Distribution Characteristics and Countermeasures of Traffic Accidents in Rural Road

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ABSTRACT: According to the serious current situation of traffic accident in rural road, the data of traffic accidents was analyzed that happened in Pucheng County, Shaanxi Province, Xi’an in 2012 using mathematical and statistical methods. Then put forward some traffic accident characteristics and regularity, such as the distribution of time, distribution of space, traffic accidents form, vehicle’s type and violated law. According to the traffic accident characteristics of distribution, in order to control and reduce traffic accidents, some countermeasures were given from the aspects of engineering, management and education.

INTRODUCTION

Rural road, an important part of the road network, is one of the most important infrastructure to guarantee rural social and economic development, which includes county road, township road and village road. In recent years, China got remarkable achievement in rural road construction. By the end of 2012, the mileage of China's rural road was 3,678,000 km (2013).

With the rapid development of rural road, continuous improvement of the rural traffic conditions and rapid increase of motor vehicles in rural road, rural road accidents are prone and the situation is grim. In 2012, for example, rural road accidents accounted for 40.76% of all accidents, the deaths accounted for 33.91 percent of nationwide traffic fatalities and the injured accounted for 39.98% (2013).

Ma Zhongying (2010) analyzed the status and trends of rural road traffic safety from 4 aspects: people, vehicle, road and environment. At the same time he analyzed the influence factors of rural road traffic safety and proposed solutions. Zhang Changsheng (2010) using statistical analysis method analyzed the morphology of highway accidents and temporal distribution characteristics and found that nearly half of the highway traffic accidents in mountains were rear-end accidents, followed by collisions and rollovers. Wang Jianjun (2005) analyzed the characteristics of highway accidents through the highway accidents’ type, cause, form distribution and weather. Wang Hui (2009) analyzed the spatial and temporal distribution, accident forms and causes of highway tunnel accidents, then proposed countermeasures to control and reduce the traffic accidents. Liu Tangzhi (2008) analyzed the road traffic accidents’ time, forms, vehicle types, road types of the integration of urban and rural areas and proposed countermeasures to prevent and control the traffic accidents. Chen Kuanmin (2003) analyzed the temporal distribution, the spatial distribution and population distribution and other characteristics of urban road traffic accidents through studying the typical city of Xi'an, and explored the related countermeasures to control and reduce urban road traffic accidents. Pei Yulong (1998) analyzed and studied the causes, monthly distribution, accident forms, road types and levels of traffic accidents obtaining corresponding results of road traffic accidents in cold areas.

From the previous studies, it can be seen that the studies of accidents time distribution, spatial distribution, form distribution, vehicle types and causes and other
characteristics are thorough which include urban road, highways (highway tunnel), integration road of urban and rural areas and cold area road. However, the studies on the distribution characteristics of rural road accidents are few.

Therefore, based on the traffic accident data of Pucheng, Shanxi Province, Xi’an of 2012, using the method of statistical analysis analyzed the rural road accidents’ characteristics of time, spatial, accident forms, and vehicle types, and then proposed countermeasures to control and reduce rural road accidents.

THE BASIC SITUATION OF RURAL ROAD AND ACCIDENTS

In order to clearly understanding the distribution characteristics of rural road accidents, a research has been done in Pucheng and got the traffic accident data of 2012. There are 759 rural roads of different levels and 2256.475 km, including 9 county roads which length is 241.449 km, 41 township roads which length is 320.586 km, 2 dedicated roads which length is 8.314 km, and 707 village roads which length is 1686.126 kilometers. Rural road density is 142.5 km/one hundred square kilometers, as shown in Table 1. In 2012, there were 813 traffic accidents in the county’s rural road which resulted 68 deaths and 582 injured. Based on the research needs, count the data of accident time, the accident sites, the number of casualties, vehicle types, accident types, accident forms and illegal accident.

DISTRIBUTION CHARACTERISTICS OF ACCIDENTS

Characteristics of time distribution

Time distribution refers to the statistical characteristics of the accident with the change of time. Researching and discovering time distribution of traffic accidents is helpful to highlight and strengthen the focus of time in practice. This paper analyzed the hourly distribution and monthly distribution of traffic accidents and casualties.

