
**JIMMA UNIVERSITY**

**SCHOOL OF GRADUATE STUDIES**

**JIMMA INSTITUTE OF TECHNOLOGY**

**FACULTY OF CIVIL AND ENVIRONMENTAL ENGINEERING**

**HIGHWAY ENGINEERING CHAIR**

# EVALUATION OF ROAD TRAFFIC CRASH DATA COLLECTION AND MANAGEMENT SYSTEM: CASE STUDY OF JIMMA TOWN

A Thesis submitted to the School of Graduate Studies of Jimma University in Partial Fulfillment of the Requirements for the Degree of Master of Science in Civil Engineering (Highway Engineering Chair)

**BY**

**YADANI FEYISA**

**SEPTEMBER, 2022**

**JIMMA, ETHIOPIA**

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(Highway Engineering Chair)

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**SEPTEMBER, 2022**

**JIMMA, ETHIOPIA**

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**Evaluation of Road Traffic Crash Data Collection and Management System: Case study of Jimma Town**

## DECLARATION

I hereby declare that the thesis entitled **"Evaluation of Road Traffic Crash Data Collection and Management System: Case study of Jimma Town"** is my original work and has not been presented for a degree in any other university and all sources of material used for thesis have been duly acknowledged.

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Signature _____ Date 19-09-2022

As Advisors we hereby certify that we have read and evaluated this MSc Thesis prepared under our guidance by Yadani Feyisa entitled: **Evaluation of road traffic crash data collection and management system: Case study of Jimma town.**

We recommend that it can be submitted as fulfilling the MSc Thesis requirements.

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## *ABSTRACT*

*Periodical increment of traffic accident in appreciable manner is currently becoming a world agenda especially in developing country like Ethiopia. The data collection plays an important role in determining the main cause of RTA and defining the laws for road users that are safer to be adopted in the future. And this investigation is designed to evaluate traffic crash data collection and management system of Jimma town. To reach up on expected outcome; the study used secondary data collected from Jimma police commission and city municipality. Primary data were collected via oral, and written interview of different concerned bodies in addition to site observation. Mainly three local road segments were selected for special emphasis on the basis of secondary data and site investigation. Basically, descriptive and statistical analysis approach was used to analyze the data collected. The study revealed that the main causes of traffic accident were identified to be nature of road and driver behaviour which accounts about 46% and 38% respectively. Statical analysis of accident data demonstrated the severity index to be 22%. In regards to accident costing, the study concluded that Jimma town is losing about 13 million birr per year due to the occurrences of accident. This study evaluated the gap of existing crash data collection forms and forwarded points to be included in details. Finally, the researcher proposed implementable corrective measures like road maintenance; follow up on driver driving licence quality, awareness creation work, installation of traffic sign and marks, vehicle examination as a management system. To counter attack the problem faced due to road traffic accident the government and other stakeholder must careful the issues to minimize road traffic accidents in Jimma town. Moreover, the developments of uniform standard across the country and use of Google Application Programming Interfaces (APIs), Global Positioning System (GPS) and online data storing mechanism in parallel with manual recording were proposed as data collection mechanism besides to crash data collection formats.*


***Keywords: -*** *Causes of Traffic Accident, Traffic Accident Analysis, Accident Cost, Crash Data Collection, Road Segments*

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# ACRONMYS

AC -Accident Cost

AAAC -Annual Average Accident Cost

ARF-Accident Reporting Form

DALYs -Disability-Adjusted Life Year

EDE-Electronic Data Entry

EDT -Electronic Data transfer

EPA -Ethiopia Press Agency

FIR-First Information Report

GDP -Gross Domestic Product

GNP -gross national product

GPS-Global Positioning System

IRF -International Road Federation

LMIC-Lowest and Middle-Income Country

MCA-Mean Cost per Accident

MMUCC -Model Minimum Uniform Crash Criteria

NHTSA -National Highway Traffic Safety Administration

RAR -Road Accident Report

RADMS -Road Accident Data Management System

RADaR- Road Accident Data Recorder

ROW -road right of way

RTAs -Road Traffic Accidents

SI -severity index

WHO -World Health Organization

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# CHAPTER ONE

# INTRODUCTION

## 1.1. Background Traffic accident and Data Collection

The data collection plays an important role in determining the main cause of TRA and defining the laws for road users that are safer to be adopted in the future. The collected data enable the decision-makers to identify the problem and economic burden, devise effective strategies, and advocate the stakeholders to invest in accident prevention programs [1],[2]. The significance also extends to understanding the injury and fatalities trend, identifying the location with most accidents and increased injury severity features, and evaluating and monitoring the usage of the strategic plans devised for the reduction in accidents. It was noted that due to absence of a standardized procedure for collecting accident data, acts as a major hurdle towards performing the fruitful analysis. Thus, to count the fatalities and injuries of the accidents, the methods and sources for the accident data collection must be analyzed and recorded in such a way that the collected data is resilient with a minimum loss of data, least data collection mistakes that could prove beneficial for the planners, engineers, and policymaker. Road accidents have become an existential problem all over the world. Despite increased safety features in vehicles, the number of road accidents is rising with each passing day. Road accidents trigger major financial loss and casualties to the road users as well as to the state as a whole Thus; it would enable them to extract the hidden information in the collected data.

Africa is therefore known as the worst performing continent in road safety. To improve road safety performance in African countries, many barriers need to be overcome. Among them stands the substantial lack of detailed knowledge on road casualties in terms of their number and associated factors leading to road accidents or affecting their consequences. There is a serious lack of road safety data in African countries, and even when data are available (e.g. through the reports of WHO, International Road Federation, IRF, etc.), little is known about data collection systems, data definitions, etc. Significant progress in road safety and crash reduction can be achieved through comprehensive road safety information system.

Reliable and accurate data are a fundamental prerequisite to understand the magnitude of road safety problems in Africa and convince stakeholders to take appropriate actions and are also needed to identify problems, risk factors and priority areas in order to formulate

strategies, set targets and monitor performance. At the same time, it is essential to assess the needs of road safety stakeholders in African countries in terms of knowledge, data and information tools, and to deliver concrete data and information that can be accessed by all stakeholders involved in road safety [3].

A common factor in road safety management system is the lack of accurate and comprehensive data related to road traffic crashes which is a pre requisite for accurate diagnosis of road safety problems which helps to develop of remedial measures and to evaluate the effectiveness of the road safety programs. Various groups and organizations use crash and related injury and death data for several purposes, however, for it to be effective for planning and evaluation of road safety action across the region, it is important that national and sub national data management is carried out in a systematic and uniform manner using standardized tools.

In Ethiopia motor-vehicles have revolutionized road transport and have brought invaluable benefits to the community and due to that revolution, the number of fatalities and injuries due to road Crash has risen dramatically. Poorly maintained road network and vehicle fleets, weak regulatory environment, mixed traffic flow system, poor traffic regulation enforcement, rapid population growth, and increase in the road network coupled with poor attitude and safety culture of road users as well undefined roles and responsibilities of various stakeholders towards road transport safety are favorable circumstances for increasing trend in road accidents and fatalities. To reduce road accidents and fatalities road accident data provides the essential information for decision-makers in the country to recognize the seriousness of the problem, in terms of the human and economic consequences. Therefore, collecting high-quality data on road accidents and on exposure is used to measure the scale of the problem and to devise effective countermeasures [4].

As in most country in the world in Jimma city traffic police department collect basic information on road traffic crashes and injuries every day and write report on reported crash. Accident recording and reporting are performed manually in the city. The main purpose of documenting this information is usually used in carrying out specific function; i.e., investigation, law enforcement, provision of healthcare, design of safer road etc. While such information may be useful to individual agencies, it cannot be used for identifying risks, selecting interventions, or measuring outcomes at an aggregate level unless is it properly coded, entered in a computerized database system, processed, analyzed and disseminated.

### 1.2. Statement of the Problem

Although there have been many publications which discuss traffic accidents, only a few articles go into any detail about traffic accident record systems. According to [5] manual, at minimum, good road crash data systems should capture nearly all crashes that result in death and a significant proportion of those that result in serious injuries; explain the vehicle, the road user and the road/environment to help identify causes, and selection of countermeasures; include accurate crash location information; and provide reliable output promptly to facilitate evidence-based decisions. In general, the existing crash data collection system of jimma town provides little information on the number and casualties of crashes because crash data collection system consists of few parameters and it is manual which is not supported by digital technology. Moreover, there are questions related to the uniformity, relevance and reliability of available data.

Road traffic Crash causes a great loss of human and economic resources by killing and disabling the productive age group of the community and also consuming the already inadequate resources and damaging invaluable property every year. According to traffic expert explanations and traffic report of Jimma town combination of factors has immensely contributed to the incidence of road traffic accidents (RTAs). Driver driving speed, rapid population growth, poor road signals, congestion, poor attitude and safety culture of road users coupled with poor traffic regulation enforcement are the most common risk factors. The researcher observed serious problems on the existing road segment. Local road segment in Jimma town is full of deterioration, drainage problem, marking problem and so on. Hence, those significant parameters have to be included in data collection system of the city.

Hence, the system of accident data collection remains inconsistent and irregular as there is neither uniform data collection formats nor any robust system of regular and systematic data retrieval which is dependable and meaningful. Accident Recording Forms with the basic aim of making them user-friendly by possibly reducing the quantum size of information asked for in these forms and at the same time recording all the information that will be required for mass reporting which can help in developing indicators for carrying out detailed accident investigations at a subsequent stage.

Figure 1. 1. Sleeping water along road side due to drainage problem [Photo taken by researcher on July, 2022 with smart phone]

As we can observe from, Figure 1. 1 shown above the drainage provided along the road side is not capable of draining available drainage. Hence, some part of road is occupied with sleeping water which in turns calls surface defects as well reduce lane width and become cause for accident.

| Addis Ababa | 2018 | | | 2017 | | | 2016 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Deaths | Serious Injuries | Slight Injuries | Deaths | Serious Injuries | Slight Injuries | Deaths | Serious Injuries | Slight Injuries |
| Tigray | 386 | 854 | 381 | 374 | 858 | 584 | 371 | 664 | 356 |
| Afar | 56 | 73 | 20 | 72 | 49 | 31 | 131 | 164 | 79 |
| Amhara | 1 104 | 1 032 | 1 252 | 1 152 | 1 181 | 1 924 | 1 035 | 1 190 | 1 990 |
| Oromia | 1 478 | 1 448 | 1 386 | 1 882 | 1 710 | 1 586 | 1 541 | 1 459 | 1 485 |
| Somalia | 132 | 127 | 134 | 204 | 533 | 447 | 157 | 408 | 396 |
| Benishangul | 91 | 136 | 266 | 36 | 126 | 215 | 33 | 224 | 395 |
| Southern Nations | 712 | 1152 | 725 | 720 | 1121 | 922 | 634 | 990 | 937 |
| Gambela | 19 | 43 | 81 | 18 | 20 | 48 | 16 | 38 | 101 |
| Hareri | 55 | 203 | 188 | 34 | 224 | 507 | 53 | 123 | 284 |
| Addis Ababa | 528 | 2 210 | 1 274 | 585 | 1 804 | 1 232 | 477 | 2 085 | 1 232 |
| Dire Dawa | 36 | 129 | 242 | 41 | 128 | 279 | 31 | 141 | 180 |
| Total | 4 597 | 7 407 | 5 949 | 5 118 | 7 754 | 7 775 | 4 479 | 7 486 | 7 435 |

Source: Federal Police Commission of Ethiopia, 2019

Figure 1. 2. Road traffic Injury victim distribution among the Regional States in Ethiopia

As we can observe from the reports of Ethiopian Federal Police Commission, Ethiopia can be marked as sensitive areas with regards to accident occurrences. Hence, to get the main the reason of accident and provide the corresponding implementable measures assessing and evaluating existing crash data collection and management system of the city is appeared to be the solution which has no extra option.

