ANALYSIS OF ROAD SAFETY IN A SMALL PROVINCIAL RURAL AREA IN QUEENSLAND

Lal C. WADHWA
Head, Civil and Environmental Engineering
School of Engineering
James Cook University
Townsville Queensland Australia 4811

E-mail: Lal.Wadhwa@jcu.edu.au
Tel: +61 7 4781 4290
Fax: +61 7 4775 1184

Abstract: The frequency, severity, nature, and causes of road accidents in a provincial rural district have been analysed and compared to urban and state road accident statistics with a view to ascertaining if the pattern and nature of accidents and, hence, the road safety issues in provincial and rural districts are different than in urban areas. In the former, the type and mix of vehicles used, the work travel patterns, seasonal influences, road conditions, the mix of local and through traffic, and driver's attitudes and education may not be identical to the urban environment. It is, therefore, not surprising to find important differences in the patterns of road crashes and road safety issues. The study has involved a comprehensive data analysis of road accidents in the Burdekin district - a predominantly agricultural district in North Queensland in Australia - over a period of six years. The results have far reaching implications in managing road safety in provincial districts.

1. INTRODUCTION

Across Australia, road safety has consistently been judged as one of the most important road transport issues. There is a perception that roads and cars are gradually becoming safer, and the governments are focussing a lot of attention and resources on road safety problems and education. Special efforts have been targeted towards speeding and drink driving. Some of the road safety initiatives introduced since 1970, which have contributed, to the reduction in road fatalities include

- Compulsory seat belt wearing for car occupants (1972)
- Reduction in blood alcohol level to 0.05 per cent (1982)
- Introduction of random breath testing (1988)
- Introduction of random road watch (1991)
- Compulsory helmet for cyclists (1992)

These initiatives have led to a gradual reduction in the number of road fatalities on Australian roads inspite of continual increase in population, number of vehicles, and the travel task. Although the fatality rates have dropped, the number of road crashes is considered still too high. Strategies are in place to reduce the toll further (Queensland Transport, 1988)

In an effort to devise effective road strategies for provincial rural areas, it is essential to discern if the road accident characteristics in these areas are different to those in urban areas, and to identify road safety problems, which are peculiar to rural areas. This study is targeted towards these objectives.

2. QUEENSLAND ROAD ACCIDENTS STSTISTICS

Queensland road toll for 1996 was 385 fatalities – the lowest for 35 years. There has been a steady decline in the number of fatalities since the 1980's. The general decline in road toll has been achieved despite a steadily rising population and a continuing increase in the number of motor vehicles on register, as shown in Figure 1.

