Identification and Improvement of Accident Black Spots on N.H.86 District Sagar, Madhya Pradesh

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ABSTRACT: *Many developing countries including India have a serious road accident problem. Road accident may involve property damage, personal injury or even causalities. "The location in a road where highest number of road accidents occurs is called a Black Spots" The main objective of this study is to provide safe traffic movement, "Accident are not Natural but they are caused" is a common cliché in the area of traffic safety. This case study based on road accident of National Highway-86 which is from Sagar to Shahgarh (76km) of district Sagar (M.P.). A large number of accidents have been occurring over such a section of 76 km length because in this section have some hazardous location or accidental black spots. The accidents are due to human error and road parameters such as improper design of road section, bad shoulder, and design of junction, sharp curves and other factors. In this study attempts to identify the most vulnerable accident black spots using weighted severity index (WSI) methods and also provide suggestion for improvements of spots. The study includes collection of data and prioritizing the accident prone location by using weighted severity index (WSI) methods. WSI method follows a system of assigning scores based on the number and severity of accidents in that particular location in the last few years. So the main objects of this study identify black spots and improvement in it.*

Key Words: Accidental Black Spot, weighted severity index (WSI).

1. INTRODUCTION

The problem of accident is very acute in Highway transport, due to complex flow pattern of vehicular traffic presence of mixed traffic and pedestrian, also due to human error or road parameters. Road accidents are the major cause of property damage, death and injuries worldwide. The basic elements in traffic accidents are road Users, vehicles, Road condition road geometry and environmental factor. Road accidents cannot totally prevent/stop, but by using suitable traffic engineering, management measure and better safety plan, so road accident rate can be decrease.

According to The Ministry of Road Transport & Highway {MORTH}-2015, Road accident are now globally recognized as a serious public health problem, the problem much more serious in our country where dose to 5,00,000 road accident caused nearly 1,46,000 deaths and left more than thrice that number injured, during 2015. The numbers of vehicle are increase due to the growth of population and growth of Technology/Automobile, which cause road accident increase, the economic losses due to Road accidents in India are over Rs 100 billion per year.

"The location in a road where the Traffic accidents often occur is called a Black spot". The Identification of location, analysis and treatment of Road accident black spots are widely regarded as one of the most effective approaches to road accident prevention. Black spots become a place on road that is considered to be dangerous because several accidents have happened there, Road accident happened their because of many reasons such as a sharp curves in a straight road, so oncoming traffic is concealed, if designs of junction are not proper on a fast road. Poor warning signs board at a road junction. Accident black spots can be improved by speed restrictions, Proper sign board and improving sightlines straightening bends etc.

In Madhya Pradesh in last year 54947 accidents occur in which 9314 persons died and 55815 Persons injured in 2015. Road accident on National Highways has gone up by 3.2 per cent from 1, 37,903 in 2014 to 1, 42,268 in 2015, Persons killed on National Highways has also gone up by 7.5 per cent from 47,649 in 2014 to 51,204 in 2015. The major causes of road accidents are road condition and its parameter design are not good and also drunken drive careless/rush driving over speeding etc.

The present study aims to identify accidental black spots on a section (sagar to shahgarh) of NH-86 by studying the accidental data provided by Police station during last five years. In this study identification of black spots by using weighted severity index {WSI} and Accident Density method {ADM} and during this study basic causes of accidents were found out and suitable remedial measures were also provided for a particular spots.

1.1 SCOPE AND OBJECTIVES -

The objectives of the study can be given specifically as the following:-

I.   To collect Accident data regarding NH-86 (Sagar to Shahgarh 76 km) from concerned Police stations last five years (20012, 2013, 2014, 2015 & 2016).

II.   To find out different methods for hazardous locations.

III.   To identify various traffic and road related factor causing accidents.

IV.   To carry out analysis of black spots using WSI methods, also determine Frequency of Road Traffic Accidents.

V.   Identification of each spots also best suited improvement for each black spot.

VI.   To carry out detailed analysis of top ranked black spots and provides suggestion for improvement of spots.

2. AREA OF STUDY

The 76 km Stretch of the NH-86 between (Sagar to Shahgarh) in district sagar , Madhya Pradesh was selected for the study. Some feature of this stretch at National highway is given below:-

1)   The entire stretch is two line national highways.