## 1.3. Research Questions

To work on the following research objectives, research questions have been formulated and specific answers need to be obtained.

1. What are the main causes of traffic accident in study area?
2. How can traffic data of different year is analyzed?
3. What are appropriate corrective measures for each type of accident?
4. What is the gap of currently existing crash data collection and management system of Jimma city?

## 1.4. Objectives

### 1.4.1 General Objective

The general objective of this study is to evaluate road traffic accident data collection and management system of Jimma city.

### 1.4.2 Specific Objectives

- ✓ To determine the main causes of traffic accident.
- ✓ To analysis traffic accident data of different year in the study area
- ✓ To provide appropriate corrective measures for each type of accident
- ➢ To evaluate currently existing crash data collection and management system in study area and proposing best practices accordingly.

## 1.5. Significance of the Study

- ✓ The study will add knowledge on understanding what risk factors contribute to the occurrence of RTA and related injuries in the town
- ✓ The data obtained in this study can be used by the road safety authority for planning and evaluating road safety measures.
- ✓ The recommendation given if considered are going to benefit the public at large on prevention of road accident and increasing safety performance.
- ✓ Other researchers will use the findings of study as a foundation for further research related to traffic crash data collection and management system.

## 1.6. Limitations of the Study

During the study, there were different variable that affect smooth implementation of the research and have its own drawback on the outcome of the research. It includes: Lack of relevant and up to date published literatures, poor quality and missing data within individual record and lack of computerized crash data bank to store detailed information on individual road traffic crashes.

## 1.7. Scope and organization of the Study

To make the scope the study manageable; this particular study focused on the three road segments were selected in which traffic accidents are recognized to be high in the town. Evaluation of existing crash data collection and management system in order to identifying main causes of RTA and providing correctives measure is the boundary of the study.

The thesis is organized in to five chapters:

Chapter one contains the background of the study, statement of problem and states the most important objective of the study.

In Chapter two, Review of literature on road traffic accident data collection and management system identified by various scholars around the globe are discussed to achieve the objective

of the study.

Chapter three gives the description of the methodology used in the study, data collection mechanism and way of study on road traffic accident aspects.

Chapter four presents the findings on data analysis and discussion related road traffic accident data collection and management system.

Finally, chapter five contains conclusions and recommendations on road traffic accident data collection and management system.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1. Background of Accident Data Collection and Management

Good data collection systems are backbone of any road safety initiative which provides invaluable information to the wide range of agencies working in road safety like a system to report and record crashes, data storage and retrieval, a process of crash analysis, and a method for reporting and otherwise distributing road safety information. Accident details are captured in road accident data management system through the Accident Report Form (ARF) screen. The ARF would be initially entered by the Police Department. The details captured are grouped under the following categories: General Details, Location Details, Collision Details, Vehicle Details, Driver Details, Passenger Details and Pedestrian Details [6].

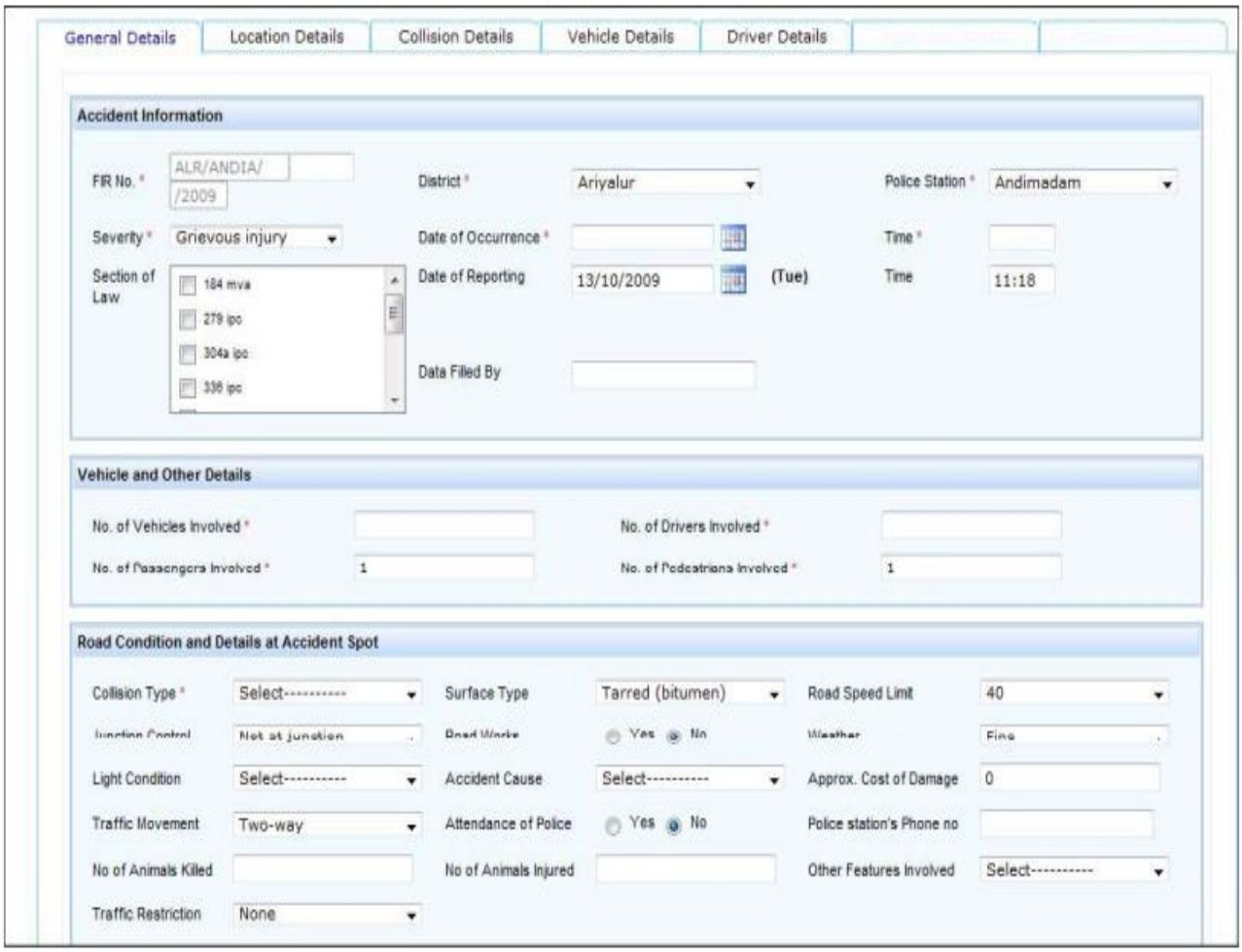


Figure 1. 3. Road Accident Data Collection System as per Government of Tamil Nadu

Sometimes existing accident data recorded by traffic police do not reflect the actual cause of road accident, and they are less useful for scientific analysis. A comprehensive data collection is required to identify exact causes of accidents and for design of countermeasures. Crash data collection mechanism in developing country is just like a crime record for adjudication purpose, not for correction in design/operation/control/behavior, cause of crash is attributed mostly to the driver fault or behavior, insufficient details such as exact location and road condition, collection method is laborious.

Minimum data to be recorded includes; Crash identification (a unique number-based system), Time (the date, hour, minute, day of week), Location (to create GIS enabled database), Crash type, Vehicles involved (number, type), Crash consequences (fatalities within 24 hours/30days, injuries, material damage) [7].

Scientific and analytical approaches to accident data collection, storage and analysis are essential in dealing with road safety problems. Police accident records in the majority of countries form the main (and sometimes the only) source of accident data. Access to the accident database is also important to identifying specific safety problems and evaluating the effectiveness of the countermeasure introduced. Accident data collection and analysis offered by technological innovation such as Electronic Data Entry (EDE), Electronic Data transfer (EDT), and Geographic Information system (GIS) are implemented in developed countries. Developing countries, should take advantage of the experience of developed countries on how the advance accident data management system works to identifying, more accurately, the main factors contributing to traffic accident.

An improvement of the data collection process will come up with significant findings that lead to potential countermeasures. An accurate road crash database is essential to determine the priorities and the results of each measure, and therefore to design any effective strategic plan. It is also necessary to have a reliable data and establish a proper and updated database system to collect, store and analyze crash-related information. Accident data collection and analysis offered by technological innovation such as Electronic Data Entry (EDE), Electronic Data transfer (EDT) would minimize invalid or incomplete information being entered into the report compared to filling the Crash Form manually [8]–[10].

### 2.1.1. Crash Data Collection Mechanism in Develop ed and Developing Country

Over time, the rate of road accidents is increasing day by day. Even though with various advancements, the developing countries are still struggling to eliminate this issue. One such possible solution could be adopting the advanced automated tools for the road accident data collection systems, based on which the policymakers can adopt the necessary strategies to avoid the accidents [2]. To tackle the complications of the increase in road accidents, precautionary measures must be adopted to decrease the number of road accidents and minimize the damages caused by them. For that purpose, smart and intelligent measures must be implemented to overcome the consequences of road accidents. These safety precautions and smart measures can only be achieved based on the data that is collected without any major loss of information, which would be made available for future analysis.

The policymakers, designers, and planners are focusing on strict traffic rules and regulations, the application of traffic control devices, and safety control systems in the vehicles that could tackle the accidental risk and reduce its numbers [11].The accident forecasting was performed in Pakistan based on the time series of 2009-2020. The forecasting of road accidents was greatly affected by the poor accident data collection as most of the accidents go unnoticed and are not reported under the official records. The road accident data was analyzed in Kenya from 2015-to 2020 using a machine learning algorithm to identify the top accident reason in the country.

The study suggested the fine-tuning of police records that could prove useful for analysis as there were missing data in the police records. With the increase in traffic volume of roads, the efficiency of the collection of road data decreases, and therefore, modern tools are required to keep up with the rise in vehicles accident on the roads. For this purpose, the collection of road data of vehicles at intersections and pedestrians crossing the intersections is taken into account.

A regression analysis was performed to improve the data collection of vehicles at the intersection. It was found that the regression technique handles the collection of road data effectively and there is minimal loss in the collection. Similarly, with advances in automation tools, the analysis tool is greatly dependent on the real-time traffic accident data; therefore, the collection methods and their reliability greatly affect the output result. The road data acquisition was assessed using seven variables on straight and curved roads. The results

indicated that the sensing system performs accurately while recording the accident data and they are displayed effectively on the vehicle systems.

In the USA, many bodies operate under state departments of transportation, which collect the data and store it in the national database. For example, the two Application Programming Interfaces (APIs) that collect the data are Map Quest Traffic and Microsoft Bing Map Traffic. The accident data is also extracted by the official departments in the USA using GIS and it provides a large image of maps with accident locations marked on them.

Similarly, another data collection geographical dataset, which operates in more than 100 countries, is called HERE Routing. Its APIs are used for traffic-enabled routing, intermodal routing, Transit routing, isoline routing custom fuel calculations, EV routing, studying road infrastructure, planning and optimizing the road signals, and much more. International Traffic Safety Data and Analysis Group (IRTAD) was developed comprising of 32 countries including the USA that saves the accident data in a common format for analysis purposes.

The UK police record accidents using STATS19 form but are not the sole organization that keeps track of accidents. The official website www.gov.uk keeps track of driving licenses, Kaggle database contains STATS19 information regarding damages done in accidents, most gender involved in accidents, and coordinates of the accident. The number of injuries, vehicle details, and fatalities are collected from the Statista website.

The UK also collects its accidents information from a local newspaper using known as The Guardian. Similarly, Collision Recording and Sharing (CRASH) system, Road Accident Data Management System (RADMS), and Road Accident Data Recorder (RADaR) were developed that collect digital collection, transmission, and storage of accident cases, and police are only required to collect the vehicle registration number, which significantly reduces errors in recording. It is further shared on the IRTAD database for universal compatibility for analysis.

