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2013Estimation of vehicle damage cost involved in Road Traffic Accidents
in Karachi, Pakistan: A Geospatial PerspectiveJamil H. Kazmi^a, Salman Zubair^{b,*}^aProfessor, Department of Geography, University of Karachi, Karachi- 75270, Pakistan^bLecturer, Department of Geography, University of Karachi, Karachi-75270, Pakistan

Abstract

Road Traffic Accidents (RTAs) are serious but ignored problem in Pakistan. Now this problem is under limelight due to disastrous impacts over society in general and over economy in particular. Karachi is considered to be the most income generating city of Pakistan. This city holds a typical feature of most road traffic accidents facing in the country and the fourth highest RTA fatalities in the world. More than 26,000 road accidents occur on the arteries of Karachi every year making it a worrisome place. Outcome of RTAs could be measured in tangible manner i.e., in term of number of life loss but intangible losses are very difficult to measure. In this paper an attempt has been made to capture the potential flaws in road geometry through Remote Sensing and embedding the land use data through the inventory of Geographic Information Systems. Moreover, overlay analysis techniques helps in identifying the high accident cost areas. In Karachi, over 35,000 vehicles are involved in crashes every year, resulting in loss of life as well as wealth. The overall repair cost over the vehicles involved in all types of RTAs in year 2012 is more than 20,000,000 PKR with Landhi Town showing the highest cost. Shah Faisal Town showed the minimum repair cost of over 300,000 due to its small aerial extent and lesser number of economic land use making it a safer place for vehicle users. Moreover, map of Karachi showing the spatial pattern of vehicle repair cost. It is suggested that the serious measures need to be undertaken to combat this problem.

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1. Introduction

Road traffic accidents (RTAs) are alarming but ignored public health challenge that requires concrete efforts for effective and viable prevention. RTAs are not only resulting in health loss, but also taking a substantial toll of financial assets worldwide. This menace is not only threatening the society but also the economies of the countries, especially developing countries are facing the economic losses due to this problem to unbearable extent; ruining the lives of many, sprouting the social dependencies and innumerable evils. Globally, it is estimated that Road crashes take away the lives of nearly 1.2 million people every year and as many as 50 million are wounded. Moreover, this specter of accidents, account for substantial economic burden in over low, middle, and high income countries nearly 1%, 1.5% and 2% of the Gross National Product (GNP), respectively. The global cost is estimated to be US\$ 518 billion per year out of that low income and middle income countries account to nearly US\$ 65 billion [1]. Moreover, these countries hold nearly 48% of the world's vehicles but account for 90% of the total world fatalities [2]. In low income group countries, this evil is impacting people directly as well as indirectly. The problem is not only hurting the economy but also turning the families into deprived conditions as a result of the fatality of bread winner of the family or severe injury could cause permanent limp or long term medication expenses turning the families into miserable situation. In Karachi, vehicle damage as a result of road crash cause severe burden to the breadwinner of the family. A sizeable share of capital need to be spent to come out of this strain and the number of days lost working and burden to the vehicle owner is also cumbersome to bear with. Following are some of the cost evaluation over vehicle damage due to road crashes in different regions of the world. In USA property damage result due to road accidents cost heavy fiscal loss in term of property damage with considerable share of 26% of total motor vehicle crash costs, occur due to road accidents. Moreover lost in term of capital is nearly \$59.8 billion [3]. The total compensation from property damaged in Road accident in Vietnam amounted to 65340 million VND for cars and 32,522 million VND (Vietnamese Dong i: e 1 USD = 21,101.50 VND) for motor cycle accidents. The average cost of property damaged for a car was 5, 7 million VND and for motorcycle were 3, 7 million VND [4].