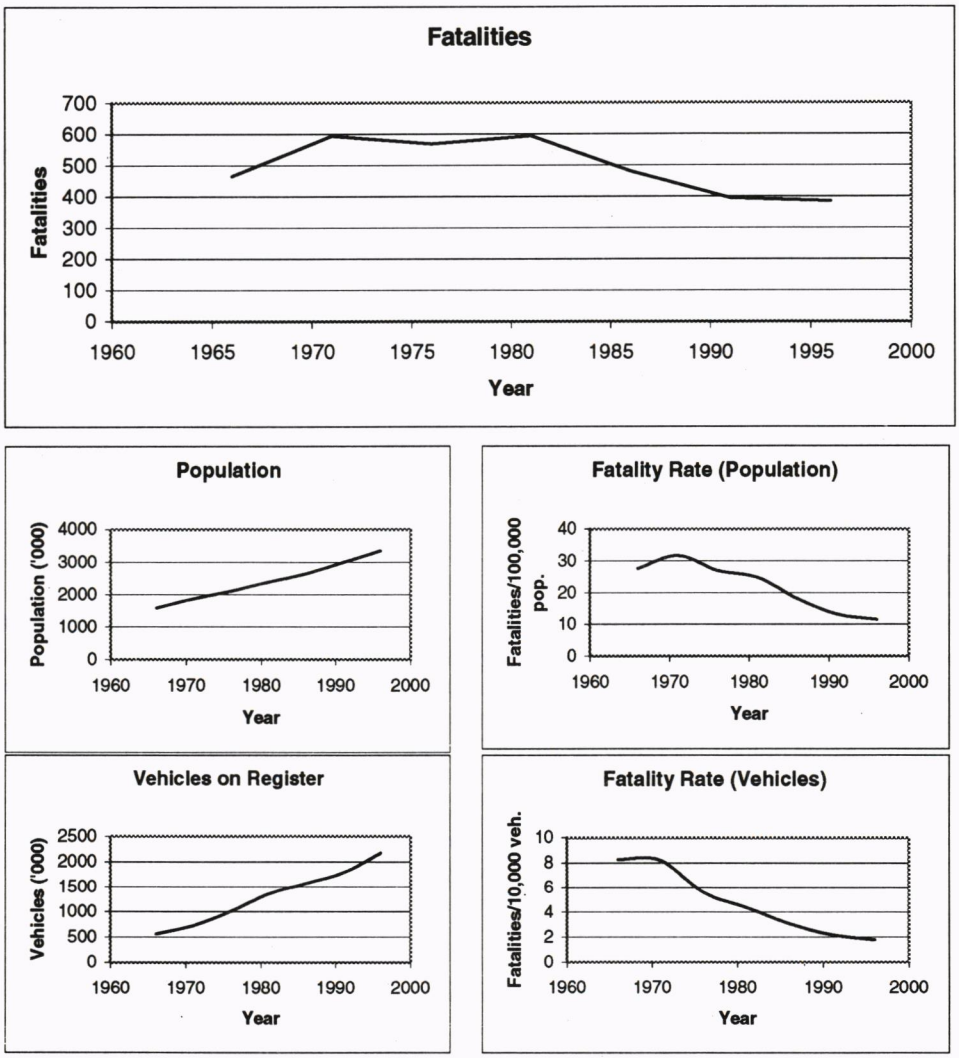

Figure 1: Queensland Road Accident Trends, 1966-96

The fatality rate expressed as the number of fatalities per 100,000 population has dropped to 11.5 from a high of 31.7 in 1971. The corresponding national statistic is 10.8. The fatality rate as a function of number of vehicles has fallen from over 8 fatalities per 10,000 vehicles on register in 1971 to a low of 1.8 in 1996.

The relative trends of key statistics relating to road crashes are shown in Figure 2.