Monthly distribution

Monthly distribution varies with the effect of local geographical factors, climatic conditions and travel habits. The research of monthly distribution can be used to develop and implement preventive measures for each month and effectively control and manage traffic safety. The number of accidents, death and injured of each month throughout the year were shown in figure 1.

It can be seen from Figure 1 that traffic accidents were maximum in October and the casualties were serious. In the two consecutive months of July and August together with December and January, accident incidences were high, traffic accidents were frequent and casualties were serious. Most of the injured occurred in July and August accounting for 20.62% of the year; and the largest number of deaths was in December and January accounting for 22.73%.

<table>
<thead>
<tr>
<th>Month</th>
<th>The number of accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>71</td>
</tr>
<tr>
<td>Feb</td>
<td>68</td>
</tr>
<tr>
<td>Mar</td>
<td>64</td>
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<td>Apr</td>
<td>65</td>
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<td>May</td>
<td>65</td>
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<tr>
<td>Jun</td>
<td>67</td>
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<td>Jul</td>
<td>67</td>
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<tr>
<td>Aug</td>
<td>65</td>
</tr>
<tr>
<td>Sep</td>
<td>63</td>
</tr>
<tr>
<td>Oct</td>
<td>64</td>
</tr>
<tr>
<td>Nov</td>
<td>71</td>
</tr>
</tbody>
</table>

(a) Monthly Distribution of Accidents
According to the information and field research, the Mid-Autumn Festival and National Day are both in October, so the travels are many. At the same time it is the busy harvest season with prominent phenomenon of occupying road to dry crops which has great influences on safe driving. In December and January, affected by rainy, snowy and fog weather the drivers’ sight become deteriorate which leads to the accident-prone and more serious accidents.

Hourly distribution

Hourly distribution is closely related to people's lifestyles and travel habits. The number of accidents, death and injured within each hour were shown in Figure 2.

As can be seen from Figure 2 that accident-prone period was 10:00-20:00. The number of accidents, death and injured accounted for 65.07%, 62.12% and 69.93% of the total. The overall regular of hourly distribution showed that as the high incidence of accidents, each hour had 61 and 60 accidents in 14:00-16:00.

In rural, people travel mainly at 10:00-20:00. At 1:00-12:00, because of approaching lunch, large traffic flow and irritable drivers, accidents are prone. 12:00-14:00 is lunch time with fewer accidents. At 14:00-16:00 the travels increase after lunch, and fatigue driving often happen especially in the hot summer weather. At 18:00-20:00 the trips going home are large, and the light line becomes dim, which show the characteristics of accident-prone in rural road. The small accident peak at early morning is mainly caused by the fatigue driving of truck drivers.
Spatial distribution

Spatial distribution of accidents mainly refers to the accidents’ number description which happen in a region within a certain time. This paper studied the proportion of accidents in different administrative levels and the accident sites at rural road.

Road distribution

Rural road include county road, township road and village road divided by road administrative level. The proportion of the county's accident was shown in Fig.3. The proportion of accidents at township road was the highest which was 40.61%.

According to the road mileage of each administrative level, got the accident rate per hundred kilometers of each administrative level, as shown in Table 1. From high to low, the order was township road, county road and village road. And the rates were 12.67%, 11.40% and 1.89% respectively.

In summary, most accidents occurred in rural road, and accident rate per hundred kilometers was the highest. The accident proportion of village road was slightly higher than the county road, but the accident death rate per hundred kilometers of township road was much lower than the county road.

<table>
<thead>
<tr>
<th>Administrative Level</th>
<th>County Road</th>
<th>Township Road</th>
<th>Village Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mileage (km)</td>
<td>241.449</td>
<td>320.586</td>
<td>1686.126</td>
</tr>
<tr>
<td>Accident Rate per Hundred Kilometers</td>
<td>11.40%</td>
<td>12.67%</td>
<td>1.89%</td>
</tr>
</tbody>
</table>

Figure 2. Hourly Distributions.

Figure 3. Proportion of Accident on each Administrative Levels’ Roads.
Location Distribution
According to the data, the accident locations are divided into the intersections, roads and streets of town. Proportions of accident in different locations were shown in Figure 4.

![Figure 4. Proportion of Accident in Different Locations.](image)

As shown in Figure 4, the accidents proportion of intersections was 42.30% which was the highest. Farm vehicles and motorcycles often collide and scrape at the intersection with the lack of traffic safety facilities, and the lack of traffic safety awareness and knowledge.

