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# INVESTIGATION OF TRAFFIC ACCIDENT PRONE AREAS RELATED TO EXISTING ROAD CONDITION AND DRIVER'S BEHAVIOR ALONG MENAGESHA- AMBO ROAD SECTION

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## ABSTRACT

Traffic accidents worldwide is increasing due to a pragmatic vehicle ownership, acquisition, which necessitates daily activities. The primary objective of this research work was to identify the most hazardous location and provide countermeasures that will minimize the traffic accident at the designated sites. The scope of the study was limited to Ambo-Ginchi- Addis Ababa road, a total length of study road section of 87kms. The traffic accident data collected from each Wededa Police station covering the period of 2012-2015. It was analyzed using a Priority value formula for EjereWereda and Holota town, and accident frequency for Ambo wereda, Dendiwereda and Welmeraweredato rank the traffic accident areas. Based on the results of the analysis, thirteen locations of the road stretch were found to be accident prone areas. Out of these sites, three of them are in Ambo Wereda, two in Ejerewereda, one in Welmerawereda, and seven in Holota town. The time when most of the accidents occurred from 3:00PM-6: 00 PM. The primary causes of the accidents were over speeding, driving without attention and some unknown reasons. Also, it showed that the drivers' age group who caused most of the accidents composed of 25-34 years old. Based on the findings of the study, it is concluded that there was the significant increase in the number of crashes in the afternoon. Young drivers are believed to cause more accidents than the older once due to aggressiveness. To minimize the occurrence of accidents along the study road section, it is recommended that provision of speed limit sign boards and warning signs at the strategic locations where traffic accident areas are identified to forewarn the overspeeding drivers. It is also recommended that the road agency should have to undertake to widen the lane width of the road, provision of sufficient climbing lane, installation of roadside Delineator, conduct roadside improvements, and repaint faded pavement markings.

**Keywords:** Accident prone area, Cause of traffic accidents, Hazardous locations, Priority value, informative and warning signs.

## 1 INTRODUCTION

Road transportation provides benefits both to nations and to individuals by facilitating the movement of goods and people. It enables an increased access to jobs, economic market, education, recreation and health care, which in turn have direct and indirect positive impacts on the health of populations. However, the increase in road transportation has also placed a considerable burden on people's health in the form of road traffic injuries, respiratory illness, and the health consequences that ensue from a reduction in physical activity. There are also additional negative, economic, social and environmental effects that arise from the movement of people and goods on the roads such as air pollution, greenhouse gas emissions, and the consumption of finite resources, community severance, and noise. For instance, according to WHO's Global Burden of disease project for 2004, road traffic crashes caused by 1.27 million deaths that year, which is a similar number to those produced by many communicable diseases. While road traffic death rates in many high-income countries have stabilized or declined in recent decades, data suggest that in most regions of the world the global epidemic of traffic injuries is still increasing. It has been estimated that, unless immediate action is taken, road deaths will rise to the fifth leading cause of death by 2030, resulting in estimated 2.4 million fatalities per year [1].

Road construction and maintenance is an essential desire for the development, especially in developing countries. Reviewing Ethiopia's road sector development (RSDP) in the past 16 years has revealed that the total road network expansion of the country has reached 85,966km. As part of the transformation plan of the country, Ethiopian government states that it will construct 82,500km of roads across the nations with a cost of 122 billion Birr during the specified period [2]. In connection to this, even though Ethiopia is going forward towards constructing the road infrastructure, the country is losing billions of dollars due to traffic accidents. For instance, from 2001/02-2004/5, the traffic accident death rate was in the range of 129 and 145 per ten thousand motor vehicles [3].

Furthermore, Ethiopia has a relatively high accident record despite having low road network density and vehicle ownership. Road traffic injury which is a physical damage of a person as a result of road traffic crash is the primary cause of traffic fatalities (any person killed immediately or dying within 30 days as a result of the road traffic injury crash). Road traffic injuries are the eighth leading cause of death worldwide [4].

Various studies done on road traffic accidents in Ethiopia have shown the escalation of the problem at the national level. Road traffic injury is high in Ethiopia, at least 70 people die for every 10,000 vehicle accidents annually [8]. According to Road Transport Authority report, 1,800 people died and 7,000 injured in 2003 across the country. In 2007/8, a total of 15,082 accidents occurred in the country. Of them, the number of people killed was 2,161 while 7,140 experienced non-fatal injuries [5]. Even though the traffic accident rate is growing spontaneously from time to time in Ethiopia, the idea of road safety is applied lately throughout the country. So it showed that the lack of proper study on the accident suspected areas and also the absence of application of appropriate countermeasures provided to mitigate the effects. According to the report of the Association for Safe International Road travel list of dangerous Ethiopian roads, Ambo to Addis road is one who is suspected to the occurrence of accidents, and also it is very congested road [6]. So that this study is proposed to be undertaken to introduce the possible countermeasures that will decrease the occurrence of road accidents within the traffic accident prone areas.