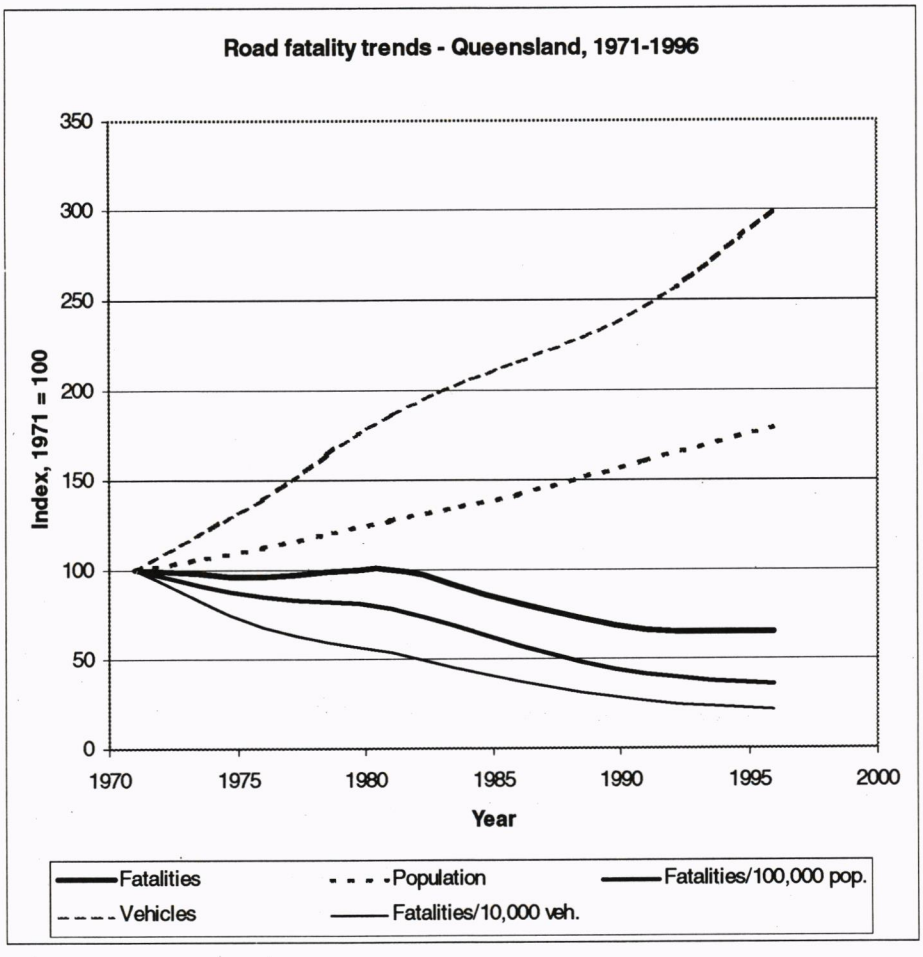

Figure 2: Fatalities, population, and vehicle registration trends, Queensland, 1971-1996

The proportion of crashes for various severity categories has remained relatively constant during 1991-96. For each 100 crashes, there were approximately two fatality crashes, 17 required hospitalisation, about 20 required medical treatment, 10 suffered other injuries, and over half of crashes resulted in property damage only (Queensland Transport, 1997).

3. THE STUDY AREA

The study area is the Burdekin District which is comprised of the towns of Ayr, Home Hill, Brandon, Giru, Clare, Millaroo, Dalbeg, and Alva with the mighty Burdekin Bridge as a centre point, 96 km south of Townsville in the State of Queensland. The area is the centre of the dynamic Australian sugar industry and is fast developing a reputation for its horticulture and aquaculture industries. It is also very popular for fishing, crabbing, wind surfing, and water skiing. Figure 3 shows the study area and its environs.

The major National Highway No. 1 (Bruce Highway) cuts through the middle of the townships of Ayr and Home Hill. It carries the highest volume of traffic in the region with some 433.432 million vehicle kilometers travelled in 1995. An itinerary of major roads in the district is provided in Table 1.

Table 1: Burdekin District Road System

Road Number	Road Name
10K	Bruce Highway (Bowen to Ayr section)
10L	Bruce Highway (Ayr to Townsville section)
545	Ayr – Dalbeg Road
548	Woodstock – Giru Road
5405	Home Hill – Kirknie Road
5472	Ayr – Ravenswood Road

The Burdekin district had a population of 19,254 persons based on 1995 census. Its annual growth rate is –0.09 per cent during 1986-95 (Australian Bureau of Statistics) The major towns in the district – Ayr and Home Hill – are laid out in a grid like manner resulting in a large number of cross intersections. The roads and streets in the district are continuously undergoing redevelopment and improvements. This has led to the alteration of several roadway features. For example, several new roundabouts have been installed since 1996.

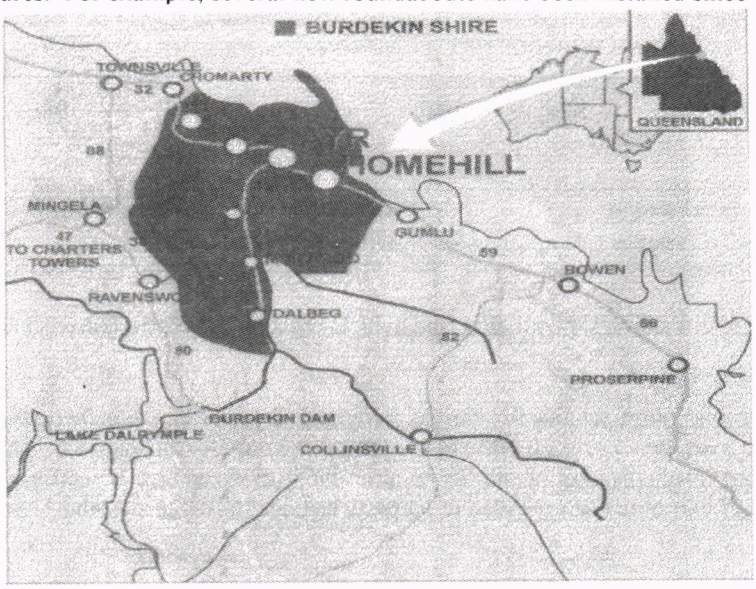

Figure 3: The Study Area

4. COMPARATIVE ANALYSIS

The road accident statistics for the State of Queensland are compared with the capital city of Brisbane and the rural district of Burdekin for the period 1991-96.

