ACCIDENT PRONE LOCATIONS (BLACK SPOTS) IDENTIFICATION AT BHANGA-MAWA-DHAKA HIGHWAY BY USING GIS

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ABSTRACT

Road Accident occurs vigorously in Bangladesh, consequently the safety of road traffic has now become major happenings for transportation Engineers. The spot there is an option for happening of the accident is so called Black spot or accident prone location. To improve the Road safety, it is required to identify the accident prone location on the road. The achievement of the development of road safety programs depends on the reliable and accurate analysis of the accident data. The goal of the study was to analysis the accident data collected from ARI, BUET and nearby police stations for the Bhanga-Mawa-Dhaka road. In this paper, the black spots were identified by using Geographic Information System (GIS) and furthermore were provided corrective measures to those accident prone locations.

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Keywords: *Road Accident, Road safety, Accident Prone Location, GIS.*

1. INTRODUCTION

Road accident has become one of the major public health problems around the world. About 1.3 million people are killed in road crashes each year, and as many as 20 to 50 million are injured, occupying 30% to 70% of orthopedic beds in developing countries hospitals. Due to traffic accident of present situation, it will take place third position from ninth position of leading contributor to global burden of disease by 2020 (Association for safe International Road Travel, 2015). It is predicting that the accident number will increase in 65% over the next 20 years if new measures to prevent traffic accident are not taken. In most cases, road safety measures of developed countries to prevent road crashes are not compatible for developing countries because of difference between economic, social, cultural and behavioral distinction. According to global crash statistics, in developing countries 90% of world's fatalities occur on the road though those countries have 50% of world's vehicle. Again half of those dying on world's roads are "vulnerable road users" such as pedestrians, cyclists and motor cyclists. The expenditure of road traffic accident is shown 1% to annual gross national product (GNP) resources of developing country, which they can't be able to bear it. So it is necessary to take measures, which can reduce traffic accident and mitigate the problem (Rahman & Newaz, 2013).

Bangladesh is a developing country. Approximately 4500 road accidents are occurred in Bangladesh as reported by the police in each year (Hoque, 2011). According to World Health Organization (2012-13), 17520 peoples are death by road accident every year that means roads in Bangladesh are virtual death traps (Prothom Alo, 2014). 1064 road fatalities are occurred per 100,000 motor vehicles in Bangladesh (Hoque et al., 2006). Annual cost of road accidents and injuries varied between 1.8 to 2.8 % of national GDP in Bangladesh (Mohan, 2002). Among this 75% accidents occur in rural areas and about 40% occur on national highways including rural segment. Approximately 43% of national highway accidents concentrated on 5% of the total length of road, which shows that accidents are clustered on a few section liable for identification and specific treatments.

In Bangladesh, database of road accident are very limited which is not sufficient for comprehensive analysis. To make a better analysis, we need to use modern technology such as Geographic Information System (GIS) with digitize road map especially for road crash analysis where every road segment have their attribute and analyzed separately. With the help of digitize map, we can easily locate the hazardous road location on spot. Specific treatment of such location significantly reduced the accident number. In this study, we will use this system to identify the black spots by a digitized road map. The Bhanga-Mawa-Dhaka road named N8 connected the south-western part of Bangladesh with the Capital Dhaka (Figure 1) which has great significance on national economy of Bangladesh and also as the largest Padma Bridge will construct on this route. The business with the capital and the movement of goods from the country's second seaport will boost by the Padma Bridge. The AADT

(Annual Average Daily Traffic) of this route is 2,394 in the year 2014 which will increase after the Padma Bridge is 11,273 in the year 2020. The study area has chosen because of recent accident statistics. The total number of accident was 895 in between year of 2009 to 2013 with 459 fatalities and 436 injured (ARI database, 2013).