Characteristics of accident form distribution
Accident form refers to the external representation of traffic accidents. Accident form can be divided into frontal collision, side collision, roll-over, rear-end, rolling, falling car, fire and the other. The proportion of the accident forms was shown in Figure 5.

As shown in Figure 5, the accidents’ top three accident forms were frontal collision, side collision and roll-over, with the sum accounting for 79% of all the accidents. Collision was still the main form accounting for 73%. Therefore, improving road conditions, increasing road safety facilities can reduce the incidence of rural road collisions.

![Figure 5. Proportion of Accident in Accident Forms.](image)

Characteristics of accidents’ vehicle type distribution
According to the number of vehicles in accidents, rural road traffic accidents are divided into single vehicle accidents, two-vehicle accidents and multi-vehicle accidents, as shown in Figure 6.
As shown in Figure 6, two-vehicle accidents occurred mostly, and multi-vehicle accidents rarely occurred. Among them, two-vehicle accidents were 624 times, accounting for 76.75 percent of the total accidents, which had a strong relationship with the sum of the collisions accounted for 73.0% of all accidents. Statistics the vehicle types among which other vehicles included forklift trucks and other engineering vehicles, and other Non-motor vehicles included disabled scooter, shelf vehicle and other models. The proportion of accident in vehicle types was shown in Figure 7.

As shown in Figure 7, the top three types were small bus, motorcycles and heavy truck, respectively accounting for 40.26%, 20.20% and 10.38%. This showed that with the improvement of rural household income, minibuses, motorcycles and motorized tricycles and other vehicles poured into ordinary family.

Characteristics of illegal accidents distribution
Analyzing illegal accidents’ distribution can explore the cause of the accidents, and has great value in managing the traffic safety and preventing accidents. The proportion of vehicles whether having licenses was shown in Figure 8.

As shown in Figure 8, the proportion of unlicensed vehicles in accidents was still high, reaching 17.0%. Its distribution was shown in Figure 9. The proportion of motorcycle was as high as 80.0%, accounting for the vast majority of unlicensed vehicle accidents.

In summary: the question that the licensed vehicles travel on rural road is very serious which includes motorcycles, agricultural vehicles, motor tricycles and minibuses.
ACCIDENT PREVENTION MEANS

Engineering means: set scientific and rational security facilities

In engineering, first the change from the "Pay attention to construction and slight conservation" to "Pay attention to construction and conservation" is needed; secondly, in order to reduce two-vehicle accidents set up traffic signs and markings and other traffic safety facilities on rural road reasonably. Set up appropriate guardrail according to road traffic environment to reduce rollover accidents and casualties. Set up appropriate instructions and warning signs at a suitable distance before the village streets and reduce accidents on the streets of towns and villages. Considering the characteristics of monthly distribution, the road maintenance in winter should be strengthened particularly to reduce the collision on rainy day and snowy day.

Administration means: Take measures of targeted administration

For the administration of people, the investigation and punishment should be enhanced especially in the aspects of alcohol, speeding and illegal overtaking, stop, turning around, etc. For the administration of the car, the tax burden of rural vehicles should be reduced. And in order to increase the licensed rate the license service should be provided at home. For the administration of the road, since the proportion of rural road accidents and fatal accident rate per hundred kilometers are the highest, the administration of rural road and township road should be strengthened.

For the administration of the traffic, according to the accident time distribution, it is quite important to strengthen the law enforcement in summer and winter, in the period of accident-prone (14:00-16:00), the peak of the casualties of a day (11:00-12:00, 14:00-16:00 and 18:00-20:00) and the small peak of accident on early morning (24:00-02:00).

Education means: carry out flexible publicity education

Help the drivers understand the distribution of traffic accidents on rural road, improve drivers’ traffic safety awareness. Strength the safety education of fatigue driving in summer, fatigue driving at night and safe driving at rainy and snowy day. Carrying out an education exhibition of traffic accident picture can improve traffic safety and legal awareness of rural drivers.

CONCLUSION

(1) According to analyzing the traffic accident statistics of a county of Xi’an in 2012, the distributions of rural road accidents were provided.

(2) For the distribution of rural road accidents, the measures were proposed to reduce road accidents in rural areas from engineering, administration and education which provided a basis to improve the rural road traffic safety level.

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REFERENCES