4.1 Queensland Statistics

Table 2: Queensland Road Accident Data, 1991-96

Year	Crashes		Occupants		Others		Total	
	total	casualty	killed	injured	killed	injured	killed	injured
1996	20623	11479	279	11891	106	3230	385	15121
1995	21252	11652	299	11864	157	3126	456	14990
1994	20828	10915	285	11089	137	3042	422	14131
1993	19571	9903	289	9833	106	2958	395	12791
1992	19164	9612	280	8913	136	3033	416	11946
1991	18169	8642	268	7631	127	2443	395	10074

Source: Queensland Transport, Annual Reports on Road Traffic Crashes in Queensland

Over the past five years (1991-96), a total of 119,607 accidents have been reported on Queensland roads. During this period, 2,193 fatal accidents resulted in 2,469 deaths. Each year, approximately ten times that number are seriously injured requiring hospitalisation and a similar number require medical treatment (Queensland Transport, 1997). In rural and remote areas where the fatality rates are highest, the need for a safe rural road system has emerged as a fundamental requirement (Jordan, 1997).

4.2 Capital City (Brisbane City) Statistics

The number of accidents reported in the Brisbane City Council area during 1991-96 totalled 34,190 of which 48 per cent involved casualties. The number of fatalities over this period was 365. This is shown in Table 3.

Table 3: Capital City (Brisbane) Road Accident Data 1991-96

Year	Crashes		Occupants		Others		Total	
	total	casualty	killed	injured	killed	injured	killed	injured
1996	5691	3108	27	3143	24	836	51	3979
1995	6030	3166	30	3137	34	896	71	4033
1994	6183	2954	37	2902	30	864	67	3766
1993	5728	2586	33	2533	17	794	50	3327
1992	5717	2513	26	2251	36	863	62	3114
1991	4841	2057	38	1933	26	689	64	2622

Source: Queensland Transport, Annual Reports on Road Traffic Crashes in Queensland

4.3 Burdekin Shire Statistics

During 1991-96, Burdekin Shire recorded 588 road crashes of which 59 per cent involved casualties. Twenty-three people were killed on roads in the district during this period. This is shown in Table 4.

Table 4: Burdekin Shire Road Accident Data, 1991-96

Year	Crashes		Occupants		Others		Total	
	total	casualty	killed	injured	killed	injured	killed	injured
1996	109	57	5	66	0	7	5	73
1995	87	49	3	53	4	13	7	66
1994	121	66	3	85	0	12	3	97
1993	93	53	2	64	0	11	2	75
1992	102	49	3	50	1	11	4	61
1991	76	37	2	53	0	5	2	58

Source: Queensland Transport, Annual Reports on Road Traffic Crashes in Queensland

4.4 Population and Vehicle Registration Data

The population and vehicle registration data for the State of Queensland, the capital city of Brisbane, and the rural district of Burdekin are presented in Table 5 for the period 1991-96.

Table 5: Population and Vehicle Registration Data, 1991-96

Year	Queensland		Brisbane City		Burdekin Shire	
	Population ('000)	Vehicles ('000)	Population ('000)	Vehicles ('000)	Population ('000)	Vehicles ('000)
1996	3354.7	2171.9	819.59	667.64	18.96	19.18
1995	3277.3	2038.9	801.96	660.20	19.25	18.72
1994	3116.0	1975.5	788.62	653.10	19.23	18.26
1993	3112.6	1847.2	779.10	638.19	19.24	17.60
1992	3030.5	1832.8	770.68	626.69	19.26	17.55
1991	2999.9	1787.0	764.91	622.19	19.25	17.46

Source: Queensland Transport, Annual Reports on Road Traffic Crashes in Queensland; and Government Statistician Office

4.5 Fatalities per 1,000 Accidents

The number of fatalities occurring per 1,000 accidents is a measure of the severity of road crashes. This statistic has been calculated for the capital city and the rural district and compared to the State average. Table 6 shows that there is wide disparity in the number of fatalities per 1,000 accidents with rural district accidents resulting in four times as many fatalities as the capital city. The State average is twice the urban statistic and half of the rural value.