Vehicle repair cost calculated in Philippine that were for per fatal accident PhP 76,930 (Philippine Peso i:e 1 US\$=50 PhP). The cost of Vehicle repair per serious injury accident was PhP 45,647. The cost of vehicle repair per minor injury accident was PhP 40,756. The cost of vehicle repair per PDO accident was PhP 33,257[5]. In Pakistan RTAs have climbed to epidemic proportions during the last 15 years [6]. According to the official estimates, about 7000 traffic fatalities occur each year in the country with 10,125 crashes registered to Police in Pakistan in 2006 [7]. These figures are based on the registered accidents whereas non registered accidents could be much more than that. In Karachi RTAs show an increasing trend with unavoidable outcome of economic burden. According to an estimate in Pakistan the fiscal cost over road crashes and injuries were more than 100 billion rupees, whereas the government has spent only US\$ 0.07 per capita (0.15% of GDP) on road safety in 1998[7]. Road Traffic Accidents are common phenomena over the arteries of Karachi. The city rank 4th in world stats for road fatalities in the world [8] with nearly 26,000 reported crashes encountering 33,000 injuries in five RTIRPC (Road Traffic Injury Research and Prevention Centre) surveillance centers in 2012 [9]. This problem not only denting the work force of the city but also highest proportion of people involved in Karachi belong to the age group 20-45 most of them are workers hurting the families[10].

2. Objective

The objective of this study was to examine the economic cost incurred due to vehicle damage, involved in road accidents/crashes.

3. Methodology

3.1. Study Area

Karachi has been divided into 18 Towns with four cantonments and 178 UCs (Union Councils) [11]. On 11th July 2011 Sindh Government has reinstated the division system in Karachi according to which the city is parceled

into five divisions namely Karachi Central, Karachi East, Karachi South, Karachi West and Malir. Moreover, substantial proportion of the city comes under cantonment areas administered by Armed forces [12]. It is also interesting to note that about 51% population of Karachi is residing in the slum areas of the city, accounting for the 37% of the total areas. These areas are the main traffic generators of the city, especially in the context of motorbikes.

3.2. Economy of Karachi

Economic importance of Karachi can be realized by the fact that the city handles nearly 95% of country's outland trade and 40% of total employment in large scale manufacturing sector. The heterogeneity of the city is depicted by the presence of people from all over the country, employing in huge number with nearly 71.6% of labor force of Sindh in large scale industrial sector in the city [13].

3.3. Motorization of the city

According to Excise and Taxation Department in 1995 the total number of vehicles, registered in Karachi were 820,000, these number of vehicles shot up to 1,000,000 in the year 2000. Especially after the introduction of car leasing facility, which resulted in the total number of registered vehicles going up to 1,400, 000 in the year 2006. Estimation suggests that more than 400 vehicles are added daily on the roads of Karachi [14]. Whereas, according to Khan (2007) total numbers of registered vehicles in year 2007 were 1,809,500 with daily increase of 545 vehicles per day[15].

Table 1: Registered vehicles in Karachi

Comparison of estimated total vehicle in Karachi			
Karachi City	2004	2011 (Estimated)	Percentage
Registered Cars	1.03 Million	2.21 Millions	66.5
Taxis	27,233	44,011	1.3
Buses	12,700	20,010	0.6
Minivans	33,200	69,135	2.1
Motorcycle	0.4 million	+ 1 Million	30.1
Total Vehicles	1.5 Million	3.32 Million	

Source: Government of Sindh (2011)

Easy loan policy and low interest rate offered by banks, erupted into the huge number of cars (66.5 %) and motorbikes (30%) in Karachi. However, public buses share the least percentage of only 0.6%. Most of the public buses are in poor conditions carry more passengers than the capacity, causing serious road accidents.

3.4. Road Traffic Accidents in Karachi

Despite many existing socio-political problems, the city is facing the problem of road accidents at alarming rate. This is proved by the fact that Karachi ranks fourth in the world as the most accident conceiving city in the world [8]. This makes the city as one of the most dangerous cities of the world beside the highest crime rate. The city is facing the increasing trend of RTAs in recent past. From year 2007 till 2012 the reported incidents of RTAs has shown the climbing trend. Recent infrastructure development in the city without keeping in view the heterogeneous road users, rate of RTAs in has climbed up certainly.

