour ; fare- Rs 1000
- ◯ Alternative 1 (अहिले भन्दा 14 जनाको मृत्यु घट्ने ; समय - बराबर ; पैसा - रू 150 बढी; जसले गर्दा हुन आउने (Fatalities - 44; Time - 9 hours ; Fare - Rs 1150)

Task 2

- ◯ Present condition (अहिलेको अवस्था) fatalities-58 ; time-9 hour ; fare- Rs 1000
- ◯ Alternative 2 (अहिले भन्दा 14 जनाको मृत्यु घट्ने; समय - 0.4499999999999993 घण्टा बढी ; पैसा - रू 80 बढी ; Fatalities - 44; Time - 9.45 hours ; Fare - Rs 1080

Task 3

- ◯ Present condition (अहिलेको अवस्था) fatalities-58 ; time-9 hour ; fare- Rs 1000
- ◯ Alternative 3 (अहिले भन्दा 14 जनाको मृत्यु घट्ने ; समय - 0.9000000000000004 घण्टा बढी ; पैसा - बराबर ; जसले गर्दा हुन आउने Fatalities - 44; Time - 9.9 hours ; Fare - Rs 1000

Task 4

- ◯ Present condition (अहिलेको अवस्था) fatalities-58 ; time-9 hour ; fare- Rs 1000
- ◯ Alternative 4 (अहिले भन्दा 29 जनाको मृत्यु घट्ने ; समय - बराबर ; पैसा -रू 300 बढी ; जसले गर्दा हुन आउने Fatalities - 29; Time - 9 hours ; Fare - Rs 1300

Task 5

- ◯ Present condition (अहिलेको अवस्था) fatalities-58 ; time-9 hour ; fare- Rs 1000
- ◯ Alternative 5 (अहिले भन्दा 29 जनाको मृत्यु घट्ने ; समय - 0.9000000000000004 घण्टा बढी; पैसा - रू 150 बढी ; जसले गर्दा हुन आउने Fatalities - 29; Time - 9.9 hours ; Fare - Rs 1150

Task 6

- ◯ Present condition (अहिलेको अवस्था) fatalities-58 ; time-9 hour ; fare- Rs 1000
- ◯ Alternative 6 (अहिले भन्दा 29 जनाको मृत्यु घट्ने ; समय - 1.8000000000000007 घण्टा बढी; पैसा - बराबर ; जसले गर्दा हुन आउने Fatalities - 29; Time - 10.8 hours ; Fare - Rs 1000

Task 7

- ◯ Present condition (अहिलेको अवस्था) fatalities-58 ; time-9 hour ; fare- Rs 1000
- ◯ Alternative 7 (अहिले भन्दा 14 जनाको मृत्यु घट्ने; समय - 0.4499999999999993 घण्टा कम ; पैसा - रू 270 बढी ; जसले गर्दा हुन आउने Fatalities - 44; Time - 8.55 hours ; Fare - Rs 1270

Task 8

- ◯ Present condition (अहिलेको अवस्था) fatalities-58 ; time-9 hour ; fare- Rs 1000
- ◯ Alternative 8 (अहिले भन्दा 29 जनाको मृत्यु घट्ने; समय - 0.4499999999999993घण्टा कम ; पैसा - रू 420 बढी ; जसले गर्दा हुन आउने Fatalities - 29; Time - 8.55 hours ; Fare - Rs 1420

Your choice tasks shows you have willingness to pay more for safety, for what do you prefer for your fee ?
माथि दिनुभएका उत्तरहरुले तपाइ सुरक्षित यात्राको लागि बढी शुल्क तिर्न राजी हुनुहुन्छ भन्ने देखाउछ , तपाई त्यो शुल्क बाट के चाहनुहुन्छ ?

- ◯ Road Improvement (सडक स्तरोन्नति)
- ◯ Safe and comfortable vehicles (सुरक्षित र आरामदायी सवारी साधन)
- ◯ Safe driving/Professional Driving (सुरक्षित चालक व्यवहार/व्यवसायिक गाडी चालक)
- ◯ all of above (माथिको सबै)

what do you prefer most among all ?
सबै मध्ये कुन सबै भन्दा बढी चाहन्हुन्छ ?