Table 6: Fatalities per 1000 Accidents

Location		1991	1992	1993	1994	1995	1996	1991-96
Queensland	State	21.7	21.7	20.2	20.3	21.5	18.7	20.6
Brisbane	Urban	13.2	10.8	8.7	10.8	11.8	9.0	10.7
Burdekin	Rural	26.3	39.2	21.5	24.8	80.5	45.9	39.1

4.6 Proportion of Crashes Involving Casualties

The proportion of accidents resulting in at least one person suffering an injury (includes fatality, hospitalisation, medical treatment or other injury) is another useful indicator of the severity of road crashes. The complement of this statistic is the proportion of property damages only accidents.

As shown in Table 7, fewer proportion of accidents in the capital city involved casualties i.e. there is a higher proportion of property damage only accidents in the urban area. Whereas 48 per cent of all accidents in the capital city involved causalities, the corresponding proportion for the rural district is 53 per cent.

Table 7: Proportion of Crashes Involving Casualties

Location		1991	1992	1993	1994	1995	1996	1991-96
Queensland	State	47.6	50.2	50.6	52.4	54.8	55.7	52.0
Brisbane	Urban	42.5	44.0	45.1	47.8	52.5	54.6	47.9
Burdekin	Rural	48.7	48.0	57.0	54.5	56.3	52.3	52.9

4.7 Proportion of Crashes per 100,000 Population

A useful measure of accident rate is the number of accidents as a proportion of the population of the area and is expressed as number of accidents per 1,000 population.

As is evident from Table 8, the number of road accidents per 1,000 population is highest in the capital city and least in the rural district. Over 7 accidents occur per 1,000 population in the urban centre compared to just about 5 in the rural district.

Table 8: Proportion of Crashes per 1,000 population

Location		1991	1992	1993	1994	1995	1996	1991-96
Queensland	State	6.06	6.32	6.29	6.68	6.48	6.15	6.33
Brisbane	Urban	6.33	7.42	7.35	7.84	7.52	6.94	7.23
Burdekin	Rural	3.95	5.30	4.83	6.29	4.52	5.75	5.11

4.8 Proportion of Casualties per 100,000 Population

Number of casualties per 1,000 population in the capital city and in the rural district are shown in Table 7 for the period 1991-96. The overall statistic for the State is also shown. The number of casualties per 1,000 population is higher in the urban area compared to the rural region but this may only reflect the higher number of road crashes in the urban area as shown earlier in Table 9.

Table 9: Proportion of Casualties per 1,000 Population

Location		1991	1992	1993	1994	1995	1996	1991-96
Queensland	State	3.36	3.94	4.11	4.53	4.57	4.51	4.17
Brisbane	Urban	3.43	4.04	4.27	4.78	5.03	4.85	4.40
Burdekin	Rural	3.01	3.17	3.90	5.04	3.43	3.85	3.73

4.9 Casualties per Accident

As is evident from Table 10, the number of casualties per accident is higher in rural area than in the capital city, although Table 9 showed that there are higher proportion of casualties per 1,000 population in the urban area when compared to the rural region.

Table 10: Proportion of Casualties per Accident

Location		1991	1992	1993	1994	1995	1996	1991-96
Queensland	State	0.55	0.62	0.65	0.68	0.71	0.73	0.66
Brisbane	Urban	0.54	0.54	0.58	0.61	0.67	0.70	0.61
Burdekin	Rural	0.76	0.60	0.81	0.80	0.77	0.67	0.73

4.10 Proportion of Fatalities

The rate of fatalities per 100,000 population is considered to be a vital statistic in road safety analysis. The long-term trend presented in Figure 2 shows a continuous decline in this statistic. A comparison is made in this section between fatalities per 100,000 population in the rural district with the capital city. Table 11 clearly shows a dramatic disparity in the fatality rate between urban and rural crashes. There are almost three times more fatalities per 100,000 population in rural district compared to the capital city.