The primary objective of the research is to investigate the causes of accidents within the traffic accident-prone areas and to provide the possible countermeasures on the road from Menagesha (Addis Ababa) to Ambo. Specifically, this study aims to identify the road stretch that is highly suspected to the occurrence of the accidents, determine the causes of the accidents, identify the time of the day at which most of the accidents happened and provide countermeasures or remedial measures to address the issue.

## 2 RESEARCH METHODOLOGY

### 2.1 Study Area

Menagesha-Ambo Road is located in Oromia Regional State of Central Ethiopian Highlands. The commencement and the completion date of this Asphalt road project were in the year 2002 and 2006 G.C, respectively. This road project implemented by West Showa Zone of Oromia Regional State in central Ethiopia. West Shewa Zone is bordered on the south by the Southwest Shewa Zone and the Southern Nations, Nationalities, and Peoples Region, on the Southwest by Jimma, on the West by East Welega, on the Northwest by Horo Gudru Welega, on the North by the Amhara Region, on the Northeast by North Shewa, and on the East by Oromia Special Zone Surrounding Finfinne. Its highest point is Mount Wanchi (3,386 meters); other notable peaks include Mount Menagesha and Mount Wachacha.It is the part of the road that connects Addis Ababa to Nekemte and Gambela. The total length of the road under consideration is 113Kms. This Road project was initially built in 1930's by Italians with base varying from 4m to 6m. In the 1950's and 1960's, the road was partially rehabilitated and upgraded to bitumen standard. The existing road of around 102km long passes through the Western Showa Zone in a westerly direction. The road passes through the principal towns of Holeta, Addis Alem, and Ginchi. According to the population census undertaken on 28/05/2007 E.C, the population number of Ambo wereda (110,796), Dendi wereda (170,233), Wolmera wereda (83,784) and Ejere wereda (89,168) and the land cover of each of the weredas are 949.46km2,

978.90km2, 656.05km2 and 581.04km2 respectively. Also, the road passes through some 33kms of hilly to mountainous terrain. The major towns such as Addis Alem, Holeta & Ginchi through which the road passes have a population of 8,447; 20,896 & 164,441 respectively. The road passes through 3.7kms of bushland, 21.3kms of built-up area, 35.6kms of farmland, 15.7kms of Re-afforested land & 42.1kms of grazing land. On the other hand, eighty-one percent of the road segment crossing farmland, and the remaining road segments are crossing built-up land and reinforced landing. Thirty-five of the road segment is also constructed by following a new route alignment.

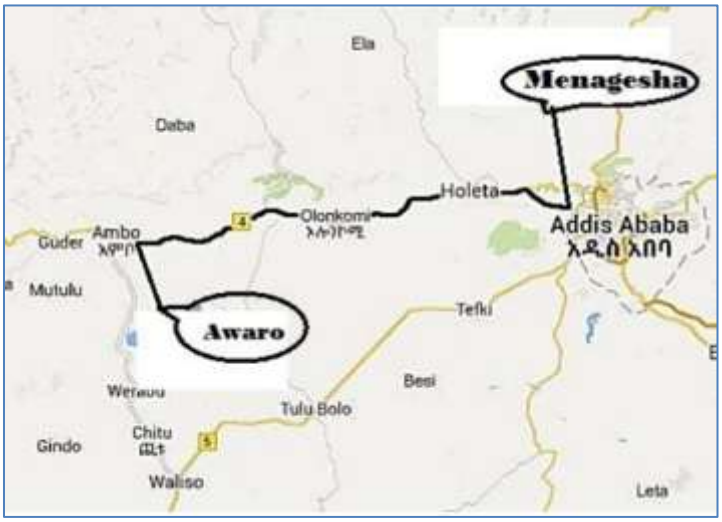


**Figure 2.1 Study Area of the Project (Source: Google 2017)**

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**2.2 Source of Data**

The primary data used in the study were field surveys through road safety audit. It was undertaken by site visiting the Traffic accident-prone areas using the prepared checklist. While, the secondary data was collected from the police stations within each wereda's, of which traffic accident records of 24 hours were noted. These data were recorded by copying the original data from the traffic accident records. In this study, the traffic accident data analyzed covering the year 2012-2015. These data were collected from Ambo wereda, Ejere wereda, Wolmera wereda, Holeta Town, and Dendi Wereda.

**2.3 Method of analysis**

The analysis was done using the Flemish government analysis method for traffic accident data. Based on these data, the following criterion was applied. First, each site within the last three years, three or more accidents have occurred is selected. Then, a site is considered to be dangerous when its calculated priority value (P) equals 15 or more, using the following formula [7].