2)   Road surface is Asphalt.

3)   No divider at this stretch/Highway.

4)   Speed limit at some Section/Location is 40 km/h.

5)   There is no lighting at Junction, Turing and Inter-section.

6)   No Toll booth, No Truck lay-By's

7)   Hard Solder was not proper at turning and curve.

2.1 Site Investigations -

A visit to the site is normally a necessary part of the diagnosis this visit has give a lot of detailed information about characteristic of road such as road section, road Junction, surface and road condition, also information about identified accidental black spots, available traffic volume, traffic obstruction and sign board at road etc.

3. METHODOLOGY

The following detailed methodology has been adopted for obtaining the various aspect of this study. There are some following steps involved in this methodology, few steps can make easier of study work.

3.1 DATA COLLECTION

In this study brief detailing about the Data collection is given in two sections. Primary data and secondary data were collected for study work. Data collection work is a huge and laborious work.

A) - Primary Data.

B) - Secondary Data.

A) Primary Data –

A. Detail of road inventory.

B. Signage inventory.

Details of Road Inventory - Road inventory includes various information about road section such as Name of the road, Length of the road, Type of the road (Rigid or Flexible pavement), carriageway width and shoulder width of road.

1)   Name of the road – Sagar To Shahghar – NH-86 76 km.

2)   Length of the Road – 76.0 km.

3)   Road carriageway width – 7.0 to 7.5 meter (Double Line) and both side shoulder.

4)   Types of Road – Road is Flexible pavement type i.e. Bitumen road.

5)   Bridges & Culverts – All Structures are good conditions.

Signage Inventory – Traffic Signs are very impotent elements of road/National highway because traffic signs guide, warn and inform to drivers for the safely and efficiently movement on road. In this inventory survey we absorbed about signage board likes types of sign board, condition of board and proper position of its.

B) Secondary Data-

In this data collection includes the collection of require accident record last five years from concerned Police department. So Road accident Record of NH-86 (Sagar to Shahghar Section) during 2012 to 2016 (last five years) was collected from Office of the Superintendent of Police Distt. Sagar (MP) and also inquiry about accident cause to police staff of nearest police station and local people. This data are used for identified top ranked black spots. Detail description of all Accident data in below table.

Table no. 01 Report Road Traffic Accidents Data [2012- 2016]
Source: Office of Superintendent of Police Dist- sagar (MP)

YEAR	ACCIDENT DETAILS	CHHAPRI TURN	BRA TIRAHA	DALPATPUR GRAM	RURAVAN TURN	GANESHPURA AREA	IMLAKHEDA TURN	CHHANBEEA	PATHANBALI GHATI
2012	TOTAL NO ACCIDENT	**14**	**12**	**29**	**4**	**2**	**5**	**2**	**15**
	DEATHS	5	1	2	1	0	1	0	4
	SERIOUS INJURY	20	10	11	5	3	6	2	21
	MINOR INJOURY	7	12	15	7	5	10	3	12
2013	TOTAL NO ACCIDENT	**9**	**11**	**18**	**6**	**2**	**7**	**2**	**12**
	DEATHS	2	0	3	2	0	0	0	3
	SERIOUS INJURY	11	7	13	7	2	9	2	18
	MINOR INJOURY	8	10	23	5	4	13	3	9
2014	TOTAL NO ACCIDENT	**11**	**8**	**15**	**3**	**4**	**5**	**7**	**19**
	DEATHS	5	0	4	0	0	2	1	5
	SERIOUS INJURY	14	13	10	2	5	7	3	27

	MINOR INJOURY	13	9	11	6	7	11	4	15
2015	TOTAL NO ACCIDENT	**15**	**7**	**26**	**4**	**7**	**8**	**3**	**16**
	DEATHS	10	1	6	1	3	1	1	7
	SERIOUS INJURY	18	9	17	5	12	9	4	21
	MINOR INJOURY	18	11	12	9	10	15	5	14
2016	TOTAL NO ACCIDENT	**18**	**11**	**23**	**3**	**3**	**10**	**4**	**20**
	DEATHS	8	0	3	2	0	1	0	11
	SERIOUS INJURY	22	5	23	7	2	6	9	31
	MINOR INJOURY	15	13	20	5	5	19	7	19

3.2 ANALYSIS OF DATA

In this section, analyzed each type of collected data like Primary and Secondary data. First of all analysis of secondary data and using weighted severity index methods for identifying accidental black spots at this study stretch than analyzed primary data.