### 2.1.2. Components of Road Accident Recording Form

The basic aim and use of recording of accident information is: Compilation of basic accident data at national level, Basic Analysis of Accidents to identify the accident blackspots and effective road safety countermeasures. All the accidents in India are reported like any other crime and written on First Information Report (FIR) along with preparation of daily diary and case report, which generally covers a detailed account of the accident spot and statements of witnesses, victims and vehicles involved in a particular road accident. However, most of the

traffic police departments do not have computerized accident recording units and, therefore, the accident storage and retrieval system is also quite poor.

In most of the states, it is recorded manually on some register and only one person is responsible for keeping the records. Also, the uniformity in recording accident data is sometimes not maintained. Very few states publish their annual accident statistics in a comprehensive way essential from road safety point of view.

Also, the awareness about the utility of the accident statistics is very low and there is lack of trained skilled personnel for this work. There are several different groups of people with road safety interests who require accident data. These include road safety officers, highway engineers, the police, lawyers, research groups, politicians, teachers, statisticians, insurance companies and members of the public.

They all tend to have slightly differing needs and reasons for wanting the data. These include:

- ✓ The investigation of particular sites or road user groups
- ✓ Designing safety schemes / devices
- ✓ Justification for highway planning Enforcement planning or prosecutions
- ✓ Education and training and
- ✓ Insurance claims.

The following format is used for recording traffic accident data in India [12].

**ROAD ACCIDENT RECORDING FORM A1**

**A. Accident Identification Details**

1. State 2. District 3. FIR No.

4. Police Station

5. Time of Accident (Hrs. : Minutes) 6. Date of Accident — Day Month Year

7. Type of Area
1. Urban
2. Rural
3. Other

8. Type of Accident
1. Fatal
2. Injury needing hospitalisation
3. Injury not needing hospitalisation
4. Damage to Property

9. No. of Vehicles Involved

10. No. of Fatalities

11. No. of Injured needing Hospitalisation

12. No. of Injured not needing Hospitalisation

13. Hit and Run
1. Yes
2. No

14. Ongoing Road Works
1. Yes
2. No

15. Type of Weather
1. Fine/Clear
2. Rainy
3. Foggy
4. Other

16. Type of Collision
1. Hit Pedestrian
2. Head on Collision
3. Hit from Back
4. Hit from Side
5. Hit Fix/Stationary Object
6. Overturn
7. Run Off the Road
8. Other

**B. Details of Accident Stretch/Location**

17. City/Town/Village

18. Road Name

19. Road Type
1. Expressway
2. National Highway
3. State Highway
4. Other Rural Highways
5. Urban Arterial
6. Other Urban Roads
7. Unknown

20. Road Number

21. No. of Lanes

22 Physical Divider Present
1. Yes
2. No

23. Type of Road Surface
1. Paved
2. Unpaved

Figure 2. 1. Accident Data Recording Format of Indian

## 2.2. Introduction to Traffic Accident Data and Its Causes

Road traffic injuries are a major but neglected public health challenge that requires concerted efforts for effective and sustainable prevention. Of all the systems with which people have to deal every day, road traffic systems are the most complex and the most dangerous. Worldwide, an estimated 1.2 million people are killed in road crashes each year and as many as 50 million are injured. Projections indicate that these figures will increase by about 65% over the next 20 years unless there is new commitment to prevention. Nevertheless, the tragedy behind these figures attracts less mass media attention than other, less frequent types of tragedy.

The World report on road traffic injury prevention is the first major report being jointly issued by the World Health Organization (WHO) and the World Bank on this subject. It

underscores their concern that unsafe road traffic systems are seriously harming global public health and development [13]. Everybody travels from one place to another place either to work or to do business or to study or to enjoy using various transport options. Vehicle is one of the most widely used transport alternative and the major source of road traffic accidents in the world. The cost to countries, many of which already struggle with economic development, may be as much as 1–2% of their gross national product.

As motorization increases, preventing road traffic crashes and the injuries they inflict will become an increasing social and economic challenge, particularly in developing countries. If present trends continue, road traffic injuries will increase dramatically in most parts of the world over the next two decades, with the greatest impact falling on the most vulnerable citizens. Appropriate and targeted action is urgently needed.

Road traffic accident (RTA) is an incident on a way or street open to public traffic, resulting in one or more persons being injured or killed and involving at least one moving vehicle [14]–[16]. Road traffic accidents have become a huge global public health and development problem killing nearly 1.3 million people a year and injuring or disabling between 20- 50 million people worldwide; thus making the loss of US 518 billion dollars globally [17]. Developing countries account for 90% of global road traffic deaths; while accounting only 20% of cars being driven and men comprise a mean 80% of casualties [18].

Estimates of the magnitude of road traffic injuries in low-income countries are primarily obtained from police records and sometimes hospital registry data; however, both sources are affected by under reporting[19]–[21]. The African Region remains the least motorized of the six world regions but, suffers the highest rates of road traffic accident having death rates well above the global average of 18 deaths per 100 000 population while the regional average is 24.1 deaths per 100, 000.

In Ethiopia RTA is common public health problem according to World Health Organization (WHO) report, Ethiopia is considered one of the worst countries in the world where RTA kills and injures a large number of road users every year nearly 2000 people die due to road traffic accidents where, 48% are pedestrians, 45% passengers and 7% drivers and over 400 to 500 million ETB is lost yearly, as a result, RTA. Amhara region accounted for 27.3% of the total road traffic accident-related deaths in Ethiopia during the year 2008 - 2009, which is the highest share among all regions and pedestrians account the highest proportion of road traffic

deaths in urban areas: Gondar, Bahir Dar and Dessie accounted for a percentage of 86.3, 54.8 and 48.5 respectively [13], [18], [22] . Even though the challenges are increasing, RTA in developing countries including Ethiopia the focus is still an under-reported and neglected area to be studied and solutions to be obtained promptly [23].

According to the recently published World Health Organization (WHO) [15] road traffic injuries (RTIs) pose a major global public health threat that has long been neglected. As the report states, over 1.3 million people die each year on the worlds' roads with 50 million people sustaining nonfatal injuries. Though 2004 estimates place road traffic crashes as the ninth leading cause of death (responsible for 2.2% of all deaths globally), modelled projections of predict made by WHO states that traffic crashes will rise to the fifth leading cause by 2030 (3.6% of all deaths) if nothing is done to mitigate this escalating problem [15].

Currently, developing countries contribute to over 90% of the world's road traffic fatalities and overall road injury, disability-adjusted life year (DALYs) increased by 2.5% between 1990 and 2010, with pedestrian injury DALYs increasing by 12.9%, more than any other category. In Africa over 80% of commodities and people are transported by roads while in Ethiopia road transport accounts for over 90% of all the interurban freight and passenger movements in the nation. Road traffic crashes pose a substantial burden in Ethiopia, as is the case for other developing countries' because Ethiopia was one of the developing countries in the world and road is the major transport scheme. Car ownership has grown rapidly at approximately 7.0% per annum on average [24].

Road traffic accident (RTA) is a major public health and development challenge. Every year nearly 1.3 million people lose their lives on the road and as many as 50 million others are injured. Globally 17 road fatalities per 100,000 populations per annum are reported. RTA is the second leading cause of death in economically active population group of 15–44 years of age; further, more than 75% of RTA casualties occur in this age group. In many countries the estimate economic loss due to RTAs is as high as 3% of their gross domestic products. The burden of RTA is disproportionally high in low- and middle-income countries (LMIC) were over 85% fatalities and 90% of disability-adjusted life years lost are reported. Fatalities secondary to RTAs is at least two-times common in LMIC than in high-income countries.

Globally RTA fatalities remain more or less constant since 2007; yet, in many developing countries the rates are increasing. Especially Africa faces the highest annual rate of road fatalities in the world– 27 per 100,000 populations. In the next few decades, the problem can even rise due to the ongoing rapid economic growth and increase in motorization in the continent [20].

The 2011 traffic accident report of the Ministry of Transport National Road Safety Council indicated that next to pedestrians (51%), passengers' accident ranks second, accounting 46% of fatality. Of the total traffic accidents, 93% of the cases were associated with human factors, 5% accounted for vehicle factors, and 2% were associated with road related problems. Similarly, the Ethiopian Federal Police report of (2011) stated that road accident level of the country is one of the worst in the world, as expressed by per 10,000 vehicles. Moreover, the report stated that majority of road accidents were concentrated in Addis Ababa, which is the capital city of Ethiopia, and Oromia region, accounting 58 percent of all fatalities and two-third of all injuries. A five-year (2003 to 2007) average traffic accident record of the Federal Police Commission show that, of the total fatal accidents, 76% were caused due to drivers' error, 6% due to vehicle technical problems, 5% due to pedestrian error, 2% due to road defects and 12% due to other factors. This indicates that drivers' error has been contributing to majority of the road accidents in Ethiopia [3], [4].

Road traffic accidents cause a great loss of human and economic resources. This problem is increasing from year to year at an alarming rate accompanying the rapid increase of population and the number of vehicles. Despite having very low road network density and vehicle ownership, Ethiopia has a relatively high accident record. According to WHO report (global status on road safety, 2015) traffic accidents in Ethiopia accounts for the death of 37.28 persons per 100,000 populations this is 2.77% of the total death in the country placing Ethiopia 12th in the world. As per IRIN Ethiopia report, annually at least 70 people die for every 10,000 vehicle accidents. Research on Characteristics of Police-reported Road Traffic Crashes in Ethiopia over a Six Year Period, 2013 states that not less than half of the accident occurred on pedestrians. Considering a six-year police recorded traffic crash study in Ethiopia 48.55% of fatality and 53.16% of Injury occurred with vehicle-pedestrian collision. It has been also stated that 70% of traffic accident happened in city road and 77% of country's vehicle population found in Addis Ababa. This shows the importance of improvement of pedestrian facility in the city [25].

Most countries have found that there is a need for there to be a legal requirement for road Crash (or particular severalties of Crash, e.g., involving personal injury) to be reported to the Police, and it is advisable that this is reinforced by insurance company rules requiring claimants to follow this law. The best source of validated Crash data will, therefore, be the Police force: either the policemen attending the scene of a Crash or when reported to an officer at a police station by the involved parties/witnesses [2].

A 2009 World Health Organization report states, Low-income and middle-income countries have higher road traffic fatality rates (21.5 and 19.5 per 100, 000 population, respectively) than high-income countries (10.3 per 100,000 population). The report also asserted that over 90% of the world's fatalities on the roads occur in low-income and middle-income countries, which have only 48% of the world's registered vehicles [15].

The situation also tends to be worsening as these countries' vehicle fleets are growing rapidly, and efforts to improve safety are not keeping pace. However, methods applied in many of the developed countries have demonstrated that it is possible to slow or arrest this growth in Crash. To achieve this requires dedicated safety workers to carry out regular, in-depth analyses of patterns of Crash and to then target many of these with various (low-cost) remedial actions likely to yield the most effective results [2].

Hence, the establishment of a reliable road Crash database and analysis system is of paramount importance, and this must be made accessible to all those bodies able to contribute to Crash reduction (like the Police, highway engineers, vehicle engineers, education services etc. [2].

The World Health Organization report pointed out that huge gaps remain in the quality and coverage of the data that countries collect and report on road traffic injuries. The report also stated that Reliable data on fatalities and non-fatal injuries are needed by countries to assess the scope of the road traffic injury problem, to target responses to it, and to monitor and evaluate the effectiveness of intervention measures [15].