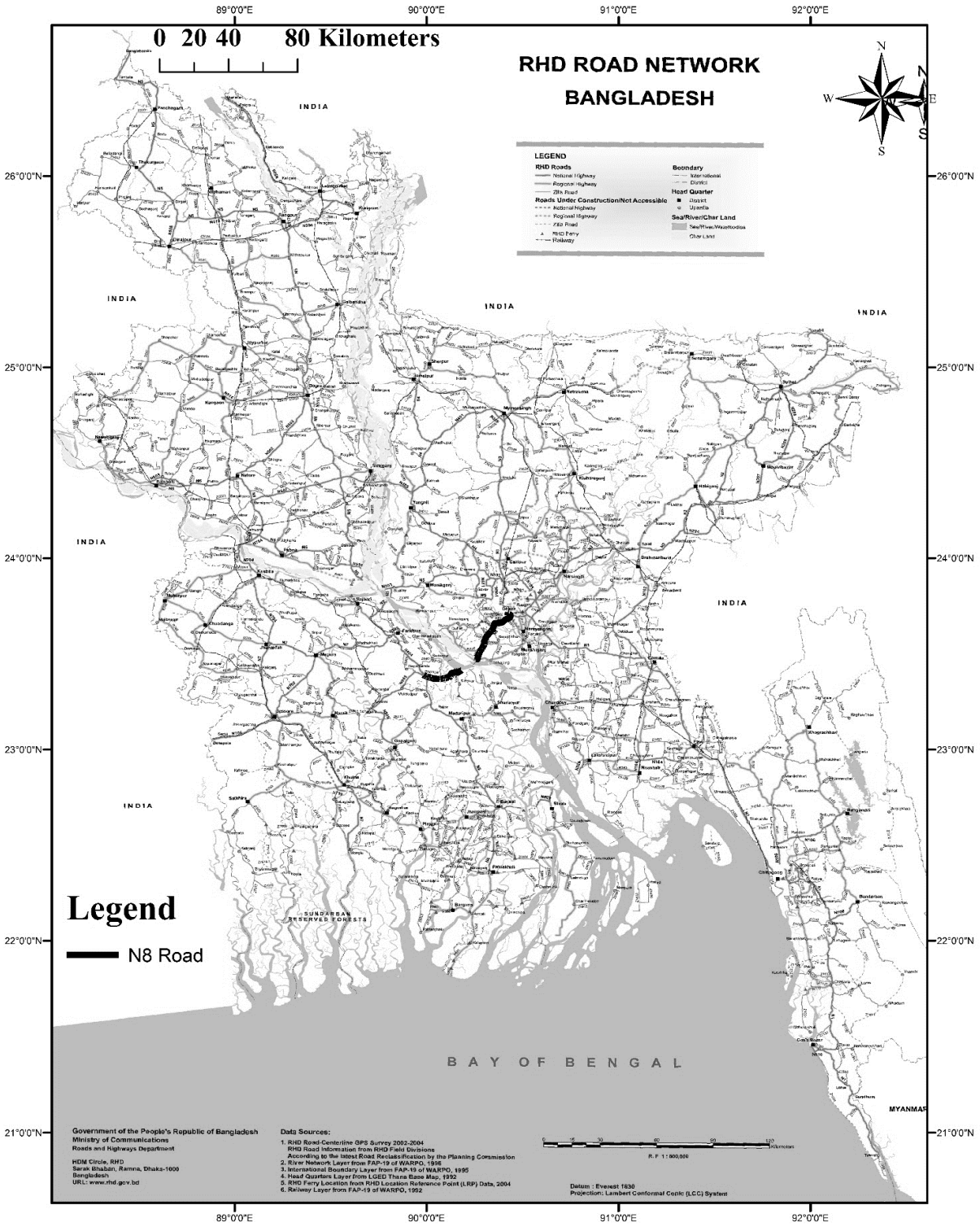

Figure 1: Dhaka-Mawa-Bhanga National Highway (N8)

2. METHODOLOGY

Road accident has great impact on national economy of a country besides its sufferings and pain. There are several methods of identifying the black spots and mitigating the crisis. For each method requires the accident database of a country over past years. But in the database, the actual accident number are not found in the database due to under reporting and few location of accident are not matched in the field due to wrong fill up the database form at the time accident. All of these make the identification of high accident road section more difficult especially for the traditional computerized programs now in use. These could also lead to wrong section of roads being identified as hazardous if not the wrongly coded crashes are identified on 2009-2013.