3.2.1 Analysis of Secondary data

The main objective of analysis is to determine the probable accident-prone zones in the considered road stretch of NH-86. Secondary data was collected for the study. Secondary data collection includes the collection of road accident data for the past five years (2012-2016) from the concerned police department and this accident data was analyzed by using weighted severity index method (WSI). "This severity method assigning scores based on the number and severity of accidents in that particular location at road in the last minimum 3 years". The number of casualties was into three degree of severity such as the fatality, serious injury and slight injury. Weighted of any accidents is based on the characteristic of accident such as location of the accident, number of person injured and number of person die in accident

(a) Severity of that accident is classified as Grievous Injury (GI), Fatal (K) and Minor Injuries
(MI).

(b) WSI value is calculated by the following formula

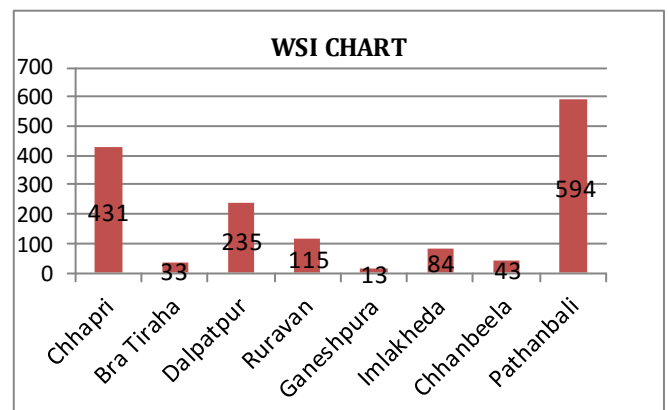$$WSI = (41 \times K) + (4 \times GI) + (1 \times MI)\dots\dots\dots Eq.(1)$$

Where- K is the number of persons killed.
GI is the number of grievous injuries.
MI is the number of minor injuries.

Sample calculation of location wise accident data by using WSI formula, Accident data put in formula from table no(1) than we determine WSI value of each location.

Location – CHHAPRI TURN-

WSI value in 2012 = (41 x 5) + (4 x 20) + (1 x 7) = 292
WSI value in 2013 = (41 x 2) + (4 x 11) + (1 x 8) = 134

WSI value in 2014 = (41 x 5) + (4 x 14) + (1 x 13) = 274
WSI value in 2015 = (41 x 10) + (4 x 18) + (1 x 18) = 500
WSI value in 2016 = (41 x 8) + (4 x 22) + (1 x 15) = 431

Table No. 02: Weighted severity index of given locations

Location	Road Traffic Accident per Year					Total	(%) Share
	2012	2013	2014	2015	2016		
CHHAPRI TURN	14	9	11	15	18	**67**	16.75
BRA TIRAHA	12	11	8	7	11	**49**	12.25
DALPATPUR GRAM	29	18	15	26	23	**111**	27.75
RURAVAN TURN	4	6	3	4	3	**20**	5.00
GANESHPURA	2	2	4	7	3	**18**	4.50
IMLAKHEDA TURN	5	7	5	8	10	**35**	8.75
CHHANBEELA	2	2	7	3	4	**18**	4.50
PATHANBALI GHAT	15	12	19	16	20	**82**	20.50
			TOTAL			**400**	100.0

Fig 01. Weighted Severity Index value Chart

3.2.2 General Characteristics of Road Traffic Accident {RTA} in Sagar To Shahgarh Road Section of N.H-86 :-

According to Road accident data from the year 2012 to 2016. Frequancy of road traffic accident at selected locations of study area given.