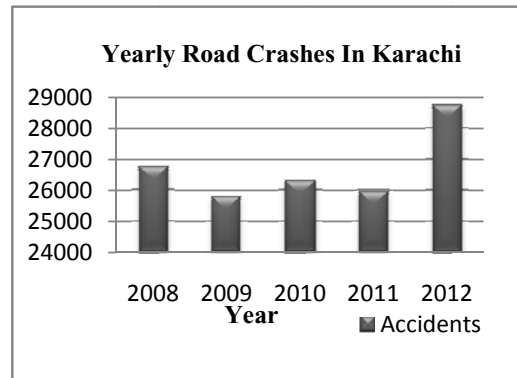


Fig.1. Yearly Road Crashes in Karachi

3.5. Grid Based Analysis

To figure out the specific area of high intensity of RTAs, 500m by 500m grids were constructed, then number of accidents in each cell were counted that took place in this cell. This was done by the help of point data layer of RTAs in ArcGIS software. On the basis of this activity five dispersed sites were selected and reviewed through RS and later confirmed from the field visits that infrastructural changes with less awareness among people has drastically increased the number of crash events. As mentioned in Fig. 2 following would be the contributing factors for high intensity of road accidents of five selected Sites.

3.6. Site#1. 5C-4 (North Karachi Town)

Greater number of Road Accidents were noticed due to increased road width at median (U-turns) and wrong entry from the other side.

3.7. Site # 2. Nagan Area(North Karachi Town)

High number of RTAs incidents were reported due to the construction of multi layered flyover, creating confusion for driver to enter at the correct destination.

3.8. Site # 3. Board Office (North Nazimaabad)

High Incidents of RTAs were reported due to the installation of signals and increased road width.

3.9. Site # 4 Liaqatabad Underpass (Liaqatabad Town)

Construction of underpass to free traffic flow has reported number of crash incidents with median and also tumbling over of vehicles especially buses has also been reported.