GIS is found to be suitable for such analysis to overcome these handicaps. In order to find the desired result, step by step procedure heve been followed.

2.1 Data Collection

To determine the accident prone location of National Highway (N8), the data were collected from

1. Corresponding police Station of the Road
2. Accident Research Institute database (ARI, 2009-2013)

2.2 Collection of Ground Control Points (GCP)

The GCP is normally collected with the help of the Google Map, Hand held GPS at the road segment where the accident occur (Aparao & Raju, 2013).

2.3 Data Processing

The collected data of accident cannot be used directly with its original format, so it is necessary to rearrange the data for analysis in which can be used as quick basis. At that time an intermediate programs are developed according to the requirements and needs of the analysis. The step are followed for identification of accident prone location (Figure 2).

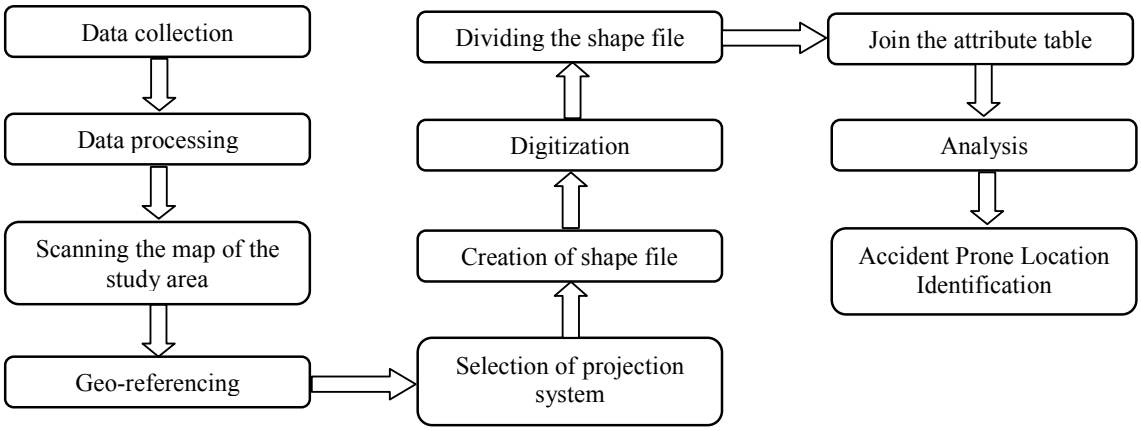

Figure 2: Steps for Accident Prone Location Identification

2.4 Map Scanning

Scanning the map of Bhanga-Mawa-Dhaka national highway network and input this image into Arc map 10.3 for digitizing. Digitized map is required for spatial analysis.

2.5 Geo referencing

Draw the vector map of Bhanga-Mawa-Dhaka national highway network. Scan map usually do not contain any information as to where the area represented on the map fits on earth surface. The projection co-ordinate system used in this study is UTM co-ordinate system.

2.6 Digitizing

Digitizing is the process of encoding the geographic features in digital form as x, y coordinates. It was carried out to create spatial data from existing hard copy maps and documents. In the Present work the geo referenced raster image of national highway (N8) is digitized using Arc GIS10.3. This type of digitization is called

onscreen digitization. Road network of the study area was digitized as line features. Accident locations are digitized as point features (Aparao & Raju, 2013).

2.7 Assigning Attributes

All vector data like as line, polygon, and point features contain various attribute table related to accident information for finding hazardous road location of the study area, which present the accident prone location graphically at the same time (Aparao and Raju, 2013).

2.8 Data Analysis

The study is conducted by two analysis as followed:

1. Accident characteristics analysis
2. Black spots identification analysis

2.8.1 Accident Characteristics Analysis

The general analysis of accident data gives an overview of accidents trends. This analysis encompasses the characteristics of accident based on criteria of Year, time, accident severity, road geometry, accident number, accident location, vehicle type etc.