Table-3, Variation of Road Traffic Accident Frequency

Sn	Location	2012	2013	2014	2015	2016
1	CHHAPRI TURN	292	134	274	500	431
2	BRA TIRAHA	93	38	61	88	33
3	DALPATPUR GRAM	141	198	215	326	235
4	RURAVAN TURN	68	115	18	70	115
5	GANESHPURA	17	12	27	181	13
6	IMLAKHEDA TURN	75	49	121	92	84
7	CHHANBEELA	11	11	57	62	43
8	PATHANBALI GHAT	260	204	328	384	594

Fig 02. Road Accident Percentage (%) share Chart

R.T.A VARIATION CHART
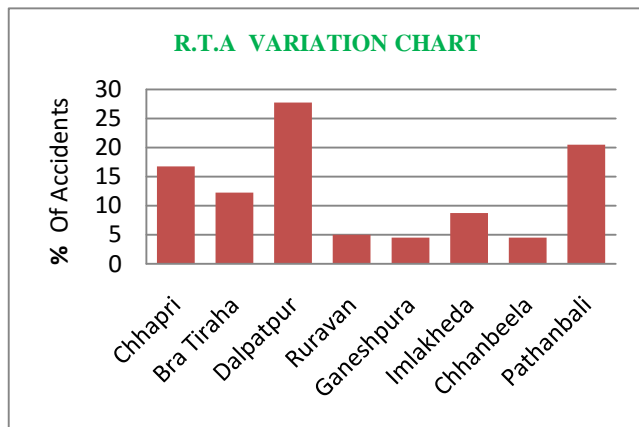
A comparison was made based on the Road Traffic Accident {RTA} occurrence between Sagar to Shahgarh study stretch of NH-86. based on the findings of this research study. There were 111 (27.75%) out of 400 accidents occurred in Dalpatpur Gram and its extension from 2012 to 2016. Pathanbali Ghat and Chhapri Turn had shared 82 (20.50%) and 67 (16.75%) accident respectively. The most vulnerable location of road traffic accidents happened in the mountainous and escarpment due to road design problems such as insufficient sight distance and width of road, sharp curve, Poor condition of carriageway, missing sign board, missing and uneven shoulder, cattalos at road, deficient and damaged road pavement marking.

3.2.3   Analysis of Primary Data collection –

➤ Road Inventory Survey :-

A detailed Road inventory survey was carried out on the entire identified spots to measure the roadway geometric parameters like width of roadway, width of the carriageway, width of footpath, median, shoulder condition, type of carriageway, surface condition and obstruction on road side or edge.

All the study stretche of sagar district are National Highway - 86. From the road inventory survey it is observed that the carriageway width of all stretches varies from 7 m. to 8 m. It is not sufficient for huge traffic and existing width is not satisfying the standards of National Highway.

In Dalpatpur, Bratiraha stretches there is no median for differentiating the direction of traffic. It may cause head collision and Wight-Time road accident due to glare problem.

In Beela, Ruravan stretches of carriageway we observed poor condition of bituminous surface because rain water overtop to become at this portion, there have not proper drainage system,

In Imlakheda, Pathanwali, Chhapri turn stretches of road under come mountain part or hilly portion which causes insufficient sight distance for vehicles at road,

➤ Signage Inventory :-

Traffic Signs are very important elements of road/National highway because traffic signs guide, warn and inform to drivers for the safety and efficiently movement on road. In this inventory survey we absorbed that no traffic lights at whole study area, even not provide at junction also missing sign boards, poor road marking, and metal crass barrier totally damage by vehicles collision same condition of road declinators,

So regular maintenance should be required in all above defects in road furniture's and provide safety for all road users. Road furniture likes road marking; road signs board, and road delineator etc are very important elements.

➤ Existing Road Problem & Road side hazard checklist during site visit:-

A. Existing Road Problem	
1	Some places Shoulder missing
2	Shoulder uneven and too narrow
3	Carriageway too narrow
4	Carriageway Asphalt defects
5	Improper median opening
6	Limited sight distance
7	Improper pedestrian crossing
8	Too small radius of horizontal curve (sharp curve)
9	Improper Drain at mountainous area
10	Missing Road marking at some stretch
B. Road side Hazard	
1	Guardrails missing
2	Improper bus Stop location
3	Damage sign board
4	No parking Place in urban area
5	No Footpath & Lighting in Urban area

4. RESULT AND DISCUSSION

Based on the analysis of accident data using Weighted Severity Index Method {WSI} and road traffic accident rate method top five black spots along the national highway (NH-86) is determined.