- ◯ Road Improvement (सडक स्तरोन्नति)
- ◯ Safe and comfortable vehicles (सुरक्षित र आरामदायी सवारी साधन)
- ◯ Safe driving (सुरक्षित चालक व्यवहार)

APPENDIX C: Road Crash Deaths in Districts (2080/81)

Source: Nepal Police

S.N.	District	Total Road Crash Deaths	S.N.	District	Total Road Crash Deaths
1	Kathmandu	112	40	Baglung	16
2	Lalitpur	37	41	Lamjung	11
3	Bhaktapur	27	42	Gorkha	5
4	Sunsari	83	43	Parbat	6
5	Jhapa	86	44	Myagdi	10
6	Morang	119	45	Mustang	2
7	Udaypur	45	46	Manang	1
8	Dhankuta	8	47	Rupandehi	107
9	Tehrathum	6	48	Nawalparasi west	30
10	Ilam	14	49	Kapilbastu	75
11	Panchthar	10	50	Palpa	36
12	Taplejung	3	51	Gulmi	9
13	Bhojpur	3	52	Arghakhanchi	13
14	Sankhuwasabha	9	53	Dang	99
15	Khotang	4	54	Banke	66
16	Okhaldhunga	7	55	Bardiya	26
17	Solu	0	56	Pyuthan	13
18	Saptari	56	57	Rolpa	20
19	Siraha	68	58	Purbi Rukum	1
20	Dhanusha	74	59	Surkhet	28
21	Mahottari	68	60	Salyan	18
22	Sarlahi	72	61	Dailekh	22
23	Rautahat	66	62	Rukum Paschim	5
24	Bara	75	63	Jumla	10
25	Parsa	51	64	Kalikot	7
26	Makwanpur	57	65	Jajarkot	7
27	Chitwan	101	66	Dolpa	3

28	Dhading	43	67	Humla	2
29	Nuwakot	11	68	Mugu	8
30	Rasuwa	4	69	Kailali	78
31	Lavre	31	70	Kanchanpur	32
32	Sindhupalchwok	25	71	Dadeldhura	11
33	Ramechhap	9	72	Doti	13
34	Dolakha	11	73	Baitadi	10
35	Sindhuli	21	74	Achham	12
36	Kaski	46	75	Darchula	3
37	Nawalparasi	46	76	Bajhang	5
38	Tanahu	22	77	Bajura	7
39	Syangja	12	Total		2369

APPENDIX D: Base Data for Fatalities, Time and Fare

Source: Study Calculation

Code	Locations	Fatalities in route to and from Kathmandu (No.)	time (Hours)	fare (Rs)
1	Achham	205	30	3850
2	Arghakhanchi	114	12	1700
3	Baitadi	202	32	2700
4	Bajhang	204	30	3700
5	Bajura	185	30	4000
6	Bardiya	169	18	2350
7	Birgunj	100	13	1150
8	Butwal	89	10	1150
9	Chhinchu	177	18	2000
10	Chitwan	90	6	600
11	Dadeldhura	199	25	3200
12	Dang	141	12	1800
13	Dhading	22	5	500
14	Dhankuta	269	15	2500
15	Dolakha	27	7	570
16	Gulmi	44	10	1750
17	Jajarkot	190	20	3800
18	Janakpur	168	13	1500
19	Jhapa	292	15	2400
20	Kailali	192	20	2500
21	Khotang	29	10	1500
22	Lumbini	111	10	1350
23	Mahendranagar	202	20	2500
24	Mustang	67	25	2350
25	Nepalgunj	161	16	2100
26	Nuwakot	6	3	500
27	Okhaldhunga	27	10	1500
28	Palpa	38	12	1600
29	Pokhara	58	9	1000
30	Pyuthan	145	12	1900
31	Ramechhap	24	5	700
32	Rautahat	104	13	1350
33	Rolpa	151	14	2200
34	RukumEast	154	17	2200
35	RukumWest	148	14	2750
36	Sarlahi	126	13	1400
37	Sindhuli	21	7	800
38	Syangja	64	12	1200

39	Taplejung	300	18	3000
40	Udaypur	191	10	1800

APPENDIX E: Calculation of Fatalities Proportion

Source: Study Calculation

Destination : Taplejung (Representing all locations traversing through Terai to the east)					
From Kathmandu	Distance along highway (Km)		Total BT road length in the district (Km)	Total fatalities in district	Proportionate fatalities in highway
Dhading	80	Thankot to Mowa khola	242	43	14
Gorkha	16	Mowa khola to Mugling	127	5	1
Chitwan	73.1	Mugling to Narayangarh to border chitwan hetauda	272	101	27
Makwanpur	49.8	Border chitwan hetauda to hetauda to churiya bridge	238.25	57	12
Bara	48.4	Churiya bridge to Pathlaiya to Dhansar river bridge	125.05	75	29
Rautahat	26.3	Dhansar river bridge to Bagmati River Bridge chandrapur	94.98	66	18
Sarlahi	35.7	Bagmati bridge to maraha bridge	97.18	72	26
Mahottari	11.9	Maraha bridge to Ratu Bridge, Bardibas	127.61	68	6
Dhanusha	28.5	ratu bridge to Kamala Bridge	180.79	74	12
siraha	43.4	Kamala bridge to Balan Bridge	127.85	68	23
Saptari	59.1	Balan to Koshi Barrage	164.57	56	20
Sunsari	43.7	Koshi Barrage to Budhi Khola, Itahari	171.58	83	21
Morang	42.5	Budhi khola to Ratuwa Bridge	98.04	119	52
Jhapa	53.2	Ratuwa bridge to charaali to jor kalash chwok	189.63	86	24
ilam	94.6	Jor Kalash chwok to Ranke	192.49	14	7
panchthar	115	Ranke to Kabeli Bridge	167.74	10	7
Taplejung	23.9		68.5	3	1
Total	845.1		2685.26	1000	300
Proportion of deaths in the public vehicle route compared to total road crash deaths in the district					0.3