P = X + 3*Y + 5*Z, where

X = total number of light injuries/Slightly injured persons/

Y = total number of serious injuries /severely injured persons/

Z = total number of deadly injuries/Fatal/

Since the accident numbers for Fatalities, Slight injuries, Severe Injuries are properly determined for Ejere wereda and Holota towns, the priority value of the Flemish government formula is used to rank black spot locations. But, due to unavailability of full data from traffic police stations which means, some of the data were blank from the 24hr traffic record. Accident frequency was used for Ambo Wereda, Dandi Wereda, and Wolmera Wereda. The final step determined the cause of accidents and the preparation of road safety audit checklist to provide countermeasures based on the site inspection.

## 3 ANALYSIS, RESULTS, AND DISCUSSION

**3.1 Characteristics of Road Traffic Accidents on the Road from Addis Ababa to Ambo (September 2012- 2015)**

A total of 271 accidents happened on the road from Ambo to Addis Ababa. This accident includes fatal, injury and property damage crashes. Figure 3.1 shows the location together with some accidents and the percentage of crashes for each area. It indicated that the highest rate of crashes occurred atHolota town.

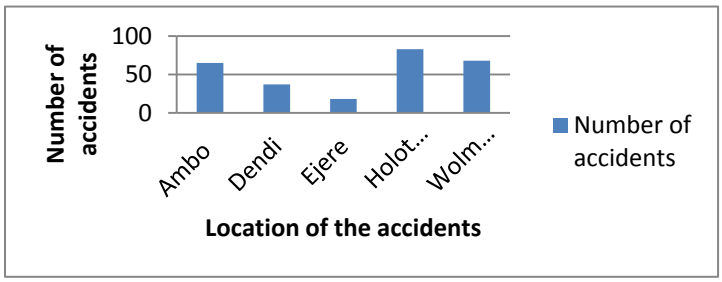


**Figure 3.1 Drivers age range vs. Type of accidents**

**Accidents by Driver Age**

Figure 3.2 shows the age range of the driver's together with the accident type. Most of the accidents which comprised of 39.53% under the unidentified category by the police officer. Next, it was drivers age ranges from 25-34 years of age, causing the 2nd highest percentage of accidents on the road from Ambo to Addis Ababa. This reveals that younger age group was suspected as the highest cause of accidents which must be given special attention.

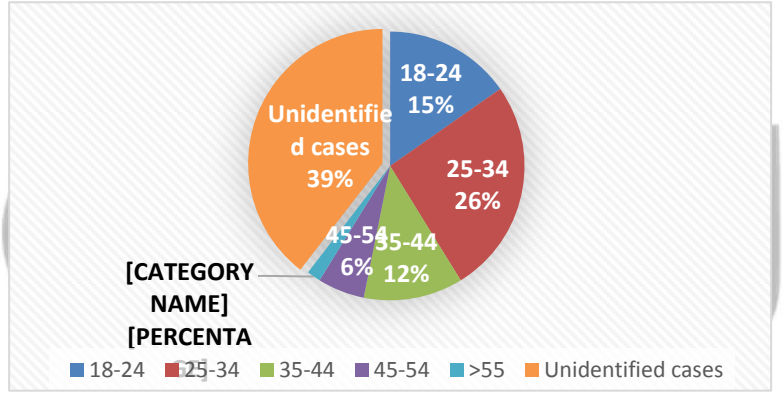


**Figure 3.2 Drivers age range vs. Type of accidents**

**Accidents by Vehicle type**

Table 3.1 shows that vehicle type together with a type of accident on the road from Ambo to Addis Ababa. This indicates that most of the accidents happened to cause by 4WD of about 23.92%, and followed by a Medium truck of 18.94%.

**Table 3.1 Vehicle Type Vs. Type of Accidents**

| Vehicle type | Fatal injury | | Injury | | Property damage | | Total | % |
|---|---|---|---|---|---|---|---|---|
| | Total | % | Total | % | Total | % | | |
| Motorcycle | 0 | 0.0 | 1 | 1.12 | 0 | 0.00 | 1 | 0.33 |
| Bajaj | 0 | 0.0 | 4 | 4.49 | 3 | 2.08 | 7 | 2.33 |
| Cars | 4 | 5.9 | 6 | 6.74 | 10 | 6.94 | 20 | 6.64 |
| 4WD | 8 | 11.8 | 32 | 35.96 | 32 | 22.22 | 72 | 23.92 |
| Small Buses | 2 | 2.9 | 5 | 5.62 | 3 | 2.08 | 10 | 3.32 |
| Large Buses | 1 | 1.5 | 2 | 2.25 | 0 | 0.00 | 3 | 1.00 |
| Small trucks | 3 | 4.4 | 4 | 4.49 | 7 | 4.86 | 14 | 4.65 |
| Medium truck | 12 | 17.6 | 12 | 13.48 | 33 | 22.92 | 57 | 18.94 |
| Heavy truck | 8 | 11.8 | 7 | 7.87 | 20 | 13.89 | 35 | 11.63 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Truck Trailers | 4 | 5.9 | 4 | 4.49 | 6 | 4.17 | 14 | 4.65 |
| Unidentified | 26 | 38.2 | 12 | 13.48 | 30 | 20.83 | 68 | 22.59 |