The occurrence of a transportation crashes presents a challenge to safety investigators. In every instance, the question arises, "What sequence of events or circumstances contributed to the incident that resulted in injury, loss of lives, or property damage?" In some cases, the answer may be simple one. For example, the causes of a single car crash may be that the driver fell asleep at the wheel, crossed the highway shoulder, and crashed in to a tree.

In other cases, the answer may be complex, involving many factors that, acting together, caused the crash to occur. It is possible to construct a general list of the categories of circumstance that could influence the occurrence of transportation crashes. If the factors that have contributed to crash event are identified, it is then possible to modify and improve the transportation system. The causes of crashes are usually complex and involve several factors, they can be considered in four separate categories:

- Driver characteristics or fault.
- Mechanical conditions of the vehicle.
- Geometric characteristics of the road way [26]
- The physical or climatic environment in which the vehicle operates.

### 2.2.1. Driver Characteristics

Road traffic accident victims often tell their friends and their doctors that they have become anxious about driving or being a passenger, and such problems are often mentioned in medical reports for compensation proceedings. A Canadian survey reported that 18.5 per cent of 524 hospitalized road accident victims suffered ‘phobias’ 3-4 years after accidents and that 31 per cent reported they now drove more ‘defensively’. Post-traumatic stress disorder as described after major disasters is an occasional complication. There has been no systematic account of the occurrence and nature of changes in driving and of changes in confidence following accidents. This paper reports a 4-6 year follow-up of consecutive admissions of road traffic accident [27].

Motor vehicle accidents are a major cause of death among Jordanians. Roughly 700 people died in 2011 in car accidents according to the Jordan traffic institute out of a total population of about 6 million people. Many factors contribute to traffic accidents. Some involve planning, design, construction, operation, surface condition, and policing of the roadways. The deadliest factor is human error. This includes unawareness of traffic rules and roadway condition; lack of driving skills; poor judgment; failure to interact and adjust to prevailing roadway conditions; and most importantly, aggressive driving. Preliminary findings of a survey questionnaire conducted in this study show that improper engineering design, inadequate traffic control, lack of traffic management, and traffic congestion are the main factors leading to aggressive driving and road rage on Jordan roadways [4], [13].

Causes of accidents are of special concern to researchers in traffic safety, since such research would be aimed not only at prevention of accidents but also at reduction of their frequency and severity. Despite the efforts made by law enforcement, transportation agencies, and other organizations concerned with roadway safety, traffic accidents and fatalities continue to grow. Roughly 700 people were killed in 2011 on Jordan roadways. This figure is alarming in comparison to the relatively small population of six million and the number of registered vehicles of about one million. Related research and studies showed that many factors are contributing to traffic accidents and road rage in the Kingdom. These factors include design errors, faulty vehicles, and weather conditions.

More importantly, most of the studies identified driving behavior and drivers' attitudes, including excessive speed, to be the major contributing factors to traffic casualties. Aggressive driving has become the norm on our highways. The traveling public frequently sees incidents of road rage on Jordan roadways. In some cases, the drivers are inattentive and would probably be apologetic for their actions. The driver is not considered aggressive in this instance. Aggressive drivers would not feel apologetic because she/he is intentionally ignoring the rights of others on the roadway. That is not saying these actions differ in term of dangerousness. If the victim driver in this case realizes that the act was unintentional, however, she/he would be less likely to retaliate against the inattentive driver. One of the most dangerous consequences of aggressive driving is that it may cause another driver to become angry and retaliate in an extreme manor. This stage of retaliation would be considered road rage. The specific behaviors which constitute aggressive driving would include:

- Tailgating
- Weaving in and out of traffic
- Improper passing (e.g., cutting in too close in front of vehicle being overtaken)
- Passing on the road shoulder
- Improper lane changes (failure to signal)
- Failure to yield the right of way to other road users
- Unwillingness to extend cooperation to motorists unable to merge or change lanes due to traffic conditions
- Driving at speeds far in excess of the norm which results in frequent tailgating, frequent and abrupt lane changes [28].

Road traffic accident is a major but neglected public health challenge. The World report on road traffic accident prevention has indicated that worldwide, an estimated 1.2 million people die in road traffic accident each year and as many as 50 million are being injured. Current and projected trends in motorization indicated that the problem of RTAs will get worse, leading to a global public health crisis. It has been indicated that, accordingly, by 2020 traffic accident is expected to be the third major killer after HIV/AIDS and TB. Due to its perception as a disease of development road traffic accidents and related injuries tend to be under-recognized as major health problems in developing countries. According to WHO report, 90% of the world's fatalities on the roads occur in low-income and middle-income countries, which have only 48% of the world's registered vehicles. For example, an estimated total of 227, 835 pedestrians die in low-income countries, as opposed to 161,501 in middle-income [29].

### 2.2.2. Vehicle Characteristics

There have been a number of research efforts undertaken in the last few decades which have all shown a close correlation between speed, road crash frequency and severity: when speed increases, the risk of a crash and of its severity increases as well. While, at an individual level, the perceived risk is low, the societal risk is high and usually not well understood. The severity of a crash follows from the laws of physics. At higher speeds, the kinetic energy released in a crash increase with the square of the speed and the changes of speed experienced by those struck by or occupying the vehicles involved increase with speed. The increase in crash risk is explained by the fact that when speed increases, the time to react to changes in the environment is shorter and maneuverability is smaller [30].

In traffic, drivers on average need about one second to react to an unexpected event and choose an adequate response – this is called the reaction time. The higher the driving speed is, the longer the distance you cover during this reaction time and before the response is initiated, reducing the opportunity to avoid a crash. Change in speed limits is often subject to intense social and political debates. In many countries, raising the speed limit on the motorway network is a recurrent political argument [31].

In urban areas, all countries have progressively moved towards a maximum speed limit of 50 km/h or less. In 2017, nearly all IRTAD countries had a default speed limit in urban areas of 50 km/h, with often lower speed limits (20, 25, 30 or 40 km/h) in residential areas or around schools. Higher default speed limits (usually 60 km/h) are found in Chile, Korea, Mexico,

Morocco and during night-time in Poland (60 km/h). When there are discussions whether to change the speed limits in urban areas, they are mostly about lowering the speed in residential areas [32]. Some countries are considering adopting a 30 km/h default speed limit, with higher limits on main arterial roads. In the Netherlands, following a full review of road classification, 70% of road in urban areas are limited to 30 km/h. Poland is considering lowering the speed limit from 60 to 50 km/h at night-time (the limit is already 50 km/h during daytime) [33].

### 2.2.3. Road Geometric Characteristics

The study conducted on the influence of road traffic management and geometric characteristics on traffic safety in Addis Ababa developed two different statistical regression models using negative binomial regression method for black spot road segments and non-black spot road sections. The research found that number of horizontal curve, number of a lane, number of vertical curves, number of access and gradient per kilometer were found to be the main influencing road geometric related variables that significantly affect traffic safety [21], [22], [34], [35].

Moreover, overtaking maneuver on multi-lane roads without the assistance of additional passing lanes is a complex driving task. It requires critical information-processing and decision-making skills, and a lengthy section of road to complete the maneuver. The rates of overtaking crashes are related to the provision and geometric design of passing lanes. When passing lanes are not provided on long sections of road lengths, there is increased potential for risky or misjudged overtaking maneuvers, particularly when sight distance is short. Also, it seems that design practices for passing lanes may not be appropriate for many drivers to pass slow traffic or multiple vehicles in a safe manner [36]–[38].

Moreover, previous studies examined the relationship of crash occurrences in terms of a number of lanes, lane width, and presence of a median, median width, type of median, shoulder width, access density, speed limit, vertical grade, horizontal curvature, and weather condition. The relationship between safety on the highway and factors listed above is the primary focus in crash reduction and predictions. In addition, some of the primary geometric design elements that can affect road safety are carriageway, grade, horizontal curvature, shoulder, median, vertical curve [24], [39]

### 2.2.4. Measurement Taken on Previous Investigation

Road traffic injury should be considered alongside heart disease, cancer and stroke as a public health problem that responds well to intervention that can prevent much of it from occurring. The known interventions were discovered through research and development conducted mainly in high-income countries. Further research and development will result in new and better interventions and ways of adapting known interventions to new circumstances. All countries can benefit by transferring and adapting road safety technology that has been proven in a few countries. The interplay of risk factors and interventions in a road traffic system is so complex that presenting them in neat risk–intervention pairings is impossible without being highly repetitive and simplistic. The following measures are provided by many researchers as reported by World Health Organization [13].

**Managing exposure with land-use and transport policy: -**

Eliminating the need or desire to travel is not possible, but the length and intensity of exposure to types of road traffic that put people at risk can be reduced [40].

**Encouraging the use of safer modes of travel**: -

Of the four main modes of travel – road, rail, air and marine – travel by road puts people at the greatest risk of injury per kilometer travelled by far. Providing convenient and affordable public transport, by rail and/or bus and coach, can reduce the distance travelled using higher-risk modes. A trip using public transport usually has a walking or cycling component. Although that component may bear relatively high risk, pedestrians and cyclists pose less risk to other road users than do motor vehicles [41]. National transport policy in many high-income countries now encourages the combination of public transport with improved safety of pedestrian and cycling routes

**Minimizing exposure to high-risk road traffic scenarios: -**

Preventing pedestrians and cyclists and, sometimes, slow-moving farm and construction vehicles from accessing high-speed motorways are a well-established road safety measure. So is preventing motor vehicles from accessing pedestrian zones [42].

**Planning and designing roads for safety**: -

A road network planned for safety has a hierarchy of roads, with several levels or classifications of road, each intended to serve a certain function [43], [44].

**Remedial action at high-risk crash sites**: -

Road crashes are not evenly distributed throughout a road network. They occur in clusters at single sites, along particular sections of road or scattered across whole residential neighbor hoods [45]. Even where area-wide impact assessment and road safety audits are carried out, experience may show that certain sites, sections or areas are hazardous and need improvement. Possibilities include: adding skid-resistant surfaces, improving lighting, providing central refuges or islands for pedestrians, adding signs or markings, improving junctions with signals or roundabouts and adding pedestrian bridges.

**Providing visible, crashworthy, smart vehicles: -**

Vehicle design can have considerable influence on crash injuries. Its contribution to crashes, through vehicle defects is generally between 3% and 5%. A recent European Commission report stated that, if all cars in the European Union were designed to be equal in standard to the best car available in each class, an estimated 50% of all fatal and disabling injuries could be prevented. Meanwhile, many low-income and middle-income countries do not set and enforce standards as high as the ones in the European Union

**Setting road safety rules and securing compliance: -**

Driving at excess or inappropriate speeds, while under the influence of alcohol, while sleepy or fatigued and without protective gear (such as seatbelts, child restraints and helmets) for all vehicle occupants are major contributors to road crashes, deaths and serious injuries. Laws alone are not enough to discourage these errors. Enforced compliance is the key. In the European Union, improving enforcement of current laws could reduce the number of road traffic deaths and serious injuries by an estimated 50% [46].

# CHAPTER THREE

# RESEARCH DESIGN AND METHODS

## 3.1 Introduction

This section describes all the procedures that were undertaken to achieve the objectives set for this study. The procedures that were adopted including all the information relevant to the collection of the data, where those data were obtained and how they were obtained are discussed. In addition, data and information sources, research instruments and method of analysis are presented.

## 3.2. Study Area

The study was conducted in Jimma town, Oromia Regional State, which is 350 km far from Addis Ababa to the South west part of the country. It is one of the ancient and largest towns in south western Ethiopia and developed on the Awetu River by the Italian colonial regime in the 1930s. The city has divided in to 17 kebeles and the population of the city is estimated to be 207,573 people in 2022. It has latitude 7°41' N 36º50'E /7.667º N 36.833°longitude.