Destination : Dadeldhura (Representing all locations traversing through Terai to the West)

From Kathmandu	Distance along highway (Km)		Total BT road length in the district (Km)	Total fatalities in district	Proportionate fatalities in highway
Dhading	80	Thankot to Mowa khola	242	43	14
Gorkha	16	Mowa khola to Mugling	127	5	1
Chitwan	35.3	Mugling to Narayangarh	272	101	13
Nawalpur	61.1	Narayangarh to Dumkibas	166.2	30	11
Parasi	39.4	Dumkibas to Khaireni	70.2	10	6
Rupandehi	47.4	Khaireni to Kothi river	219.75	107	23
Kapilbastu	61.6	Kothi to Dhan khola	195.54	75	24
Dang	74.5	Dhan khola to Ameliya	341	99	22
Banke	87.2	Ameliya to Man khola pul	150.36	66	38
Bardiya	65.7	Man khola to Chisapani bridge	205.07	26	8
Kailali	131	Chisapani to Attariya to Faltude bazar	312.48	78	33
Doti	32.5	Faltude bazar to Gaira bazar	123.41	13	3
Dadeldhura	34.3		117.86	11	3
Total	766		2542.87	664	199.3
Proportion of deaths in the public vehicle route compared to total road crash deaths in the district					0.30

Destination : Mustang (Representing all locations traversing through mid hills of west)					
From Kathmandu	Distance along highway (Km)		Total BT road length in the district (Km)	Total fatalities in district	Proportionate fatalities in highway
Dhading	80	thankot to Mowa khola	242	43	14
Gorkha	16	Mowa khola to Mugling	127	5	1
Tanahun	71.4	Mugling to Kotrebazar	154.81	22	10
Kaski	62.5	Kotrebazar to Pokhara to Parbat gate, Lumle	120.03	46	24
Parbat	37.5	Parbat gate to myagdi parveash dwar	37.04	6	6
Myagdi	31.7	myagdi dwar to tal bagar	34	10	9
Mustang	60.6		168	2	1
Total	1476.4		882.88	134	65
Proportion of deaths in the public vehicle route compared to total road crash deaths in the district					0.49
				134	65

Destination : Khotang (Representing all locations traversing through mid hills of east)

From Kathmandu	Distance along highway (Km)		Total BT road length in the district (Km)	Total fatalities in district	Proportionate fatalities in highway
kavrepalanchwok	57	Sanga to Nepalthok	117.53	31	15
Sindhuli	94	Nepalthok to Ghurmi	280.68	21	7
Okhaldhunga	14.7	Ghurmi to Dudhkoshi bridge, Jayaramgaht	75.66	7	1
Khotang	64.3	bridge to Diktel	200.92	4	1
Total	2066.1		674.79	63	24
Proportion of deaths in the public vehicle route compared to total road crash deaths in the district					0.38

Proportion of fatality adopted for each location

Percentage of total fatality considered	0.3		0.5	0.4
Districts	Bajhang	Jhapa	Syangja, Mirmi	Dolakha
	Jajarkot, tallu	Kailali, Dhangadi, rajapur, gulariya	Dhading	Khotang
	Achham	Lumbini, taulihawa	Nuwakot	Mustang
	Arghakhanchi, Sandhikharka	Mahendranagar	Pokhara	Okhaldhunga
	Baitadi	Nepalgunj, kohalpur		Ramechhap
	Bajura	Palpa		Sindhuli
	Bardiya, Basgadhi, Bhurigau, Thakurdwara	Pyuthan, Bagdulla, Khalanga		
	Birgunj, kalaiya	Rautahat, Gaur		
	Butwal, bhairahawa, sunauli	Rolpa, Liwang		
	Chhinchu, surkhet	Rukum East ,Rukumkot		
	Dadeldhura	Rukum West, chaurjahari		
	Dang, Bhaluwang, Lamahi, ghorahi	Sarlahi, Malangawa		
	Dhankuta	Taplejung		
	Gulmi, tamghas	Udaypur, Gaighat		
	Janakpur			