**Accidents by Time of the day**

Figure 3.3 shows the time of the day together with the injury of crashes. Based on the data gathered, most of the accidents happened during daytime, which was 6:00 AM to 9:00 PM. The highest number of accidents occurred between 12:01Noon to-3: 00 PM on the day.

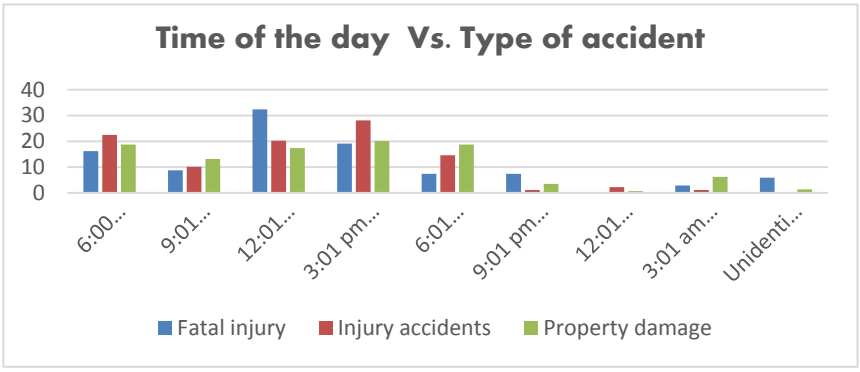


**Figure 3.3 Time of the day vs. Type of accidents**

**3.2 Priority Value in the Sampled Population**

The priority value is calculated based on a Flemish government formula which is P = X + 3*Y + 5*Z

Where:

X = total number of light injuries/Slightly injured persons/

Y = total number of serious injuries /severely injured persons/

Z = total number of deadly injuries/Fatal/

This formula was applied for two weredas to rank the accident-prone areas.

**I) Ejere Wereda**

A total of about eleven traffic accident-prone areas is identified within this weirdo. Table 3.2 shows that the calculated values of priority value based on fatalities and injuries for each accident-prone area. The highest priority value is recorded on Lega Berga Bridge with a priority value of 76, followed by Cirrii with a priority value of 15.

**Table 3.2 Identified Traffic Accident Prone Areas at Ejere Wereda**

| Accident prone areas | Fatalities | Injuries | | Priority value (P) |
|---|---|---|---|---|
| | | Slight | Severe | |
| Cirrii | 2 | 1 | 2 | 15 |
| LagaBerga Bridge | 3 | 6 | 11 | 76 |
| Beekkattee | 2 | 0 | 0 | 2 |
| Around Ejere Elementary School | 2 | | | 2 |
| Algawerash | 1 | | | 1 |
| Beekkattee | 1 | | | 1 |
| HoraaKarree | 1 | | | 1 |
| Around Salaalee | 1 | | | 1 |
| Kampii | | | 1 | 5 |
| Infront of Mika'el | 1 | | | 1 |

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| | | | | |
|---|---|---|---|---|
| Mobil | | 1 | | 3 |

**II) Holota Town**

A Total of about thirty-four black spot locations are identified within this wereda. Table 3.3 shows that the calculated values of priority value based on fatalities and injuries for each black spot locations. The result indicates that the more than 50 priority value is recorded in miizanaa(mizantabya), Lagahoolotaa, kruchery and in front of a golden hotel. However, there were accident-prone traffic areas which are recorded minimal, of which in this study, those locations are omitted.

**Table 3.3 IdentifiedTraffic Accident Prone Areas at Holota town**

| Accident prone areas | Fatalities | Injuries | | Property Damage | Priority value(p) |
|---|---|---|---|---|---|
| | | Slight | Severe | | |
| Condominium | 0 | 1 | 1 | 3 | 8 |
| In front of Golden hotel | 1 | 3 | 8 | 3 | 50 |
| Kruchery | 1 | 4 | 9 | 6 | 58 |
| Galaanee | 0 | 2 | 0 | 1 | 6 |
| Holota Bridge | 0 | 1 | 0 | 3 | 3 |
| Goldeen | 0 | 1 | 0 | 0 | 3 |
| Karaatuurii | 2 | 12 | 0 | 5 | 38 |
| Around Abayneh hotel | 0 | 2 | 0 | 0 | 6 |
| Around Flower Station | 1 | 7 | 0 | 4 | 22 |
| LagaHoolotaa | 2 | 7 | 7 | 2 | 58 |
| Mizanaa(MizanTabya) | 0 | 27 | 4 | 5 | 101 |
| Gabreelii | 1 | 7 | 14 | 3 | 92 |
| Sheelii | 0 | 0 | 3 | 1 | 15 |
| Around Hawi Hotel | 1 | 7 | 1 | 1 | 27 |
| SadamooKaraatoorii | 1 | 1 | 0 | 1 | 4 |
| Car training Station | 0 | 0 | 1 | 0 | 5 |
| Firii born | 0 | 2 | 0 | 1 | 6 |
| Infront of Itopy bank | 0 | 2 | 0 | 0 | 6 |
| Around Adifinyaa(park) | 0 | 2 | 0 | 1 | 6 |