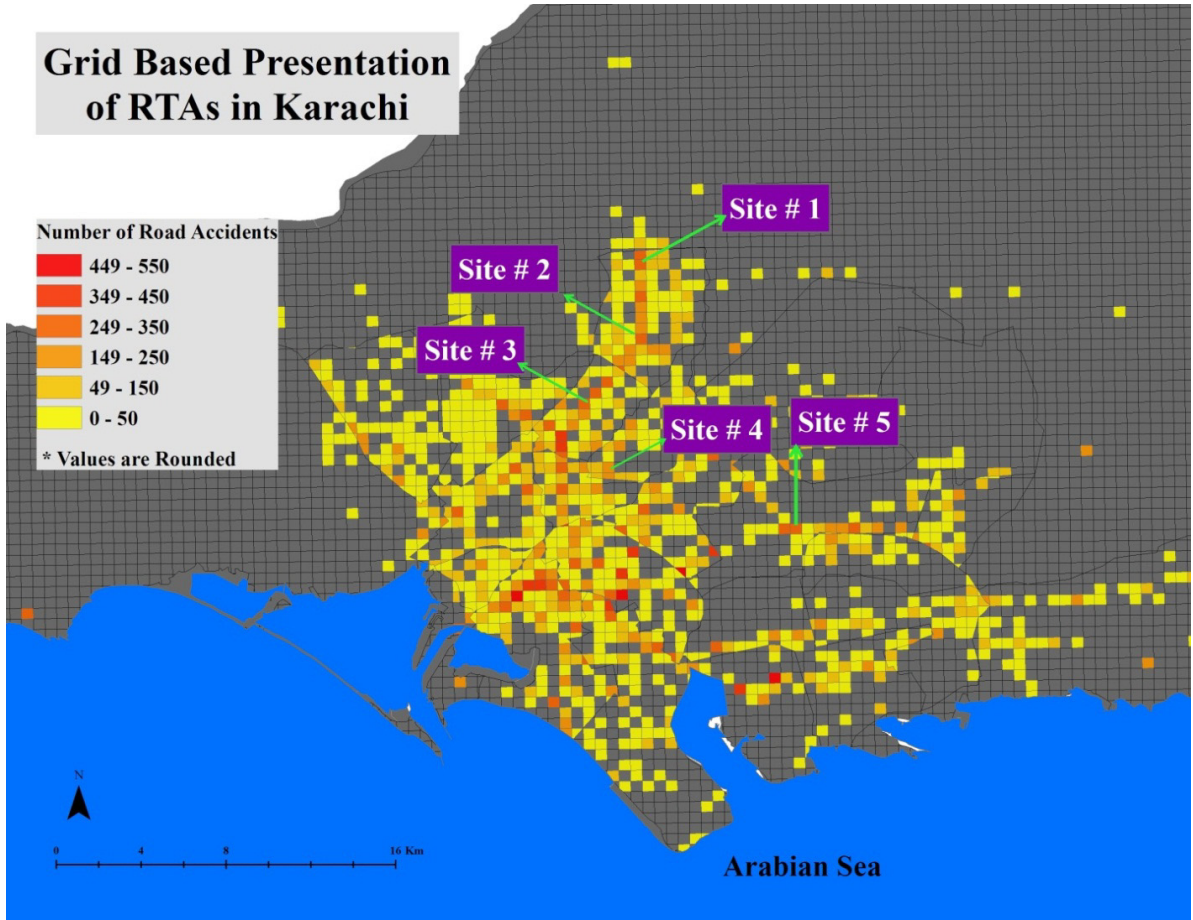


Fig. 2. Grid-Based Analysis of (RTAs) Road Traffic Accidents in Karachi

3.10. Site # 5. Drig Road Bridge (Faisal Cantonment)

Wrong construction of drig road flyover with inlet on extreme right lane has increased the number of RTA events. Karachi is having right hand drive vehicles with left slow lane, so that inlet of flyover on extreme right side results to many RTAs.