2.8.2 Black spots identification Analysis

For the purpose of analysis, the highway is divided into 200m segments. There are many criteria's to identify accident prone location. The identification criteria of black spots in this study is, firstly the locations where the number of fatal accidents in 0.2 Km to 0.5 Km of road over a period of 5 years equals or exceeds three accidents are identified as blackspots. Another analysis is, adjacent locations (within 2 Km) with fairly high accident were aggregated to one hazardous location (Rahman & Raju, 2013).

3. RESULTS AND DISCUSSIONS

3.1 Accident Characteristics Analysis

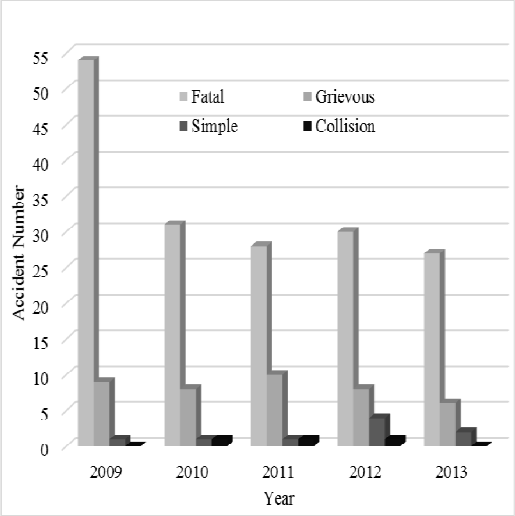

Figure 3: Yearly accident severity

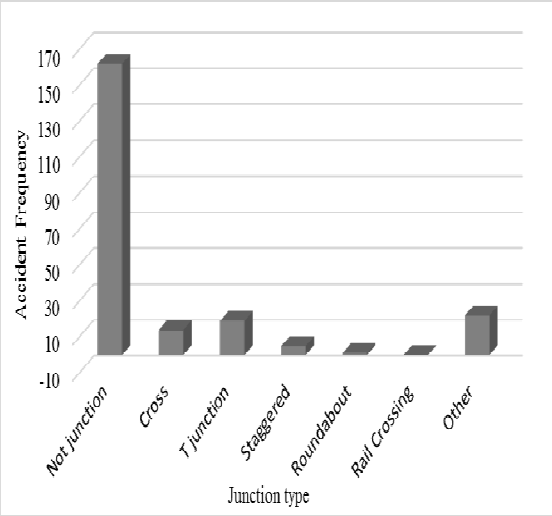

Figure 4: Accident severity by junction type

Figure 3 shows that yearly distribution of accident over 2009 to 2013 in N8 route. In this study period it shows high fatality accident frequency in 2009 year and then it's approximately decreasing the rate of accident because of increasing in under reporting of accident.

Most of the accident occurs in non-junction segment of highway about 73% of total accident, 27% accident concentrated on the other type of junction. 9% accident occurs on T-junction type segment of highway. Accident in different junction type is given in Figure 4.