Table 11: Proportion of Fatalities per 100,000 Population

Location		1991	1992	1993	1994	1995	1996	1991-96
Queensland	State	13.2	13.7	12.7	13.5	13.9	11.5	13.1
Brisbane	Urban	8.4	8.0	6.4	8.5	8.8	6.2	7.7
Burdekin	Rural	10.4	20.8	10.4	15.6	36.4	26.4	20.0

4.11 Proportion of Crashes per 10,000 Vehicles on Register

The rate of total crashes per 10,000 vehicles is much lower in the rural district of Burdekin compared to the capital city or the State as a whole.

Table 12: Proportion of Crashes per 10,000 Vehicles on Register

Location		1991	1992	1993	1994	1995	1996	1991-96
Queensland	State	102	105	106	105	104	95	101
Brisbane	Urban	78	91	90	95	91	85	88
Burdekin	Rural	44	58	53	66	46	57	54

4.12 Proportion of Fatalities per 10,000 Vehicles on Register

Table 13 shows that fatalities per 10,000 vehicles in the capital city are less than half of the corresponding State or the rural district rates. In 1996, whereas the State rate was 1.77 fatalities per 10,000 vehicles, this statistic had a value of 2.6 for the rural district but only 0.76 for the capital city.

Table 13: Proportion of Fatalities per 10,000 Vehicles on Register

Location		1991	1992	1993	1994	1995	1996	1991-96
Queensland	State	2.21	2.27	2.14	2.14	2.24	1.77	2.13
Brisbane	Urban	1.03	0.99	0.78	1.03	1.08	0.76	0.95
Burdekin	Rural	1.14	2.28	1.14	1.64	3.74	2.61	2.09

5. BURDEKIN ROAD ACCIDENT DATA

5.1 Accident Data

The data for this study were obtained from Queensland Transport. The data covering the six-year period (1992-97) involved 632 individual records. The crashes had to meet the following criteria in order to be included in the database:

The crash occurred on a public road and
- ❖ a person is injured or
- ❖ the value of property damage is greater than $2,500 after 1 December 1991 ($1,000 prior to this date) or
- ❖ at least one vehicle is towed away

The data were categorised into 28 fields. Some of these fields are discussed below:

5.2 The Roadway Feature

There are nine descriptors of roadway feature in the database, as shown in Table 14.

Table 14: The Roadway Feature

Code	Description
10	Intersection – Cross
11	Intersection – T Junction
12	Intersection – Y Junction
13	Intersection – Multiple Road
15	Intersection – Roundabout
20	Bridge, Causeway
30	Railway Crossing
50	Merge Lane
99	Not Applicable

5.3 Descriptive Crash Action Code

There are 89 Descriptive Crash Action (DCA) codes listing almost every possible accident scenario. These codes categorise the type of accident for statistical purposes.

5.4 Traffic Control

The types of traffic control at the intersections are given in Table 15. This data is very useful for conducting an engineering analysis of the accidents occurring at the

intersections. The location of traffic control devices and their visibility to the driver has also been examined. Code 99 – no or unknown traffic control – has been used to characterise accidents at non-intersection locations as well as at uncontrolled intersections.

Table 15: Traffic Control Devices

Code	Traffic Control Device
2	Road/Rail worker
4	Operating traffic lights
6	Railway lights only
8	STOP sign
9	Give Way sign
10	Railway Crossing sign
11	Pedestrian Crossing sign
99	No or unknown traffic control

5.5 Crash Severity

Accidents are stratified by severity where the severity of an accident is based upon the most severe injury sustained by any person involved in the accident. Severity is an important dimension of an accident as it is often used to rank accidents and different monetary values are placed on accidents of different severity for the purpose of evaluation. The database provides five classification of severity:

- Fatality
- Hospitalisation
- Medical treatment
- Minor injury
- Property damage

A fatal accident is one in which a death occurs within 30 days after the accident. Property damage must exceed $2 500 for an accident to be reported to the Police and be recorded in the database.

5.6 Unit Type

Seventeen descriptions of unit types (car/station wagon, bus, tractor, pedestrian etc.) are used in the database with codes from 1 to 15 and 97 – 98.