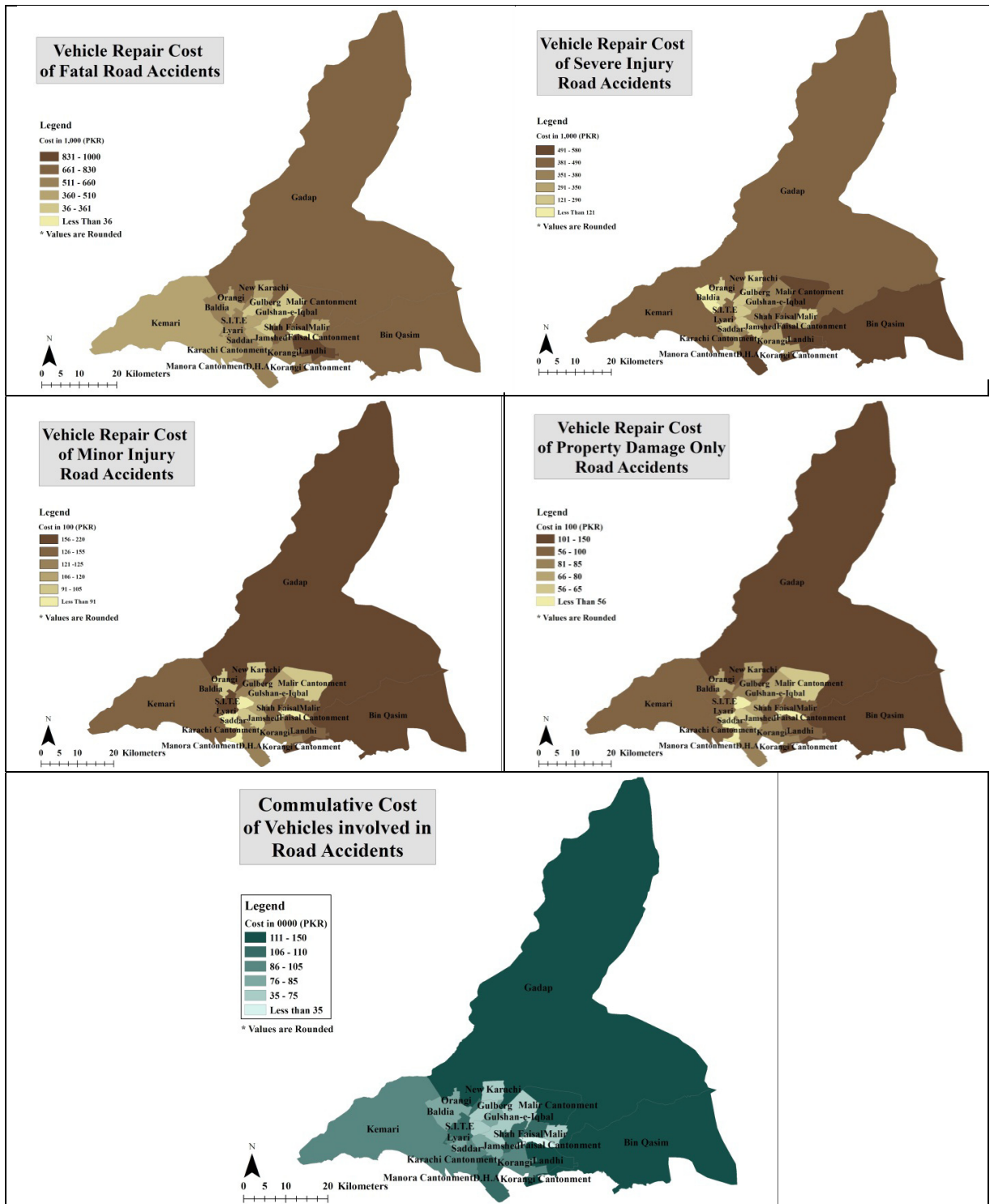


Fig. 3. Town-wise distribution of vehicle repair cost, based on 2012 data

4. Data Collection

A questionnaire was designed to find out the economic cost incurred due to road accident vehicle repairing. For that purpose questionnaires were sent to fifty different insurance companies. Most of the companies have not responded and those who responded has provided very general cost value of claims that made the situation even more complex. To overcome this problem it was decided to interview the car repair workshops and also the vehicle owners who had experienced the road accidents, preferably in recent time that is for the year 2012. After interviewing more than 75 garages, formally and informally, overall cost estimation were estimated for each type of vehicle. Human Capital Approach was employed to compute the vehicle damage cost because this technique is preferred in under developed countries, where data availability is difficult.

To find out the cost over vehicle repairment involved in road accidents following steps were taken:

- **Remote Sensing** technique was employed to capture the possible areterial engineering design flaws through very recent satellite imageries of 2013. **GIS (Geographic Information System)** techniques were used to embed the landuse value with overlay analysis to find out the high accident cost areas. Calculation of severity index with help of over all data that has been provided the average number of accidents that were considered as vehicle damage atleast.
- Accidents were catagorised into four classes: fatal, severe, minor and PDO (Property Damage Only).
- Types of vehicle were classified in the form of table. Number of units involved of each type of vehicle were found out. To evaluate the weighted value percentage of each type of vehicle were found out. Then average repair cost which was investigated through questionnaire were added with towing cost and with percentage of each vehicle type; that produces the average weighted value.
- Than this value was multiplied with the adjustmant factor of each type of accident (fatal severe minor and PDO). Then the value was multiplied with the severity index value of each accident type. The same steps were applied for different sverity type accidents. No towing cost were applied to minor accidents and PDO because such vehicle can be brough to the workshop due to minor damage. The same procedure was applied for all towns.

5. Results and Discussions

Tables 2 to 7 with self-explanatory results are provided in this section. Cost calculation of vehicles repairing that involved in RTAs, showed the diversity of vehicles. Involvements of motorbikes were highest in number but their repair cost is very low, whereas, heavy vehicles consume gigantic proportion of capital in repairing process.

Table 2. Vehicle involvement in Minor Accident in Karachi in 2012

Repair Cost of Vehicles involved in Minor Accidents	No. of Units	%	Repair	Weighted
Type of Vehicles	Involved		Cost in (PKR)	Values
Motorbike	24368.00	0.68	1000.00	678.59
Minivan/Coaster	756.00	0.02	12000.00	252.63
Bus/Coach	1410.00	0.04	100000.00	3926.48
Truck	661.00	0.02	20000.00	368.14
Taxi	236.00	0.01	80000.00	525.76
Bicycle	307.00	0.01	400.00	3.42
Car	3592.00	0.10	10000.00	1000.28
Water/Oil Tanker	92.00	0.00	20000.00	51.24
Rickshaw	2972.00	0.08	500.00	41.38
Dumper	120.00	0.00	30000.00	100.25
Trailer	239.00	0.01	20000.00	133.11
Loading Pickup	1127.00	0.03	5000.00	156.92
Animal Cart	13.00	0.00	600.00	0.22
Push cart	17.00	0.00	400.00	0.19
Total	35910.00	1.00	299900.00	7238.61
Average Cost of Repair (PKR)				14477.22