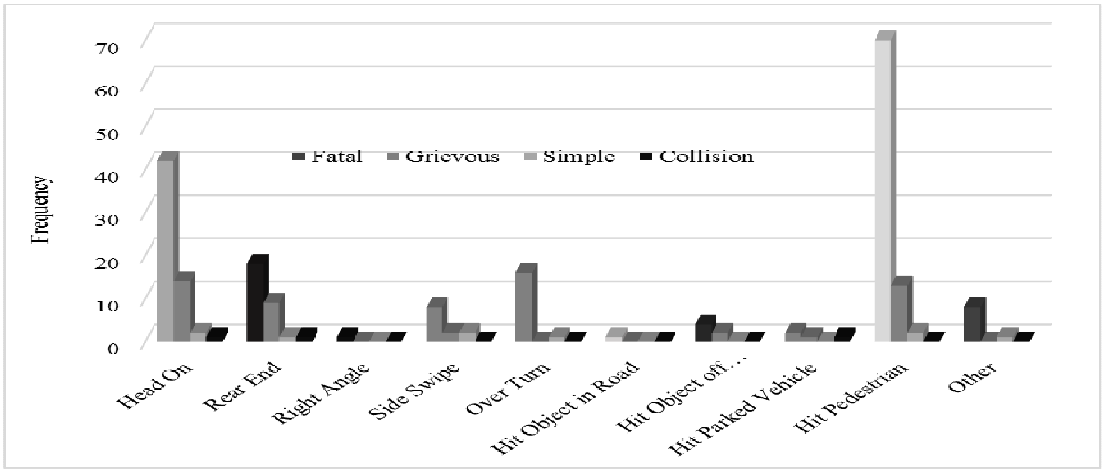

Figure 5: Accident Severity by collision type

Among the road user, pedestrians are most vulnerable to accident of this study area, from the data over 2009-2013 pedestrian accident constitutes 37%. Head on type collision constitutes 30% and side swipe type collision constitutes 9%. The different type of collision occurred of this route is given in figure 5.

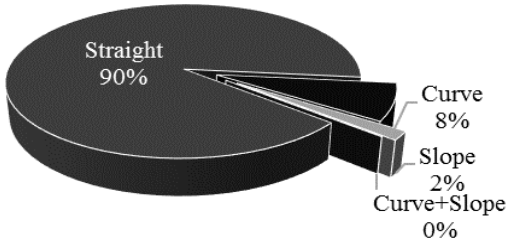

Figure 6: Accident severity by Road geometry

Straight road segments are most responsible to accident, 90% of accident happened on this route. Curve segment constitutes 8% accident, 2% occurs in slope areas. Accident by road geometry is given in Figure 6.

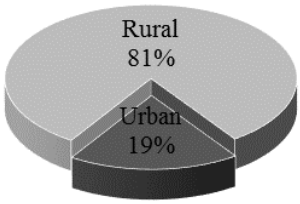

Figure 7: Accident severity by location

Most of the accident occurs in rural part of national highway due to improper existing traffic control system. Slow moving vehicle like three wheelers, tempo, CNG's etc. are used in rural section of highway and high speed vehicles need to overtake them that's why there are highly possibility to cause accident. In this study route shows, 81% accident constitute in rural part and 19% accident occurs in urban part of national highway. In Figure 7 shows the accident occurrence by location type.

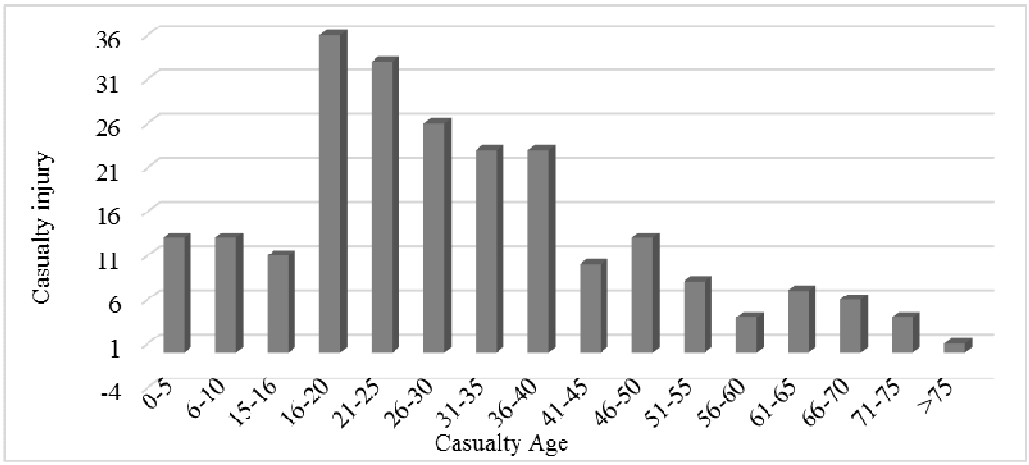

Figure 8: Pedestrian accident severity by age group

From the analysis of the data, it is found that age group 16-20 is most vulnerable pedestrians, their accident frequency is high as 36. Second vulnerable pedestrians are age group of 21-20 and their accident frequency is 33. Accident severity by pedestrian is shown in Figure 8.