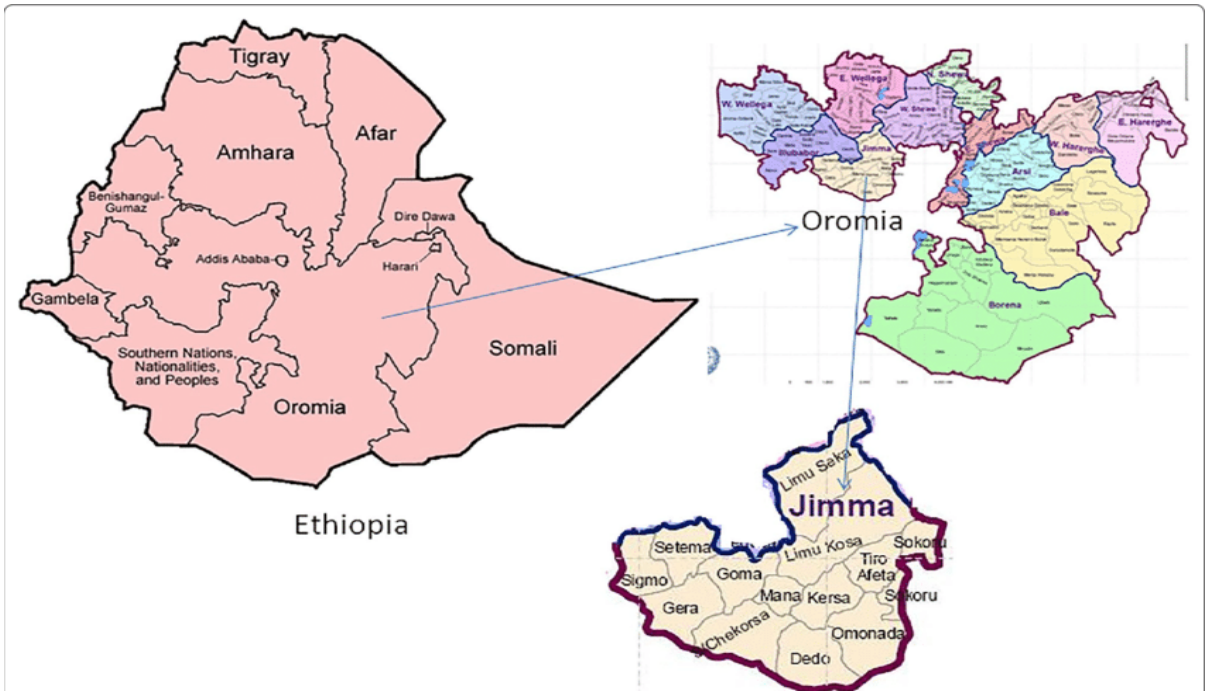


**Figure 3.1 Map of jimma town**

**(Source https://www.google.com/search?q=Map+of+jimma+town)**

## 3.3. Research Design

This particular study mainly focused on qualitative data collected from different experts as far as qualitative research is concerned. The decision in the choice of the research type is mainly depends on the type of study and availability of the information required for the study. Qualitative research emphasizes on meanings, experiences and descriptions to evaluate data collected towards a particular issue [47] [48]. The specific objectives formulated under this research were accomplished via following the research methodologies which can be summarized as follows:

The first is to undertake a literature search on previous publications on crash data collection and management system. The Literature review was carried out throughout the whole research project, this was to compile, discuss and interpret collected data related to the thesis objectives. Many literature sources were used as secondary and references which includes academics periodicals, research journals, archival document within the past dissertations and internet resources. Oral interview was conducted at different offices concerning sensitive local road segment.Site observation was also done to evaluate the nature of existing road on traffic accident. Oral and written interview questions were prepared and distributed to concerned bodies on the basis of the research objectives. Finally, conclusions and recommendation were drawn after squeezing information obtained from all procedures.

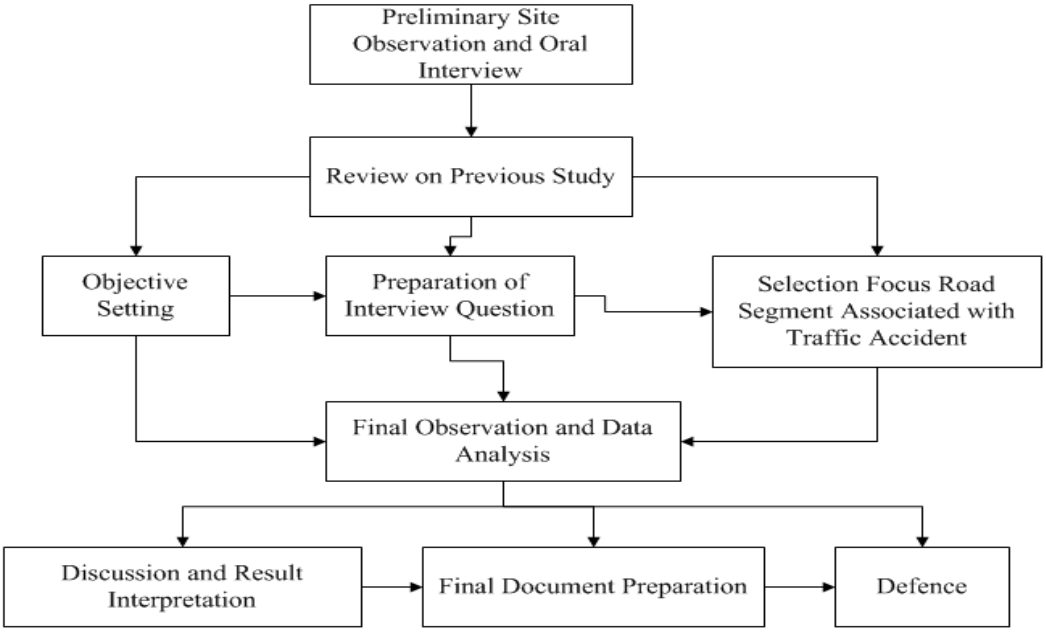


**Figure 3.2 Research Design Frame Work**

## 3.4. Sampling Area and Sample Size

The criteria for selection of the sample areas were the magnitude of vehicle traffic accidents in the town is high. The selection procedures were on the basis of previous accident records, Interview of different experts and by visiting the actual nature of road segments. Jimma town drivers, police officers and traffic accident management employee were consulted during the data collection process. Random selection procedure was used to gather information about main cause of accident, data collection and traffic regulation enforcement.

## 3.5. Data Collection Procedures

As usual; this particular study considered both primary and secondary data. The research was conducted first by identifying the causes of traffic accidents through literature review and desk study on selected road segment, traffic accident data reports of the town and documents, and manuals. Oral and written interview questions were prepared to explore the cause, type and victim of the accident. Field measurements and technical observations were also done to gather data on the geometrical features of different intersections and road segments for traffic accident prediction with help of GPS. Some elements of road were addresses like; number of lanes, lane width, configurations of lanes, grade, marking of road, road right of way (ROW) and drainage. Finally, sampling areas and number of samples were identified.

## 3.6. Data Processing and Analysis

### 3.6.1. Descriptive Analysis

The traffic accident data collected from the enterprise is analyzed and characterized using descriptive analysis to examine the relationships among variables and to identify possible source of cause and contributing factors. This helps to know which accident variables frequency are significantly higher compared to crashes of other relative variables. In spite of this, accident frequency can be used to analyze the relationship between accident variables. Accordingly, graphs, charts, tables etc. are used to support the findings and give logical meanings for the output, which can help for realization and clear interpretation.

### 3.6.2. Statistical Analysis

In order to characterize the populations of crash, statistical analysis will be applied to determine the uniformity of the collected data. Statistics is the science and art of experimenting, collecting, analyzing, and making inferences from data. The following are most of Statical analysis approach for this study

**A) Severity Index: -**

A widely used statistics for the description of relative crash severity is the severity index (SI), defined as the number of fatalities per crash or the number of Injuries per crash. Crash severity index is used for assessing the level of severity between accident variables. This approach is widely used for analysis of relative severity of crashes. Unlike accident frequency, crash severity index provides the severity of each crash relative to accidents registered during a specific time. Mathematically, Crash Severity Index can be expressed in terms of the following relation.

$$\boldsymbol{Severity\ Index(SI)} = \frac{\boldsymbol{Number\ of\ Injuries\ or\ Death}}{\boldsymbol{Total\ Number\ of\ Crash}}$$

**B) Accident Cost: -**

In order to identify the weighted value for accident severity of Jimma town, it is important to define the cost of accident in Ethiopia. But there is no cost of accident developed for Ethiopia. However, based on accident cost developed by Murad Mohammed (2011) Jimma town accident costing can be performed. In this case, Accident Cost (AC) is used to describe the combined effect of number and severity of accidents. Annual Average Accident Cost (AAAC) is expressed in terms of Birr/year or $/year, which is calculated with the following formula.

$$\boldsymbol{Accident\ Cost(F+HI+LI+PD)} = \frac{\boldsymbol{A(F)*MCA(F)+A(HI)*MCA(HI)+A(SI)*MCA(SI)+A(PD)*MCA(PD)}}{\boldsymbol{Time(T)}}$$

Where:

A-Number or magnitude of accident for a given year

MCA-Mean Cost per Accident

T-Period of time under review

## 3.7. Study Variable

### 3.7.1. Dependent variable

Dependent variable is more related to the general objective of the study that is evaluation of importance of collecting reliable crash data for the improvement of road traffic crash management system of Jimma town.

### 3.7.2. Independent variable

Independent variables of the study are:

- ✓ Traffic accident reporting format
- ✓ Knowledge gap between professional in data collection and management
- ✓ Lack of training for traffic police on crash data collection
- ✓ Lack of automatic or electronic data collection system

# CHAPTER FOUR

# ANALYSIS AND DISCUSSION OF RESULTS

## 4.1. Introduction

The analysis of traffic accident is very important for different purposes. One purpose is to identify the main causes traffic accident and working over the corrective mechanism. Provision of corrective saves the loss of life as well as economy.

As indicated on section 1.3 this study is designed to answer the following basic questions.

1. What are the main causes of traffic accident in the study?
2. How can traffic data of different year is analyzed?
3. What are appropriate corrective measures for each type of accident?
4. How do crash data collected are managed in Jimma town?

To address designed research questions and specific objectives collected road traffic accident data was analyzed and interpreted in descriptive and statical manner. Preliminary observations and oral interview were conducted at the very beginning of the study to obtain necessary information. To avoid the limitations of one type of data analysis both descriptive and statical analysis methods were applied. This ensured that understanding was improved by integrating different ways of thinking. In this regard, the research findings, interpretation and discussions are presented in the following sections.

## 4.2. Main Causes of Traffic Accident in Jimma town

### 4.2.1. Addiction, Nature of Road, Driving Behaviour and other factors

The main causes of traffic accident in jimma town were concluded to be Road and driver behaviour. One hundred and fifty written (150) interview questions were distributed equally to different experts like police commission office, city municipality and Taxi drivers. Roadside studies indicate that 1-15% of drivers drive under the influence of one or more drugs of abuse. After drug use, drivers are more often culpable for an accident than non-users [49]–[51]. Many researchers concluded driver‘s behaviour like alcohol use, chewing chat to be a significant causes of traffic accident occurrences[19], [52], [53]. The result and analysis of collected traffic accident data showed that addiction was the main causes of traffic accident. Moreover, they raised another associated problem. If the driver did not use the addiction (alcohol, chat or etc.) on time, she/he may sleep while driving which is another serious problem [54], [55].