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**3.3 Accident Frequency in the Sampled Population**

Accident frequency is applied based on an Australian government's formula, which takes into account the occurrence of accidents for the duration of the three-year period and it states that if more than three accidents happened in the last three-year period, then the site is considered as Traffic Accident prone areas. So that accident frequency value is determined for three weredas, and the locations are ranked based on this.

**1. Ambo Wereda**

A Total of about six accident-prone areas are identified within this wereda. Table 3.4 shows the list locations together with accident frequency and the rank orders. From the total accidents occuredMacawacan, Awaro, Mininii, and Bayokurbiranked from one to three, while Meti town ranked lowest.

**Table 3.4 Identified Locations at Ambo Wereda**

| Accident Prone Areas | Accident frequency | Rank |
|---|---|---|
| Makawacan | 20 | 1 |
| Awaro | 12 | 2 |
| Minini | 10 | 3 |
| Bayokurbi | 10 | 3 |
| Meti | 2 | 4 |

**2. Dendi Wereda**

A Total of thirty Traffic accident-prone areas is identified within this weredo. Table 3.5 shows the list locations together with accident frequency and the ranked order. Other places omitted due to its minimal impact on accidents. From this, there were seven accident locations happened twice in the last three years while different locations, the accident occurred only once.

**Table 3.5 Identified Traffic Accident Prone Areas at Dendi Wereda**

| Accident Prone Areas | Accident frequency | Rank |
|---|---|---|
| Telle | 2 | 1 |
| Around Secondary High school | 2 | 1 |
| Around Mazorya | 2 | 1 |
| LegaJamjam | 2 | 1 |
| LegaDerabbah | 2 | 1 |
| Around Bacho mountain | 2 | 1 |
| DannoEjersaGibee | 2 | 1 |
| Jaldumazoriya | 1 | 8 |
| Huluko | 1 | 8 |
| Michitu | 1 | 8 |
| Fakkarees | 1 | 8 |

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3. **Welmera Wereda**

Table 3.6 shows the list of blackspot locations together with accident frequency and the rank orders. The result indicated that there were forty-six or more than 90% of accidents frequently happened in the last three years at Menagesha. This location represents the highest occurrence of accidents which must be cross-examined the condition of the road.

**Table 3.6 Identified Traffic Accident Prone Areas at Wolmera Wereda**

| Accident Prone Areas | Accident Frequency | Rank |
|---|---|---|
| Menagesha | 46 | 1 |
| Talaca | 3 | 2 |
| Suba | 2 | 3 |
| Robgebya | 1 | 4 |
| Markos Station | 1 | 4 |
| WalmeraCooqaa | 1 | 4 |
| Asgorii | 1 | 4 |

**3.4 Locations of Hazardous location**

Finally, after the priority value and the accident frequency are determined, each site within the last three years, three or more accidents have occurred was selected. Then, a place is considered to be dangerous when its priority value (P) equals 15 or more. Based on the findings of the study, thirteen hazardous locations are prioritized from all selected sites.

A total of thirty traffic accident-prone areas identified on the road from Addis Ababa to Ambo. From the total accidents, three are

from Ambo wereda, two are from Ejere wereda, and seven locations are from Holota town. Table 3.7 shows the list of identifying traffic accident prone areas together with their rank orders within each wereda.

**Table 3.7 Identified Traffic Accident Prone Areas, Ambo to Addis Ababa**

| Accident prone areas | Rank | |
|---|---|---|
| Makawachan/BayoKurbi | 1 | Ambo wereda |
| Awaro | 2 | |
| Minini | 3 | |
| Legaberga Bridge | 1 | Ejere Wereda |
| Chiri | 2 | Ejere Wereda |
| Menagesha | 1 | Welmera Wereda |
| Mizana(MizanTabya)/Gabrel | 1 | Holota Town |
| LegaHolota | 2 | |
| Kruchery | 3 | |
| In front of Golden hotel | 4 | |
| Karaturi /Around Flower Station/ | 5 | |
| Around Hawi Hotel | 6 | |
| Shell | 7 | |

**3.5 Causes of Road Traffic Accident at Hazardous Locations**

The cause of an accident is determined based on the traffic accident data collected from the traffic police stations.