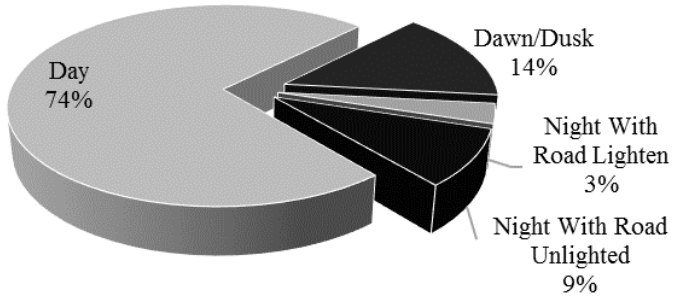

Figure 9: Accident severity by lighting condition

As the human activity is happened at day time, consequently human connection with the take place at this time than other time. So major road accident occurs at day time and its found 74% accident occur at day time. 14% accident occurred in dawn and dusk. Dark road segment constitute 9% accident and lighting segment of highway constitutes 3% accident. Accident severity by lighting condition is given in figure 9.

3.2 Black spots identification Analysis

The study was made on N8 national highway over 65 km length. For analysis purpose, the route was subdivided into 325 segment where each segment has equal distance of 200 m. Here four black spot were found in 65 km road segment according to the Geographic information system (GIS) analysis. The detailed of those segments are given below the Table 1.

Table 1: Blackspot and HRL on Dhaka-Mawa-Bhanga Highway (2009-2013)

Km post	Length (m)	Location	Total accident
14.5-15	500	Hasnabad	2
17.5-17.7	200	Equiria Bazar	3
43.3-43.5	200	Shibchar	3
59.0-59.5	500	Gharua/ Baman kanda bus stand	3

The accident location on the basis of 2009-2013 Accident Research Institute (ARI) database is shown on the figure 8. And finally accident prone location hazardous locations are shown on the Figure 9.