Table 3. Cost of Vehicle Repair per Fatal Accidents

Repair Cost of Vehicles involved in Fatal Accidents Type of Vehicles	No. of Units Involved
Average Repair Cost per Vehicle/weighted value	269650
Adjustment Factor for Fatal Accident Vehicle Repair	1.55
Vehicle Repair Cost per Fatal Accident	417957.5
Average No. of Vehicles Involved in a Fatal Accident	1.54
Cost of Vehicle Repair per Fatal Accident (PKR)	643654.6

Table 4. Cost of Vehicle Repair per Serious Injury Accident

Repair Cost of Vehicles involved in Severe Accidents Type of Vehicles	No. of Units Involved
Average Repair Cost per Vehicle	173419.98
Adjustment Factor for Serious Injury Accident Vehicle Repair	1.40
Vehicle Repair Cost per Serious Injury Accident	268800.98
Average No of Vehicles Involved in a Serious Injury Accident	1.50
Cost of Vehicle Repair per Serious Injury Accident (PKR)	364181.97

Table 5. Cost of Vehicle Repair per Minor Accident

Repair Cost of Vehicles involved in Minor Accidents Type of Vehicles	No. of Units Involved
Average Repair Cost per Vehicle	7238.61
Adjustment Factor for Minor Injury Accident Vehicle Repair	1.25
Vehicle Repair Cost per Minor Injury Accident	9048.26
Average No of Vehicles Involved in a Minor Injury Accident	1.51
Cost of Vehicle Repair per Minor Injury Accident (PKR)	13662.87

Table 6. Cost of Vehicle Repair per PDO Accident

Repair Cost of Vehicles involved in Minor Accidents Type of Vehicles	No. of Units Involved
Average Minor Repair Cost per Vehicle	7238.61
Adjustment Factor for PDO Accident Vehicle Repair	0.85
Vehicle Repair Cost per PDO Accident	6152.82
Average No of Vehicles Involved in a PDO Accident	1.60
Cost of Vehicle Repair per PDO Accident (PKR)	9844.51

Table 7. Cumulative vehicle repair cost involved in all types of RTAs in Karachi (2012)

Town Name	Total vehicle Repair Cost (PKR)
Landhi	1502385
Malir Cantonment	1370274
Bin Qasim	1366358
Gadap	1290977
Site	1180673
DHA	1107824
Karachi Cantonment	1061036
Korangi	1006673
Lyari	874962
Jamshed	792054
Baldia	784219
Orangi	774500
Gulberg	771814
Liaqatabad	740498
New Karachi	727351
Malir	719174
Gulshan-e-Iqbal	699468
North Nazimabad	646643
Shah Faisal	367161

Karachi bears considerable economic loss in terms of vehicle repair, involved in road traffic accidents. Above tables showing the total repair cost over vehicles involved in all types of road accidents. Landhi town depicts the highest economic cost. This could be due to the land use of this town. Landhi Town is important for economic activities and is also known as L.I.T.E (Landhi Industrial and Trading Estate). Hence, the involvement of vehicles, especially heavy vehicles is obvious in this town. Pakistan Steel Mill is also situated in Landhi town and is the source of employment of thousands of people. Heavy vehicle movement in commuting goods to and from the city increases the chances of heavy vehicle involvement in road accidents. However, Shah Faisal town represents the least economic cost with possible reasons of smallest area and low commercial land use and the involvement of heavy vehicles in RTAs is hardly observed and reported there.

6. Conclusion

This problem of road traffic accidents need to be taken seriously and concrete measures need to be adopted on priority basis. Karachi being the economic hub of the country; losing lion's share of economic assets in road crashes making the life worrisome for the commuters. Economically productive areas are under serious threat to RTAs experiencing huge economic loss in term of vehicle damage. To minimize the outcome of this problem, serious precautionary steps need to be taken to avoid the further loss of lives and economic resources. It has been revealed that GIS and Remote Sensing techniques are highly useful for identifying the high and low cost areas. From the analysis it has been found that Landhi Town is implicated as the highest cost and Shah Faisal Town as the lowest, the GIS analysis has also been highly helpful in discovering the associated factors for the lowest and highest cost values.

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