**1. Ambo Wereda**

A Total of four causes of accidents is identified in this weredo. Table 3.8 shows the cause of accidents with the number and percentages of each of the causes of the total. There were 69% of the accidents due to over speeding, 28% due to driving without attention, 2% due to failure in a vehicle and unidentified cases.

**Table 3.8 Cause of accidents in Ambo wereda**

| Cause of accident | Number | % |
|---|---|---|
| Overspeeding | 45 | 69 |
| Driving without attention | 18 | 28 |
| Unidentified | 1 | 2 |
| Failure in vehicle | 1 | 2 |
| Total | 65 | 100 |

**2. Dendi Wereda and Ejere Wereda**

Total of Eight causes of accidents is identified in this wereda. Results show that the cause of accidents with the number and percentages of each of the causes of the total. Ten percent of the accidents were due to Driving without attention&overspeeding, 6% was due to Failure to give-way for Pedestrians, while 5% were due to Driving without attention, and 9% unidentified cases by the traffic police. On the other hand, a total of three causes of accidents is identified in Ejere wereda. Table 3.9 shows the cause of accidents with the number and percentages of each of the causes of the whole, of which 44% of the accidents happened due to Driving without attention, 6% due to Failure to give-way for vehicles and 50% of the accidents not identified by the traffic police.

**Table 3.9 Cause of accidents in Ejere wereda**

| Cause of Accident | Number | % Of Total |
|---|---|---|
| Driving without attention | 8 | 44 |
| failure to give away for vehicles | 1 | 6 |
| unidentified | 9 | 50 |
| Total | 18 | 100 |

**4. Holota Town**

A Total of sixteen causes of accidents are identified in this Wereda. Table 3.10 shows cause of accidents with the number and percentages of each of the causes from the total. There were 20% of crashes happened due to overspeeding,24% due to Driving without attention, 10% due to Following too closely,9% due to Failure to give away for pedestrians Pedestrians**,** 5% due to Others, 4%

due to (Driving with fatigue, & Failure to give-way for vehicles),3% due to (Over speeding& Driving without attention, Influence of alcohol or drug & Improper overtaking) and 1% due to (Improper Turning, Failure to respect Traffic sign, Pedestrian Error, Excess Loading & unidentified cases by the police).

**Table 3.10 Cause of accidents in Holota Town**

| Cause Of Accidents | Number | % |
|---|---|---|
| Overspeeding | 20 | 26 |
| Driving without attention | 19 | 24 |
| Driving with fatigue | 3 | 4 |
| Failure to give away for Pedestrians | 7 | 9 |
| Following too closely | 8 | 10 |
| Failure in vehicle | 3 | 4 |
| Inability to give away for vehicles | 3 | 4 |
| Others | 4 | 5 |
| Over speeding& Driving without attention | 2 | 3 |
| Influence of alcohol or drug | 2 | 3 |
| Improper Turning | 1 | 1 |
| Failure to respect Traffic sign | 1 | 1 |
| Pedestrian Error | 1 | 1 |
| Improper overtaking | 2 | 3 |
| Unidentified | 1 | 1 |
| Excess Loading | 1 | 1 |
| Total | 78 | 100 |

### 3.6 Measures to Minimize the Road Traffic Accidents in Hazardous Locations and Features of the locations

On the next step, the checklist is prepared to collect road condition data on traffic accident prone areas. The accident-prone areas are evaluated using the same evaluation criteria. The criteria based on ERA road and safety manual on 2001, as well as road safety and Audit guide for rural roads (Rural roads Project-1). The countermeasure is provided by site visiting the accident-prone areas with traffic officers (police inspectors) using the checklist. The road configuration of the area is properly observed, and the sample images were taken at each accident area.

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**a) Holota town**

**Gabreelii/Mizanaa/**

This location is found around Ethiopian road authorities size and weight control station. Its location is in town section. The countermeasure that should be applied on this road is: - Edge side and Central traffic marking should be painted. Also, Island should be provided in the intersection area. The sufficient pedestrian walking lane should be provided and also speed limit post should be installed.

Figure 3.4 Gabriel Existing Road Condition

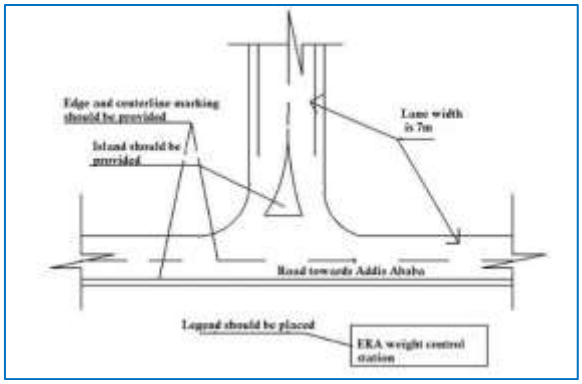


Figure 3.5 Gabriel after Countermeasure applied.