Table No.04: Result showing Top Five Black spot

Rank	Accident Black Spot Location
1	PATHANBALI GHAT
2	CHHAPRI TURN
3	DALPATPUR GRAM
4	RURAVAN TURN
5	IMLAKHEDA TURN

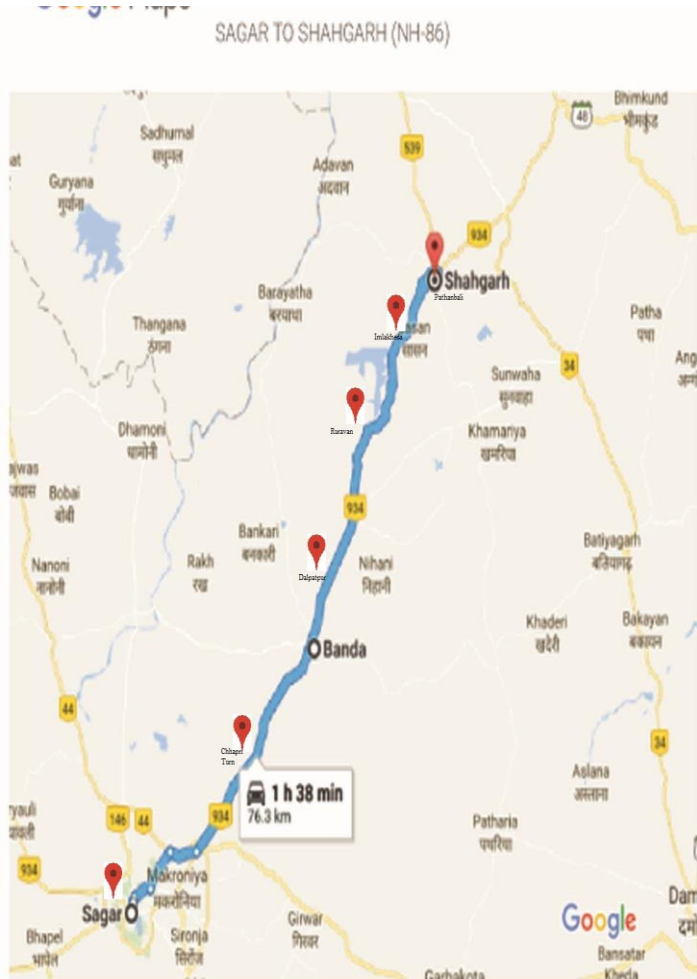Fig 03.Study Area from selected Road{ Sagar To Shahrarh}
Source: Google map

1. PATHANBALI :-

This is identified as the most vulnerable accident stretch on Sagar-Sahgarh (N.H-86) in dist. sagar, This stretch under uneven Mountain terrain , One side of this stretch deep ditch and other side large stones of mountain. This existing road was constructed on sidle of mountain, there have a following some deficiency:-

1) At this High Gradient which cause Break down/ Break fails and other mechanical problem cleat in heavy vehicles, vehicle uncontrolled them.

2) There have a very sharp curve.

3) No Guard rail & improper sign board. Improper retaining wall at curves also no Extra winding.

4) No proper Marking, road delineators and lighting.

5) No drainage system which causes rain water flow over to carriageway than create in this condition stripping and slipping, Damage shoulder.

Fig1.1 Pathanbali Accident locations.
Source: Site visit photography.

Suggestion:-

1. Maintain Gradient according to NH IRC standards.

2. Provide Extra winding at Sharpe curve**.**

3. Remove/Cutting Large & Heavy stone from shoulder.

4. Provide Hard shoulder in Proper width.

5. Increase curve radius.

6. Provide Proper Road marking and road delineators.

7. Provided speed limit, warning and mandatory signal**.**

Fig 1.1: Suggestions for Improvement Pathanbali Location.

2. CHAPRI TURN: -

This is second top most vulnerable accident stretch on road section, two bland turn very close at this spots and old trees and mountain of road side which cause of other vehicles front rear collusion at turns.

1) Uneven shoulder also improper width.

2) Inadequate super elevation design at curves.

3) No extra winding.

Fig 1.2 Suggestions for Improvement at Chapri Turn location.

3. DALPATPUR :-

The accident stretch identified in Dalpatpur village. This stretch under come of NH-86. There have not any other bypass for passing of vehicles. All heavy load passenger vehicle pass into Dalpatpur village and market, shops, schools, bank, office & other public place established both sides of road which cause many accident problem create at this stretched.

1) There have not bus stop all passenger bus stay on road and all passengers move over the carriageway i.e. improper bus stop location.