Table 4. 1. Main Cause of traffic accident in Jimma town

| Age | Addiction | Driving Behavior | Road | Environmental Factor | Other (Effect of used Vehicle, Driving License, Impermissible loading, Night trip) |
|---|---|---|---|---|---|
| <15 | 2 | 0 | 3 | 1 | 0 |
| 15-30 | 14 | 2 | 24 | 2 | 2 |
| 30-50 | 30 | 1 | 19 | 3 | 3 |
| >50 | 23 | 1 | 11 | 2 | 5 |
| Sum | 69 | 4 | 57 | 8 | 10 |
| **Percent** | **46** | **2.7** | **38** | **5.3** | **6.7** |

As we can infer from table 4.1, the share of addiction concerning traffic accident occurrences was said to be about 46% which is marked as the governing causes of traffic accident in jimma town.

There was also another problem marked as the significant causes which was nature of road. The increase in severity of injury is significantly associated with the lack of road maintenance and traffic management system. The surface of road plays a vital role in driving comfort. I have shown the detail of most significant problems of jimma town local road in Appendix C. Nowadays nature of road and environmental effects on traffic accident is becoming a major concern for researchers. Even though there were many identified defects on Jimma town local road Marking, Surface defects, Drainage Problem and Carriageway problem was shielded in significant parameters. On road segment from Honey land Hotel to Qochi taxi tera; half and full of road section was occupied with sleeping water, sleeping mud and challenging potholes as well as surface defects. Hence, the driver in the forward and backward direction were in competition to occupy free and normal road carriage way. The cumulative of those problems in this particular study was drainage challenges.

As a result of problem described above the carriageway of the road at some sections was hardly minimized. For example, on road segment via Aretu Anbessa to St. Gebrel Church roads carriageway can be calculated as follow with the recorded coordinates. The coordinates of the road around key afer was (7.68241, 36.83369) and (7.6824, 36.8336), using distance formula the width of road became

$$(x1 - x2)^2 - (y1 - y2)^2 = 1.12m$$

This is very challenging. A very striking example of the effect of the road structure on the incidence of road accidents was clearly shown in London [22], [34], [58]–[60]. The researcher observed the site in physically, interviewed different expert and suggested the section to be questioning. Hence, for this particular study the share of nature of road to traffic accident was about 38% which is the second most contributing factors.

The researcher also investigated extra factors causing traffic accident beyond addiction and nature of road which could be summarized as; disobeying of traffic rule, drainage problem, narrow lane width due to loading and unloading of construction material, mal functionality of vehicle and etc.

**Figure 4. 1. Sleeping Water and Soil along Road side [Photo taken by Researcher on July, 2022]**

As we can observe from figures 4.1, there will be the probability of accident due to uncertainty of road surface.

.

**Figure 4. 2. Half and/or Full Part of the Road Occupied with Water and Mud [Photo taken by Researcher on July, 2022]**

As we can observe from figures 4.2, accumulation mud on half part of the road due to drainage problem decrease lane width and become cause for traffic accident.

## 4.3. Traffic Data Analysis of Different Years

### 4.3.1. Descriptive and Statical Analysis

As shown in chapter one section 1.8, there was no well-structured and organized accident data in Jimma town. Analysis of this data was done in descriptive form. Descriptive analysis is to examine the relationships among variables and to identify possible source of cause and contributing factors. This helps to know which accident variables frequency are significantly higher compared to crashes of other relative variables [64].

Table 4. 2. Magnitudes of Injury registered in Jimma town from 2014 to 2022

| Year | Death Injury | High Severity Injury | Low Severity Injury | Property Damage Only | Sum |
|---|---|---|---|---|---|
| 2014 | 8 | 12 | 2 | 35 | 57 |
| 2015 | 13 | 23 | 17 | 24 | 77 |
| 2016 | 22 | 14 | 12 | 17 | 65 |
| 2017 | 20 | 27 | 21 | 38 | 106 |
| 2018 | 18 | 16 | 9 | 40 | 83 |
| 2019 | 10 | 3 | 10 | 39 | 62 |
| 2020 | 17 | 8 | 5 | 19 | 49 |
| 2021 | 11 | 4 | 2 | 21 | 38 |
| 2022 | 9 | 3 | 2 | 30 | 44 |
| Sum | 128 | 110 | 80 | 263 | 581 |

According to recorded traffic accident data of jimma town from 2014 to 2022, all traffic accident types were happened like death injury, high injury, low injury and property damage only. The degree of each accident was however variable from year to year. As we can infer from figure 4.3 the governing injury recorded in jimma town was property damages while death injury being second. The magnitudes of other accident types were relatively small. This is may be due to strict adherence or follow up performed by concerned bodies in addition to newly installed traffic lights, zebra and so on.

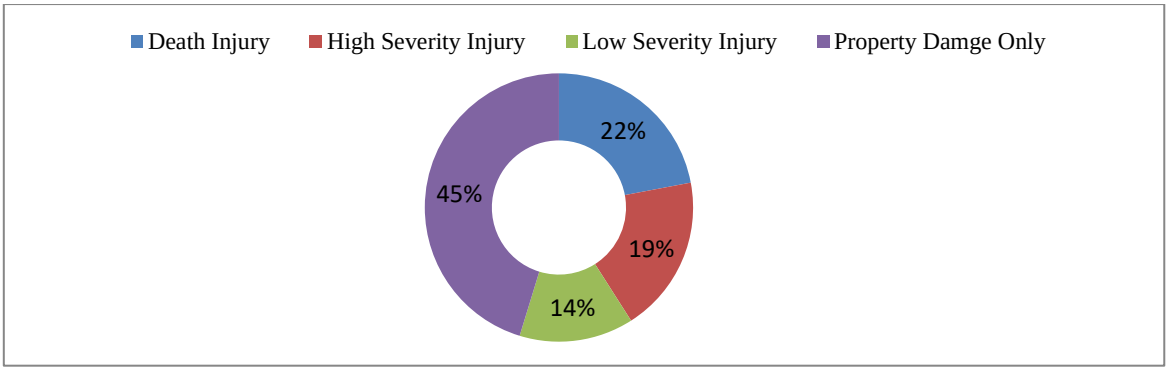


**Figure 4. 3. Accident Data Comparison in Percentages**

**A. Severity Index (SI): -** A widely used statistics for the description of relative crash severity is the severity index (SI), which is defined as the number of fatalities per crash or the number of Injuries per crash. Crash severity index is used for assessing the level of severity between accident variables. This approach is widely used for analysis of relative severity of crashes Mathematically; Crash Severity Index can be expressed in terms of the following relation.

$$\boldsymbol{Severity\ Index(SI) = \frac{Number\ of\ Injuries\ or\ Death}{Total\ Number\ of\ Crash} = \frac{128}{581} * 100 = 22\%}$$

**B. Accident Cost: -** In order to identify the weighted value for accident severity of Jimma town, it is important to define the cost of accident in Ethiopia. But there is no cost of accident developed in Ethiopia. However, based on accident cost developed by [9], [65]-[69] it is possible to calculate the weighted accident costs. In this case, Accident Cost (AC) is used to describe the combined effect of number and severity of accidents. Annual Average Accident Cost (AAAC) is expressed in terms of Birr/year or $/year, which is calculated with the following formula.

$$\boldsymbol{Accident\ Cost(F+HI+LI+PD) = \frac{A(F)*MCA(F)+A(HI)*MCA(HI)+A(SI)*MCA(SI)+A(PD)*MCA(PD)}{Time(T)}}$$

Where:

A-Number or magnitude of accident for a given year

MCA-Mean Cost per Accident

T-Period of time under review

On the basis of accident cost determined by Murad Mohammed in 2011, accident cost of Jimma town can be computed.

**Table 4. 3. Accident Cost in Million**

| Accident Cost (million birr) As per Report of Murad Mohammed on October 2011 | | | |
|---|---|---|---|
| Death or Fatality | High Injury | Light Injuries | Property Damage |
| 0.47 | 0.26 | 0.097 | 0.03 |

On the basis of accident cost determined by Murad Mohammed in 2011, these values are proposed to be used for estimating the weighted value for accident severity and the annual average accident cost. Accordingly, Jimma town road accident cost for death, serious injuries, light injuries and property damage is estimated in table 4.4 based on the above accident costing.

**Table 4. 4. Accident Cost of Jimma town from 2014 to 2022**

| **Types of Accident** | **Number** | **Unit Cost (Million Birr)** | **Total Cost (Million Birr)** |
|---|---|---|---|
| Death Injury | 128 | 0.47 | 60.16 |
| High Severity Injury | 110 | 0.26 | 28.6 |
| Low Severity Injury | 80 | 0.097 | 7.76 |
| Property Damage Only | 263 | 0.03 | 7.89 |
| | Total | | 104.41 |

The analysis shows, among other things, road accidents erode more than 0.49% of the country's Gross Domestic Product (GDP). On the basis of the above result, the total accident cost for Jimma town for the past eight year is 104.41 million birr or 1.98 million $; where 60.16 million ETB for fatality, 28.6 million ETB for serious injuries, 7.76 million ETB for light injuries, and 7.89 million ETB for property damage. Accordingly, the annual average accident cost of Jimma town is estimated as Birr 13.05 million or $ 0.247 million (estimated with an exchange rate of Birr 52.66 for $1). This implies that Jimma town cost around 13 million birr per year due to the occurrences of accident on the respective road segments.

## 4.4. Corrective Measures for Frequent Traffic Accidents

Life is very expensive resources which cannot be replaced (recycled) or expressed in monetary value like others property. Many researches have been conducted throughout the world to demonstrate the effects of road accidents on public health concern, local, regional and global effects on socio-economic developments and environmental protections. Everyone killed, injured or disabled by a road traffic crash has a network of others, including family and friends, who are deeply affected. It would be impossible to attach a value to each case of human sacrifice and suffering, add up the values and produce a figure that captures the global social cost of road crashes and injuries.

The economic cost of road crashes and injuries is estimated to be 1% of Gross National Product (GNP) in low-income countries, 1.5% in middle-income countries and 2% in high-income countries. The global cost is estimated to be US$ 518 billion per year. Low-income and middle-income countries account for US$ 65 billion, more than they receive in development assistance [4], [70], [71]. Road traffic injuries place a heavy burden, not only on global and national economies but also household finances. Many families are driven deeply into poverty by the loss of breadwinners and the added burden of caring for members disabled by road traffic injuries. By contrast, very little money is invested in preventing road crashes and injuries. Global research and development funding for road traffic injuries were estimated in 1996 to range from US$24 to US$33 million, compared with more than US$900 million for HIV/AIDS [5], [72], [73].

Ethiopia recorded 29,493 traffic accidents during the first nine months of 2021/2022 fiscal year, a decrease of 5.8 percent when compared to the same period last year," the state-owned media outlet Ethiopia Press Agency (EPA). The number of heavy injuries caused by traffic accidents during the nine months of the 2021/2022 fiscal year, which stood at 4,430, was an increase of 7.4 percent when compared to the same period last year. The Ethiopian Ministry of Transport and Logistics also disclosed that 3,555 people suffered light injuries during the review period. And 1.74 billion Ethiopian Birr (about 33.7 million U.S. dollars) worth of property damage was caused by traffic accidents during the period, up 157.4 percent. Although Ethiopia has one of the lowest per capita car ownership rates in the world, deadly traffic accidents are fairly common, with a host of factors to blame, including bad roads, reckless driving, a flawed driving license issuance system and lax enforcement of safety rules [14], [18].

It is very challenging to loses this much budget for traffic accident and associated injuries yearly. Hence, concerned bodies like police commission, city municipality and road authority, road user have to work in pair to minimize the impact of traffic accident and increase safety performance. As far as traffic accident protection is concerned, researcher suggest the following implementable engineering measurements.

**Road Maintenance:**

In the selected study area certain road segments were under excessive damages like alligator cracking, excessive potholes, surface defects, marking and drainage problems. Rough and damaged road surface must be maintained leads to mechanical damage vehicle which will bear other secondary injuries. Moreover, the researcher suggests appropriate traverse and longitudinal drainage structure which is sufficient and safe to drain all tributary discharges. There was on-going construction projection identified in the study area; here material loading and unloading, stocking material alongside was the main constraint. Therefore, Right of Way (ROW) should have to be maintained and protected.