**LegaHolota (Around 27.5km from Addis Ababa)**

The countermeasures that should be undertaken are the removal of the obstruction from the curve; the road width should be widened because it does not accommodate the existing traffic volume, Centerline pavement marking should be provided, because the existing ones are already removed (faded). Since the road is with steep gradients, the proper speed limit post should be installed

along the road, and finally, Roadside Delineator should be established that guides vehicles move along the curve.

**Crushery (approximately 33km from Addis Ababa)**
Likewise, the countermeasures that should be applied are similar to the previous countermeasures except for the existing shoulder which must rehabilitate.

**Infront of Golden Hotel**
Within this road section, the countermeasure that should be applied is: a) Provision of Roadside Delineator to guide vehicles negotiating the horizontal curve, b) Since the stretch is with the steep gradient and the sharp curve, guardrail should be provided along the curve, c) Removal of obstruction from the roadside.

**Karaturi**
The road is found in front of the Ethiopian Medious PLC. And the most of the road stretch is flat and with the absence of horizontal curve.
The countermeasure that should be applied is a) The longitudinal length of the road is very long and flat (around 700m long), that vehicles always speed up to overtake other vehicles so that speed limit post should be provided, b) The original pavement markings are already fading. Therefore, it must be repainted, and c) The remarking the existing roadside pedestrian was walking lane.

**Around HawiHotel**
The countermeasures that should be implemented are: a) since it is broken back type of curve, proper traffic sign should be installed along this curve, b) The lane width is not enough, and there is also pavement deterioration along the road so that the pavement should be rehabilitated and also the pedestrian walking lane should be provided, c) The route is with very steep gradient, so that speed limit post should be installed d) The horizontal curve radius is very big that guard rails should be installed along the road.

**Shell**
The countermeasures that should be applied are: a) half lane of the pavement is entirely deteriorated, and vehicles leave their way in order to use the half asphalt, so that it must be rehabilitated, b) Enough shoulder width should be provided along the road, c) Pavement markings are not visible, so that the pavement marking should be repainted, both centerline and edge markings.

**MENAGESHA**
There are two sites identified as traffic accident-prone areas or hazardous inside Menagesha town, one at approximately 22km and the other at 20km from Addis Ababa respectively. The most stretch of the road configuration of Menagesha is covered with more than 13 horizontal curves and in connection with this; this road is a very congested type of road while viewing the traffic characteristics.

**i) At approximately 20km from Addis Ababa**
The countermeasures that should be applied are: a) Pedestrian walking lane should be provided; b) The length between the curves is so small that it needs design revision, c) The centerline marking should be re-painted, d) Speed limit post should be installed, e) There are obstructions inside the curve, so that blockage should be cleared.

ii) **At approximately 22km from Addis Ababa**
The countermeasures that should be undertaken: a) the lane width is not sufficient, so that it should be widened, b) There are Equilaptus trees surrounding the curve that obstructs the vision of the drivers, so that it should be cleared, c) There is a steep gradient along the road stretch so that speed limit posts should be installed along the road, d) There is already existing concrete roadsideDelineator but it was damaged by accidents, therefore, repair should be done.

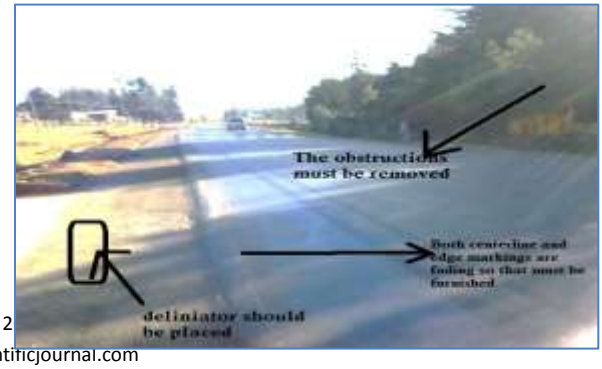

Figure 3.6 Menagesha Existing Road Condition

Figure 3.7 Menagesha after countermeasure applied.

**b) AMBO WEREDA**

**WacanMazoriya**

The countermeasures that should be undertaken are: a) Roadway width should be increased, b) proper guardrail should be installed, c) Climbing lane should be provided to assist the faster moving vehicles to pass, d) There is steep gradient, so that speed limit posts should be installed, e) Pavement marking is faded, so that it should be re-painted, f) There is the problem of Mis- phasing so that, the design should be reviewed.