2) Improper pedestrian crossing.

3) Most of the vehicles are parked on the road itself which leads to traffic jams.

4) Footpath is not provided on either side.

Fig 1.2 : Chhapri Turn Accident locations.
Source: Site visit photography.

Suggestion:-

1) Remove & Cutting of tree and other obstruction form road side, increase sight distance.

2) Provide Hard Shoulder both side of Road.

3) Redesign the super elevation because as compare to the left side maintain as per Indian practice the super elevation is limited to 0.07-0.10.

4) Also provide extra winding at curve.

Fig 1.3, Dalapatpur Gram Accident locations.

Suggestion:-

1) Provide separate bus bay's.

2) Provide footpath on both sides of the road for safety of pedestrians.

3) Provide the zebra crossing near bus stand. Public place and junction for safe crossing of the pedestrians.

4) Provide parking so that vehicles cannot stand on side of road.

5) Provide awareness about traffic rules for public

4. IMLAKHEDA :-

At this top vulnerable accident spots, Horizontal curve of very small radius is constructed on the hilly portion of rood, which cause loaded and high speed vehicle become uncontrolled at turn,

1) Too small radius of horizontal carves.

2) Cross barrier to totally damage.

3) No proper road marking and road declinator.

4) No lighting and sing boards at turn.

Fig 1.4 Imlakheda Turn Accident locations.
Source: Site visit photography.

Suggestion:-

1) Increase radius of horizontal carves, also maintain super elevation.

2) Provided proper cross barrier.

3) Provided road marking, and Road declinators.

4) Remove & Cutting of tree and other obstruction form road side, increase sight distance.

Fig 1.4 Suggestions for Improvement at Imlakheda Turn locations.

5. RURAVAN TURN :-

This Black Spots identify near Rooravan village.

1) Therefore called Rooravan Turn.

2) Inadequate super elevation design at curves.

3) No extra winding of both side of Road.

4) No Proper cross barrier.

Fig 1.5 Ruravan Turn accident locations.
Source: Site visit photography.

Suggestion-

1) Increase radius of horizontal carves, also maintain super elevation.

2) Provided proper cross barrier.

3) Provided road marking, Road declinators.

Fig 1.1 Suggestions for Improvement at Ruravan Turn locations.

5. CONCLUSIONS

The Identification and analysis of accident black spots help in identifying the stretches where accident are more and these spots reduce road safety in general. The spots on road where traffic accidents frequently occurred are termed as black spots. Present study was an attempt to find out most vulnerable accident spots at section sagar to shahgarh of national hirgway-86 Distt. sagar MP.

The Weighted severity index method and Road Traffic Accident {RTA} frequency was used to rank the accident locations on selected section of national highway-86. The top five spots were selected as black spots as per WSI value from the collected road traffic accident data and suggest some possible measures improve the transportation system. The overall methodology was found to be effective for the identification, evaluation and treatment of accident black spots if sufficient data is available.

This study carried out two critical data one was road accident data and other was a road geometric data. Road accident data was collected from Police department, this data are used to briefly describe general characteristics of the road accidents like accident location, number of accidents per year, number of person die and number of person injured. Road geometric data collected from field survey this data describe wide range of road geometric design elements and its harmful effects on the traffic.

Based on the analysis of accident data the frequency and occurrence of road traffic accidents revealed dramatic variations because of the impact of various factors such as temporal variation (i.e. monthly, yearly) Alignment effect (i.e. Tangent, mountainous and escarpment areas) Driver characteristic, Traffic rules awareness etc. On the other hand causes of road traffic accidents based on the vital information from the pedestrian, local people, drivers and officers of nearest police station through questionnaire

survey and interviews; road design problems over speeding, failure to give way to vehicles and pedestrians, overtaking in winding horizontal curves, no awareness of traffic rules.

During field survey of study area observed some safety defects and deficiencies like Deteriorated pavement surface, sharp curve, uneven shoulder, carriageway width, improper median opening, no drainage system, blind turns at mountainous area etc. and road furniture deficiency likes non availability of parking lane, no guard rails at turn, missing sign boards, no proper road marking and poor lighting at urban area etc. these deficiencies may be reduce, implementation of the suggested improvements will help to increase the overall road safety.

6. ACKNOWLEDGMENT

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