APPENDIX F: GDP Deflator Calculation

Source: NRB

1	2004/5	2005/6	2005
GDP at Producers' Price (Nominal)	589411.7	654084.128	621748
Real GDP at base year 2000/01	463165	480435	471800
		GDP deflator in 2005	131.782
	2013/14	2014/15	2014
GDP at Producers' Price (Nominal)	2022455	2186608.09	2104532
Real GDP at base year 2000/01	669341.3	692849.567	681095
		GDP deflator in 2005	308.992
	2022/23	2023/24	2023
GDP at Producers' Price (Nominal)	4,738,941	5,050,092	4894517
Real GDP at base year 2000/01	942207	975558	958883
		GDP deflator in 2005	510.44

APPENDIX G: Source Code for Binary Logit Model Using R Studio

```
# Import the Excel file

df <- read_excel("D:/MSTrE 079. puspa/Thesis/Trial R/2Rnormalised.xlsx", range = "A1:H3177")

# Transform data into long format

library(tidyr)

library(dplyr)

df_long <- df %>%

  pivot_longer(

    cols = c(priceP, fatalityP, timeP, priceA, fatalityA, timeA),

    names_to = c(".value", "option"),

    names_pattern = "(price|fatality|time)([PA])"

  ) %>%

  mutate(choice = ifelse(choice == option, 1, 0))  # Assign 1 if option matches choice, else 0

# View the transformed data

head(df_long)

# Install and load necessary packages

install.packages("sandwich")

install.packages("lmtest")

library(sandwich)

library(lmtest)

# Fit the binary logit model
```

```
model <- glm(choice ~ price + fatality + time,
             data = df_long,
             family = binomial(link = "logit"))


# Compute clustered standard errors
clustered_se <- vcovCL(model, cluster = df_long$Respondent_ID)
# Display results with clustered standard errors
coeftest(model, vcov = clustered_se)
```

APPENDIX H: Sample Data

S.N	Gender	Age	Marital	Child	Employment	Income	Destination	Frequency	Business purpose	Government works	Education	Health	Family and social	Near miss	Risk perception	Risk cause	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8	Willing to pay for	Most preferred
1	F	2	M		1	2	3	1	0	1	0	0	1	1	2	1	A 1	A 2	P	A 4	P	P	A 7	P	4	1
2	M	2	U		1	3	3	1	0	0	0	0	1	2	2	4	A 1	P	A 3	P	A 5	P	A 7	A 8	4	3
3	M	1	U		5	1	20	2	0	0	1	0	0	2	4	1	A 1	A 2	A 3	P	A 5	P	A 7	A 8	4	1
4	M	3	U	Y	4	4	21	4	1	0	0	0	0	2	4	3	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	4	1
5	M	5	M	Y	6	4	9	3	1	0	0	0	0	2	3	3	A 1	P	A 3	A 4	A 5	A 6	P	A 8	2	99
6	M	4	M	Y	2	4	24	2	1	0	0	0	0	1	4	1	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	4	1
7	F	4	M	Y	2	3	19	3	0	0	0	0	1	2	3	2	A 1	A 2	A 3	P	P	A 6	P	A 8	3	99
8	F	2	M		7	1	29	4	0	0	0	0	1	2	3	2	A 1	A 2	P	A 4	P	A 6	A 7	P	3	99
9	M	3	U	Y	2	4	10	4	1	0	0	0	0	1	3	1	A 1	A 2	A 3	P	A 5	P	P	P	3	99

10	M	1	M		1	3	12	2	0	1	0	0	1	1	2	1	A 1	A 2	A 3	P	A 5	A 6	P	P	4	1
11	M	2	U		1	2	17	2	0	1	0	0	1	1	3	1	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	4	1
12	M	3	U	Y	1	2	10	2	0	1	0	0	1	1	2	1	A 1	A 2	A 3	P	A 5	P	P	A 8	4	1
13	M	2	M	Y	1	2	37	2	0	1	0	0	0	1	2	2	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	4	1
14	F	4	M	Y	1	2	31	1	0	0	0	0	1	2	1	99	A 1	A 2	P	A 4	A 5	A 6	A 7	A 8	1	99
15	F	2	M		1	2	27	2	0	0	0	0	1	2	2	1	A 1	A 2	A 3	A 4	A 5	A 6	A 7	P	4	1
16	M	3	U	Y	4	2	31	2	0	0	0	0	1	2	3	1	P	A 2	A 3	A 4	A 5	A 6	P	A 8	4	2
17	F	4	M		5	2	3	2	0	0	1	0	1	2	1	99	P	A 2	P	P	A 5	P	P	P	4	1
18	M	1	U		5	2	29	1	0	0	0	0	1	2	2	1	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	4	1
19	F	3	U	Y	1	2	19	1	0	0	0	0	1	2	3	4	P	P	P	P	P	P	P	P	99	99