**Follow up on Quality of Drivers Driving Licence:**

The role of human on the occurrences of traffic accident is more than 50% which is committed by driver. Many respondents suggested that the driving licence of each driver has to be of good quality. The driver who could not write her or his name may hold driving licences. Therefore, to obtain the qualified drivers licence donation agents have to be responsible accordingly.

**Create Awareness:**

The behaviour human being is flexible and condition dependent. Hence, police commission, city municipality, road authority, road user and Health experts have to show the impact of addiction (alcohol, smart phone, chat or etc.). Successive training has to be delivered in different times. This training should not only for addiction case it should also projected to issues like loading beyond permissible capacity of vehicle, disobeying traffic rules, denying overtaking, driving with higher speed, leaving station without the station permission and so on. Moreover, the researcher pointed solution ideas on Jimma university community. All staff members and student of the university have to form traffic club jointly. This group has to create awareness about wearing of helmet, seating belt, unlicensed driver.

**Installation of Traffic sign and Marks:**

The victim of traffic accident is loading huge loads on socio-economic developments of a country. Installation of any supportive sign and marks are very important. Besides to geometric design elements like transition curves to control the speed of vehicle speed delineator have to be installed where ever necessary. Observed topography of selected road segment in study requires a protective concrete or steel post.

**Vehicle Examination:**

All parts of vehicle have to be functional. The most recommend deed in examination is to avoid the use of damaged and repaired vehicle.

## 1.5. Evaluation of Accident Data Collection and Management System

**Crash Data Collection System**

Traffic police in Jimma town play a twofold role in traffic safety. They primarily take the responsibility of improving safety by enforcing the traffic regulations. They secondly carry out crash investigation and reporting mainly for own use to document evidences required for court ruling, and to identify priorities and plan enforcement strategies.

When the accident occurs the police, patrol come to the accident location and collect crash data manually fill a preliminary form which contains basic information such as vehicles plate number, driver's names and little preliminary sketch of the accident and location then vehicles are removed from the accident locations and the drivers will go to the police station were the police investigator are there to investigate the accident sequences. A police officer attending a Crash collects the data through Crash recording form and decides on fault at the scene of the Crash. The police officer uses his/her decision on whom among the involved parties is to be blamed for the Crash.

But accident data collection has to convey full information about the occurrences of traffic accident at specific segments of road which includes road related detail, Vehicle detail, driver detail, Weather condition during accident and so on. As stated in contents of Figure 2. 1 accident data recording forms of Indian embraces types of accident, types of areas, types of collision, weather condition, road type, road number and road surfaces as main parameters.
The crash data record form is not standardized and some of the attributes about the event are often described in narrative form [5].

Minimum Uniform Crash Criteria (MMUCC) guide line of USA recommends that law enforcement should collect 77 of the 110 data elementals at the Crash scene, which include 19 crash data elements, 30 vehicle data element and 28 personal data elements, were each element has several attributes. The remaining data elements should be obtained after linkage to the other state data files such as driver history, roadway inventory data, hospital and other health/injury data [74].

The output of this investigations showed that Jimma town crash data collection system has a gap of conveying or displaying all necessary information which are very important for the analysis of traffic accident. Moreover, Jimma town crash data collection system missed a detail of crash data records like crash data elements, Vehicle data elements, personal data elements and others information. For instance, concerning personal data elements, if this data is not available it is difficult to give health related services for damaged individuals. In addition, this it is not possible to analysis the relation between age and accident. To sum up, limited information concerning the detail of accident strongly affects analysis. On section 4.2 above addiction, nature of road, driver behavior, and environmental factors are discovered as the main causes of traffic accident. Hence, Crash reporting formats of these particular study areas have to incorporate those important and influential points.

**Crash Data Management System**

Traffic data collection has strong impacts on the analysis of traffic accident and their management system. Inefficient, inaccurate, and unreliable collection method of traffic accident data results in wrong analysis. Due to wrong analysis, proper implementable corrective engineering measures are incorrect too. Hence, special emphasis has to be given to collection mechanism so as to minimize mistake and error. Data collection and recording of the study area is only manual which is not accessible to all responsible stake holders. Therefore, the researcher suggested the developments of uniform standard and use of Google Application Programming Interfaces (APIs), Global Positioning System (GPS) in parallel with manual recording.

# CHAPTER FIVE

# CONCLUSIONS AND RECOMMENDATIONS

## 5.1. Conclusions

Transportation is a medium communication with which people in different areas communicate about social, economic and political activities. It creates a bridge of success and achievement. The healthy services of transportation are interrupted due to many influential parameters; of which traffic accident is one and most critical. Road traffic accident is currently becoming a discussion agenda all over the world.

This study is focused on evaluation of road traffic crash data collection and management system of Jimma town. Different experts like police commission, city municipality, road user, drivers and health professionals were involved as population of the study.

Crash data collection process in jimma town is in manual base therefore missing data and inaccurate information are being expected moreover current road Crash data collection forms are much below the best practices of other countries and it could not serve the needs of all stakeholders and it is clear that the existing crash databases in the country are poor and inadequate.

The findings of this study reveal there is a need to improve crash data collection and management system identify specific traffic safety problems, communicate safety issues to the public and media, make better programming and resource allocation decisions and enable better monitoring and program evaluation.

The lack of uniformity in crash data will result failure to perform problem identification, establish goals and performance measures, allocate resources, determine the progress of specific programs, and support the development and evaluation of highway and vehicle safety countermeasures by comparing with the standard specifications.

The town crash data recording format missed the relevant content of the road crash records which was required for any road safety improvement work. The reporting forms currently used by the concerned polices are not well prepared and formatted to include details of each crash, road, vehicle and personal data elements.

The interview results, site observation and eight-year traffic accident data were analysed in correspondence with designed specific objectives and the following conclusions are forwarded:

- Evaluation of existing accident data, collected interview results and site observation analysis results selected most important road segments. For the whole selected road segments the main causes of traffic accident was identified to be nature of road and driver behaviour which accounts about 38% and 46% respectively.
- According to recorded traffic accident data of jimma town eight years (2014 to 2022), all traffic accident types were happened like death injury, high injury, low injury and property damage only. The degree of each accident was however variable from year to year. The governing injury recorded in jimma town was recognized to be property damages. Statical analysis of accident data was performed with severity index (SI) and Accident cost determination. The severity index of the study was about 22%. In regards to accident cost, this particular investigation concluded that Jimma is losing about 13 million birr per year due to the occurrences of accident on the respective road segments.
- It is very challenging to lose billions of dollars for traffic accident and associated injuries yearly. Hence, concerned bodies like police commission, city municipality, road authority, road user has to work in pair to minimize the impact to some extent. As far as traffic accident protection is concerned, as researcher, suggest the following implementable engineering measurements. The main corrective measures are road maintenance; follow up on driving licence donation companies, awareness creation work, installation of traffic sign and marks, vehicle examination.
- Evaluation of crash data collection form revealed that the city crash data collection system has a gap of conveying or displaying all necessary information which are very important for the analysis of traffic accident. The form missed to embraces a detail of crash data records like crash data elements, Vehicle data elements, personal data elements and others information. As various addictions, nature of road, driver behavior, and environmental factors are discovered as the main causes of traffic accident the crash reporting forms of these areas have to incorporate those important and influential points. Generally, to avoid uncertainty of traffic data analysis special emphasis has to be given to for collection and storing mechanism. The researcher suggested the developments of uniform standard, use of Google Application Programming Interfaces (APIs), Global Positioning System (GPS) and online storing mechanism in parallel with manual recording.

## 5.2. Recommendations

The discussions on the main problems of crash data collection and road safety management were outlined previously. Based on the findings, the following recommendations are proposed to strengthen road safety management in Jimma town and the accuracy level of the research can be improved and useful if the following mentioned recommendation are identified and thoroughly investigated by the organizations and other researchers to:

- Observed failure on existing road segment has to be maintained urgently. This could be implemented by collaboration of the town road authority, municipality and traffic police and are useful in reducing frequency and severity of accident.
- Supporting the road traffic crash data collection and data sharing system with technology as standardized mobile app enables taking all necessary data from crash scene and deliver information to central database system through internet.
- To minimize missing and inaccuracy of data, utilization of GPS and GIS system is important to identify the exact accident location in order to introduce a proper counter measure used for significant accident reductions and reductions in the severity of injuries. Moreover, online storage of accident data along manual records.
- Addiction, nature of road, driver behavior, and environmental factors were discovered as the main causes of traffic accident. Hence, Crash reporting formats of these particular study areas have to incorporate those important and influential points for the minimization of TRA.
- Crash data must be available for free to all road safety stakeholders through the internet without any restrictions in order to encourage the analysis of accidents data and the development of a better understanding of road safety characteristics and trends.

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# APPENDICES

**Appendix A: Interview Questions prepared in English and translated to Ahmaric Language**

1. **Have you ever seen traffic accident in jimma city? If so what types of damage was happened?**

_____

_____

_____

2. **On reducing the occurrences of traffic accident what do you think is the role of the following bodies**

A. Road users (Briefly Explain)

_____

_____

B. Traffic sign and marks (Briefly Explain)

_____

_____

C. Road authority (Briefly Explain)

_____

_____

D. Add other (If any)

_____

_____

3. **On which parts of road do you think that the probability of accident occurrences high and why?**

    A. On curve part like horizontal or vertical curve

    _____

    _____

    B. On tangent or straight part

    _____

    _____

C. On transition from curves to straight or vice versa

_____

_____

4. **Rate the understanding of road users concerning traffic accident occurrences**
    A. High level of understanding
    B. Medium level of understanding
    C. Low level of understanding
    D. Poor level of understanding
5. **Based on your answer on the above question what types of action have to be taken to increase knowledge of road users**
    A. Delivering video and image supported training for road users timely concerning traffic accident
    B. Posting pre informative sign on areas sensitive to traffic accident
    C. Checking the validity of driving license for all types of vehicle
    D. Making the degree of punishment strict after identifying situation of accident
    E. Creating awareness on different types of addiction specially for driver
    F. Avoiding night trip if it is assumed to be a causes of the accident
    G. Other (Specify)

_____

_____

6. **How do you think the traffic accident occurs?**
    A. Due to types of road like asphalt or gravel road
    B. Due to speed of driver
    C. Due to geometric elements of road
    D. Other (specify)

_____

_____

7. **During traffic accident occurrences what types of damage do you think is most probably happen?**
    A. Death injury
    B. High severity level damage

C. Low severity level damage

D. Property damage only

**State your answer with reason. Please provide the corresponding corrective measures depending on your answer?**

_____

_____

8. **On what types of terrain do you think traffic accident is high?**
   A. On flat terrain type
   B. On rolling terrain type
   C. On mountainous terrain type
   D. On escarpment terrain type
9. **Do you think traffic accident data collection is useful or not concerning:**
   A. Identifying causes of traffic accident (Briefly Explain)

      _____

      _____

   B. Installation of traffic device (Briefly Explain)

      _____

      _____

   C. Other (Specify)

      _____

      _____

10. **Is there any special mechanism of managing the collected traffic data in Jimma city municipality or in any concerned bodies? If yes of what type?**

---

**If not, Please suggest what to do in the future?**

_____

_____

_____

11. **If you have any extra ideas or messages concerning the occurrences or minimizations of traffic accident please briefly state?**