Fig 3.8 Wacan Mazoriya Existing Road Condition

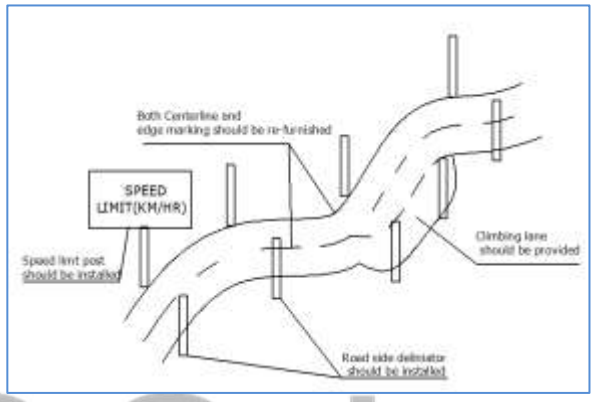


Fig 3.9 Wacan Mazoriya after countermeasure is applied

**Awaro**

The curve is broken following type of curve, so it needs design revision, pedestrian walking, Speed limit post and curb should be provided since it is an entrance to town section, a Roadside landscape should be leveled to flat, Obstructions inside the curve should be removed, Roadside Delineator should be placed.

**Miniinii**

The obstruction inside the curve, which obstructing the driver's vision must be removed. The existing guard rail is not functioning and sufficient along with the left side so that it should be re-installed, and Traffic signs are needed inside the curve.

Figure 3.10 Minini Existing Road Condition

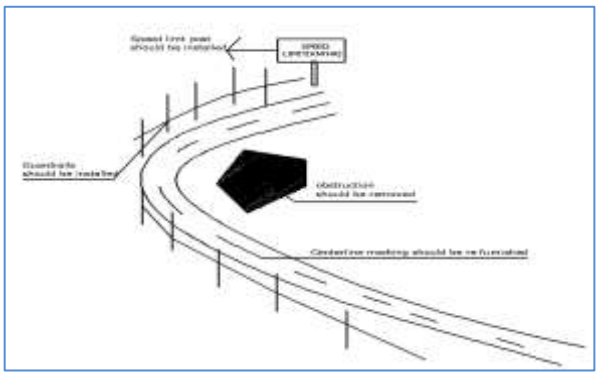

Fig 3.11 Minini after Countermeasures applied

**c) DANDI WEREDA**

**Lega Berga (46km from Addis Ababa)**

Pavement is deteriorating along the road stretch, so it should be rehabilitated. Speed limit post should be installed. Clearing of trees along the line of sight should be taken. Repainting of Centerline was marking, and provision of the climbing lane is needed, supporting slow moving vehicles and give-way for faster moving vehicles.

**Chiri (Around 39km from Addis Ababa)**

Obstruction near the curve should be removed (trees are around). Speed limit posts should be installed. Since the shoulder width is not sufficient should be increased. Road side Delineator should be installed along the road.

Figure 3.12 Chiriexisting condition

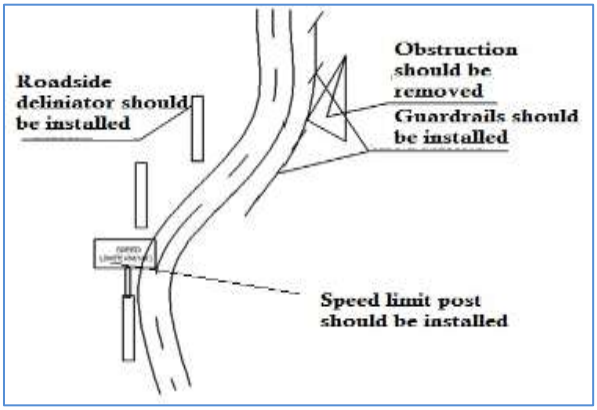


Figure 3.13 Chiri after countermeasure applied

**4 CONCLUSION**

Road safety audit and traffic data analysis from September 2012-2015 were gathered in the road corridor. Based on the available data, priority value and accident frequency were used to rank the traffic accident prone areas. Priority value was used for Ejere Wereda and Holota town, while Accident frequency used for Ambo Wereda, Dendi Wereda, and Welmera Wereda. Results indicated that Makawacan/Bayokurbi, Minini, LegabergaBridge, Chiri, Menagesha, Legaholeta, Kruchery, Infront of Golden Hotel, Karatury, Around Hawi Hotel and Shell were the traffic accident-prone areas along Addis Ababa to Ambo road. The condition of the identified road sections have a problems of insufficient lane width, unimproved roadside, an absence of climbing lane, an absence of the roadside Delineator, fading of pavement marking and the absence traffic signals. Due to this, the accidents that happened within the traffic accident-prone areas occurred between 12:00NN-3: 00 PM on the day, representing a majority of the accidents incurred by the age group between 25 and 34 such as overspeeding, and driving without attention.

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