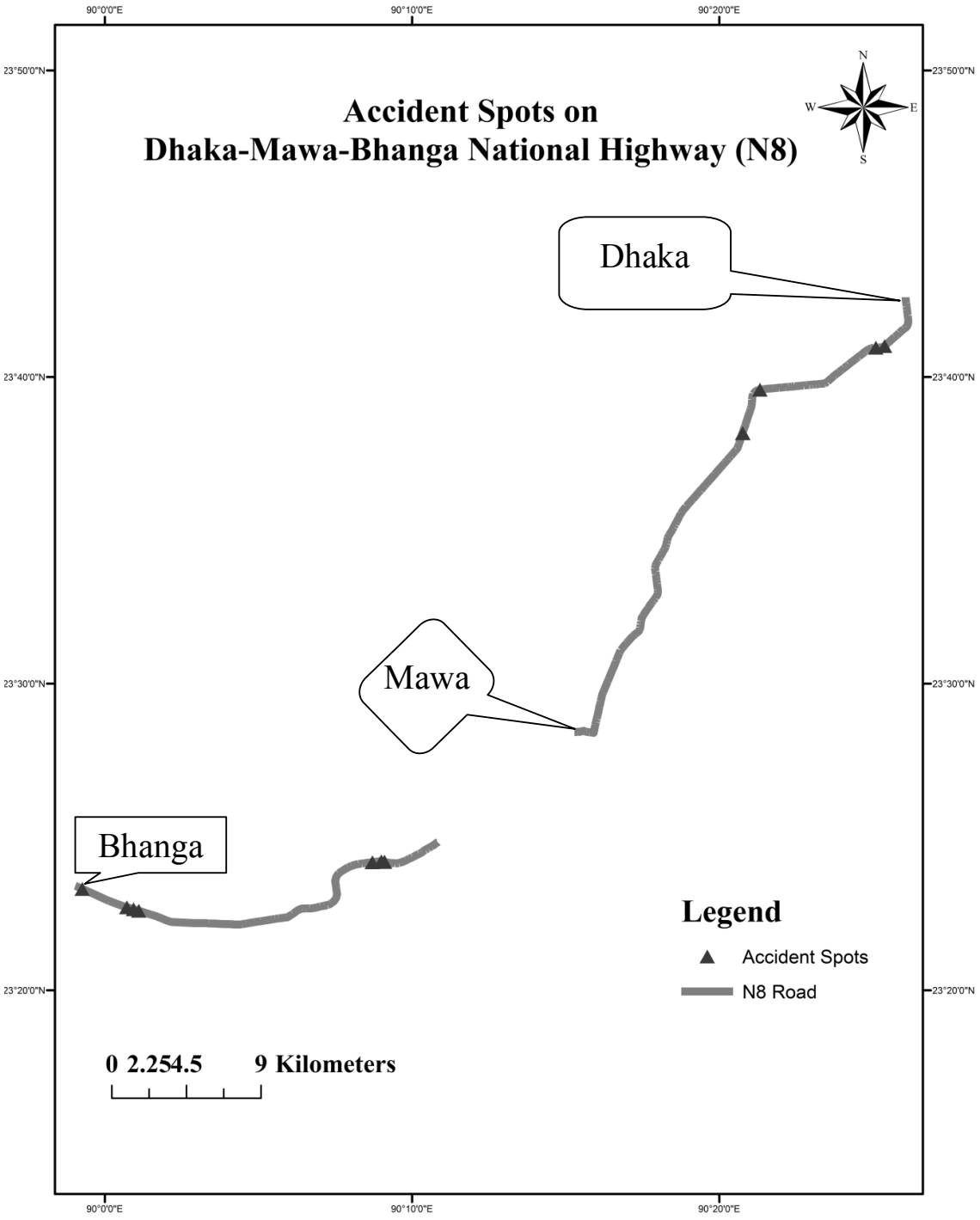

Figure 8: Accident spots on Dhaka-Mawa-Bhanga N8 route

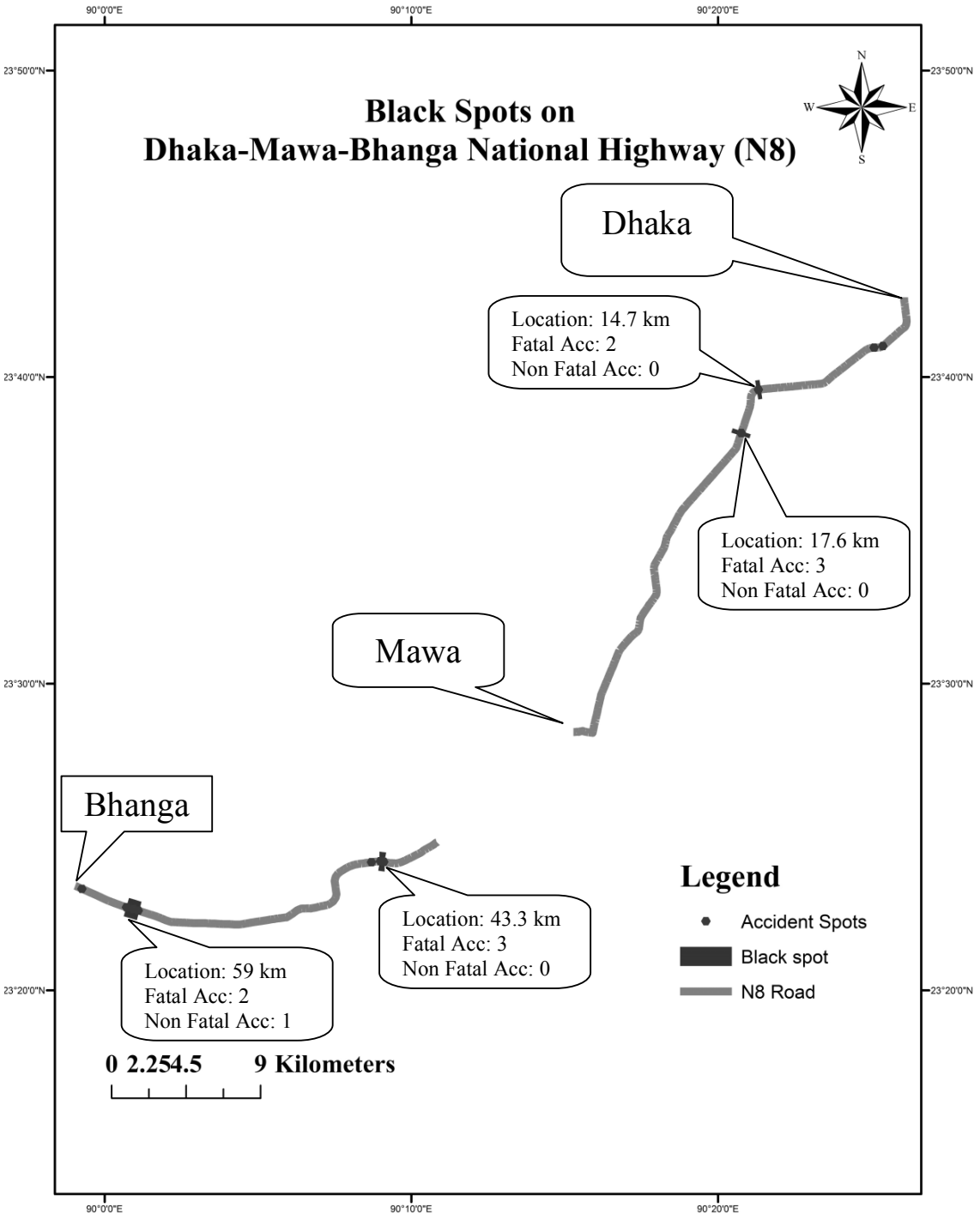

Figure 8: Black spots on Dhaka-Mawa-Bhanga N8 route

4. CONCLUSIONS AND RECOMMENDATIONS

Now-a-days safety of road network has become major issue to community in Bangladesh. In this paper, the implementation of GIS in accident analysis has discussed and tried to identify the exact accident prone location. The national highway (N8) which connected the two north western divisions was analyzed from Dhaka to Bhanga about 65 km. In the study period 2009-2013, accident occurred in only about 3.38 percent of total length

of N8 route, it is clear that accidents are amenable to targeted and site specific treatments. From the analysis, it was found, four specific segment of national highway are being treated as accent prone location. As Khulna is industrial city of Bangladesh and the world heritage sites are located in this region and also largest Padma Bridge will be opened in 2018, traffic volume will be amplified manifold with this existing volume. So treatment of those segments is necessary. On the basis of results and findings, the necessary remedial measure should be taken to make the use of the national highway safe and efficient. Some remedial measure are as follows.

a) Among road user pedestrians are the most amenable to accident on N8 route. So pedestrian facility such as briar, overpass, underpass, zebra crossing, pedestrian signal etc. should be established in those sections on the basis of its function Also focus on speed reduction near schools, bazar and residential should be considered.
b) Head on and Rear end collisions are the dominating collision types at all the segments of both the highways. Undivided highway, reckless overtaking are the main causes of head on collision. So divided highway and special overtaking sections should provide. Speed variation is the main cause of rear end collision. So exclusive lane for NMV may reduce rare end collision.
c) Appropriate signs, road markings, fencing, guardrails, junction modifications, and improvements to visibility should be considered as remedial measure.
d) Dangerous and inappropriate operation of heavy vehicles (buses and trucks) such as reckless overtaking, overloading and braking/stopping on roads and road sides are particularly a serious problem in all those segments.

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