_____

_____

1. **በጅማከተማየ ትራፊክ አደጋ አይተህ ታውቃለህ? ከሆነ ምን አይነ ት ጉዳት ደረሰ?**

_____

_____

2. **የ ትራፊክ አደጋን በጭነ ስ ረገ ድ የ ሚከተሉት አካላት አስተዋፅኦ ምን ይመስልዎታል?**

ሀ. የ መንገ ድ ተጠቃሚዎች (በ አጭሩ ያብራሩ)

_____

_____

ለ. የ ትራፊክ ምልክቶች እና ምልክቶች (በ አጭሩ ያብራሩ)

_____

_____

ሐ. የ መንገ ድ ባለስልጣን (በ አጭሩ ያብራሩ)

_____

_____

መ. ሌላ ያክሉ (ካለ)

_____

_____

3. **በየ ትኞቹ የ መንገ ድ ክፍሎች ላይ የ አደጋ ዕድሉ ከፍተኛ ነ ው ብለው ያስባሉ እና ለምን?**

ሀ. ከርቭ ክፍል ላይ እንደ አግድምወይምቀጥ ያለ ኩርባ

_____

_____

ለ. በ ታንጀንት ወይምቀጥታ ክፍል ላይ

_____

_____

ሐ. ከ ጥምዝ ወደ ቀጥታ ወይምበ ተቃራኒ ውሸ ግግር ላይ

_____

_____

4. **የ ትራፊክ አደጋን በሚመለከት የ መንገድ ተጠቃሚዎችን ግንዛቤ ደረጃ ይስጡ**

ሀ. ከፍተኛ የ ሚዳት ደረጃ

ለ. መካከለኛ የ ሚዳት ደረጃ

ሐ. ዝቅተኛ የ ሚዳት ደረጃ

መ ደካማየ ሚዳት ደረጃ

5. **ከላይ በተጠቀሰውጥያቄ ላይ በሰጠኽ ሜልስ ላይ በመሞረት የ መንገድ ተጠቃሚዎችን እውቀት ለሜጨሞር ምን አይነ ት እርምጃዎች መወሰድ አለባቸው**

ሀ. የ ትራፊክ አደጋን አስመልክቶ ለመንገድ ተጠቃሚዎች የ ቪዲዮ እና ምስል የ ተደገፈ ስልጠና በወቅቱ መስጠት

ለ. ለ ትራፊክ አደጋ ተጋላጭበሆኑ አካባቢዎች ላይ ቅድመሚጃ ሰጪምልክት መላጠፍ

ሐ. ለሁሉምዓይነ ት ተሽከርካሪ የ መንጃ ፍቃድ ትክክለኛነ ት ሚረጋገጥ

መ የ አደጋ ሁኔታን ከለየ በኋላ የ ቅጣቱን ደረጃ ጥብቅ ማድረግ

ሠ. በተለያዩ የ ሱስ ዓይነ ቶች ላይ በተለይ ለ አሽከርካሪዎች ግንዛቤ ማፍጠር

ረ. ለ አደጋውመንስኤ ይሆናል ተብሎ ከታሰበ የ ሌሊት ጉዞን ማስወገድ

ሸ. ሌላ (ይግለጹ)

_____

_____

6. **የ ትራፊክ አደጋውእንዴት ይከሰታል ብለውያስባሉ?**

ሀ. እንደ አስፋልት ወይምጠጠር መንገድ ባሉ የ መንገድ ዓይነ ቶች ምክንያት

ለ. በ አሽከርካሪ ፍጥነ ት ምክንያት

ሐ. በ መንገድ ጂኦ ሜትሪክ አካላት ምክንያት

መ ሌላ (ይግለጹ)

_____

_____

**7. በትራፊክ አደጋ ወቅት ምን አይነ ት ጉዳት ሊከሰት ይችላል ብለውያስባሉ?**

ሀ. የ ሞት ጉዳት

ለ. ከፍተኛ የ ክብደት ደረጃ ጉዳት

ሐ. ዝቅተኛ የ ክብደት ደረጃ ጉዳት

መ የ ንብረ ት ውድሞት ብቻ

ሜልስህን በምክንያት ግለጽ። እባኮትን በሜልስዎ ሚሰረት ተጓዳኝ የሚተካከያ እርምጃዎችን ይስጡ?

_____

_____

**8. የ ትራፊክ አደጋ ከፍተኛ ነ ውብለውየ ሚያስቡት በምን ዓይነ ት የ ሜሬት አቀማመጥ ላይ ነ ው?**

ሀ. በ ጠፍጣፋ የ ሜሬት ዓይነ ት ላይ

ለ. በ ሚሽከረከረ ውየ ሜሬት ዓይነ ት ላይ

ሐ. በ ተራራማየ ሜሬት አቀማመጥ ዓይነ ት ላይ

መ escarpment ሜልከዓ ምድር አይነ ት ላይ

**9. የ ትራፊክ አደጋ ሚጀ ማሰብሰብ ጠቃሚነ ውወይስ አይደለ ምብለውያስባሉ፡ -**

ሀ. የ ትራፊክ አደጋ መንስኤዎችን ማለየ ት (በ አጭሩ አብራራ)

_____

_____

ለ. የ ትራፊክ ማሳሪያ መትከል (በ አጭሩ አብራራ)

_____

_____

ሐ. ሌላ (ይግለጹ)

_____

_____

**10. የ ተሰበሰበውን የ ትራፊክ ሚጃ በጅማ ከተማ ማዘ ጋጃ ቤት ወይም በሚመለከታቸው አካላት የ ማከተዳደር ልዩ ዘዴአለ?**

_____

_____

አ ዎ ከሆነ ምን ዓይነ ት?

_____

_____

ካልሆነ ፣ እ ባክዎን ወደፊት ምን ማድረግ እ ንዳለብዎት ይጠቁሙ?

_____

_____

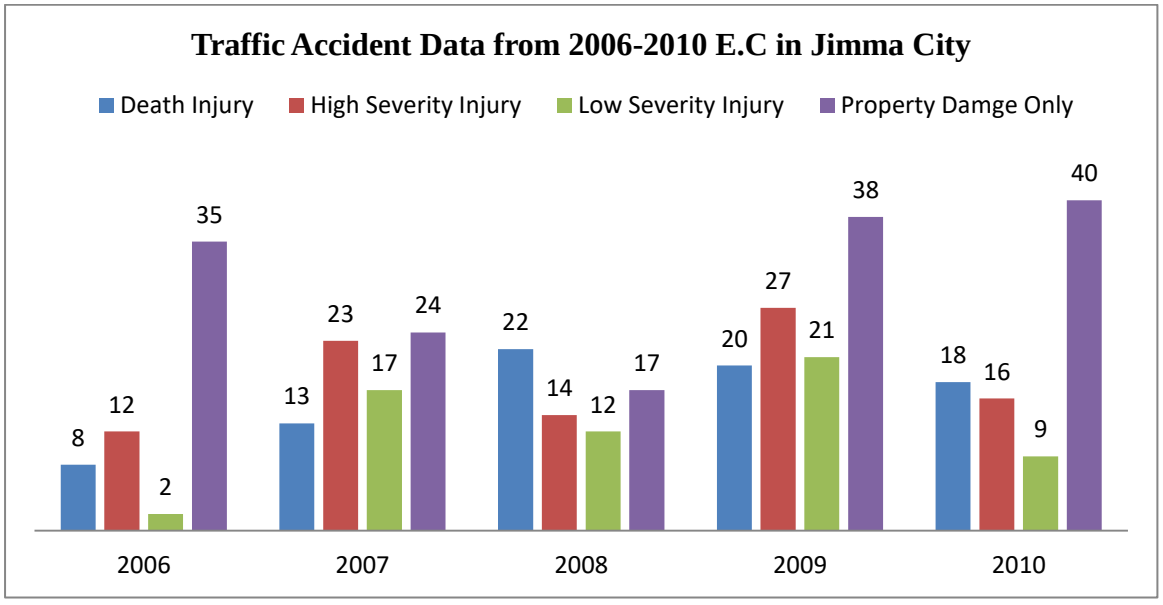
**11. የ ትራፊክ አደጋዎችን ማከሰት ወይም ማቅነ ስን የ ሚመለከቱ ተጨማሪ ሀሳቦች ወይም ማሟ ዕክቶች ካሉዎት እ ባክዎን በአ ጭሩ ይግለጹ?**

_____

_____

## Appendix B: Jimma town Traffic Accident Data of Different Years

| Year | Death Injury | High Severity Injury | Low Severity Injury | Property Damage Only | Sum |
|---|---|---|---|---|---|
| 2006 | 8 | 12 | 2 | 35 | 57 |
| 2007 | 13 | 23 | 17 | 24 | 77 |
| 2008 | 22 | 14 | 12 | 17 | 65 |
| 2009 | 20 | 27 | 21 | 38 | 106 |
| 2010 | 18 | 16 | 9 | 40 | 83 |
| 2011 | 10 | 3 | 10 | 39 | 62 |
| 2012 | 17 | 8 | 5 | 19 | 49 |
| 2013 | 11 | 4 | 2 | 21 | 38 |
| 2014 | 9 | 3 | 2 | 30 | 44 |
| Sum | 128 | 110 | 80 | 263 | 581 |
| | 22.03098107 | 18.93287435 | 13.76936317 | 45.26678141 | |



## Appendix C: Selected Road segments

| Road Segment | Location | Remarks |
|---|---|---|
| Aretu Anbessa to Saint Gebrel Church | Lat=7.67477<br>Long=36.85325 | Potholes, Alligator cracking<br>Pipe draining liquid wastes is projected from Jimma Hotel to the pavement<br>Almost all part of ROW is covered with marshy |
| | Coordinate on right side of road<br>Lat=7.68241<br>Long=36.83369<br>Coordinate on left side of road<br>Lat=7.6824<br>Long=36.83365 | Road side material deposit, Loading and unloading of material<br>Roadside Plantation<br>Drainage from resident<br>The part of road around JUCAVM is so hilly on one side. There is no protective concrete post. |
| | | Excessive alligator cracking<br>Sleeping water at left side<br>ROW is minimized<br>Drainage Problem |

| Road Segment | Location | Remarks |
|---|---|---|
| Ajip Taxi Tera to Maremiya around St. Kidane MihretChurch | Lat=7.67477<br>Long=36.85325 | Excessive surface defects, Cracking, Potholes<br>**Side Drainage problems**; Some discharge is released to the road from university compound |
| | Coordinates on right side<br>Lat=7.67541<br>Long=36.8528<br>Coordinates on right side<br>Lat=7.67544<br>Long=36.85267 | **Accumulation of waste and mud along road side**<br>Due to instability of underlying pavement material the center of the road is bulged. |
| | Coordinates on right side<br>Lat=7.67837<br>Long=36.85066<br>Coordinates on left side<br>Lat=7.6784<br>Long=36.85068 | Excessive sleeping water and mud<br>Surface defect and no road mark<br>Potholes at different intervals<br>Traffic Congestion due to irregularity of the road<br>Road side Shopping<br>Excessive rutting |

| Road Segment | Location | Remarks |
|---|---|---|
| Tishayer to Ajip taxi tera | | **The available Open channel ditch** was not capable of draining all drainages of the area. This in turns leads to overflow and minimization of road carriageway |
| | Lat=7.67131<br>Long=36.85567 | Excessive pavement distress was observed along road centre line. Pavement materials are disintegrating due to number of repeated traffic loading. |
| | <u>Coordinates on right side of road</u><br>Lat=7.67189<br>Long=36.85525<br><u>Coordinates on left side of road</u><br>Lat=7.67187<br>Long=36.85506 | The width of the pavement seems two lanes. But there is no mark or median.<br>Discharge on this area is greater than the capacity of provided **drainage**. Hence, excess water and mud is sleeping on the road side which minimize the total width of road (about 1.5m of road side was occupied with sleeping water and mud)<br>Gutter was completely closed. |

## Appendix D: Site Photo Taken during Observations