6. DETAILED ANALYSIS OF BURDEKIN ROAD ACCIDENT DATA

The data were first checked for errors (logic, repetition, incomplete etc.). Data, which appeared, suspect were flagged and related to data from other accompanying files. Data were sorted into the following six classifications: location, time of year, type of accident, severity, vehicle type, and contributing circumstances

6.1 Accident Frequency

There were 632 accidents in the district over the study period. Figure 4 shows the number of accidents for each year. It shows the lowest number of accidents in 1995, an increase of about 25 per cent in 1996, and no change in 1997 compared to 1996. This led to the perception of a significant increase in number of accidents in the district. Although this perception is correct when viewed in the context of 1995 data, the number of accidents in 1996 and 1997 are just about the average during the study period.

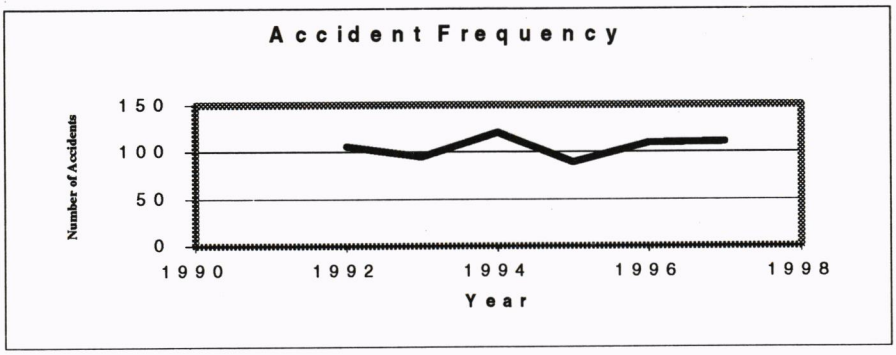

Figure 4: Accident Frequency in the Burdekin District

6.2 Seasonal Variations in Accident Frequency

Figure 5 shows the average number of accidents for each month in the district. It is obvious that there are far more accidents in the second half of the year compared with the first half. No plausible explanation can be offered for this surprising trend recognising that the periods of fewer accidents coincide with intense harvesting activity.

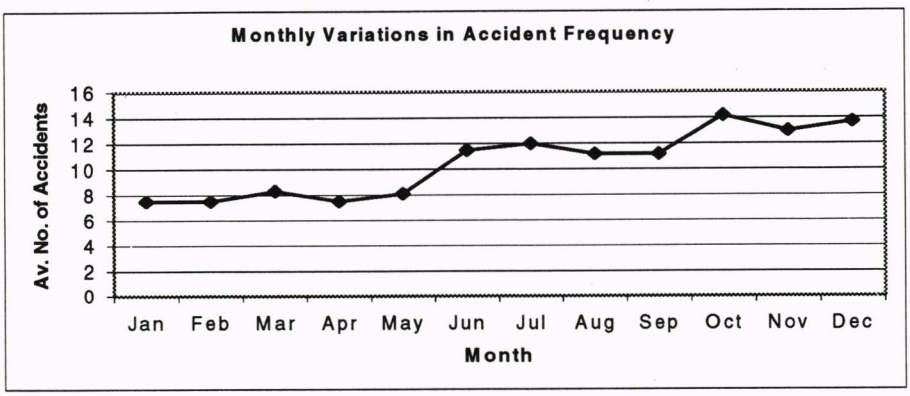

Figure 5: Monthly Variation in Accident Frequency

6.3 Accidents Severity

Table 16 shows the severity of accidents over the study period. Although only about 2 per cent of all crashes in Queensland involve fatalities, this proportion is about twice the state average. Over the six-year period, there were 22 fatalities among 632 accidents.

Table 16: Accident Severity

Year	Fatality	Hospitalisation	Medical Treatment	Minor Injury	Property Damage	Total
1992	4	20	16	11	55	106
1993	2	19	23	9	42	95
1994	2	24	27	13	55	121
1995	7	17	16	9	40	89
1996	5	15	29	8	53	110
1997	2	24	30	5	50	111
Total	22	119	141	55	295	632

6.4 Accidents by Time of Day

Most of the accidents occur between 8 am to 8 pm with peak coinciding with the peaks of the commuter period between 8 – 10 am and more predominantly with the afternoon peak between 4 – 6 pm. This is common with urban accident patterns.

6.5 Accident Classified by Road Feature

Table 17 shows the frequency of accidents by road feature.

Table 17: Accident Frequency by Road Feature

Roadway Feature	Number of Accidents in						
	1992	1993	1994	1995	1996	1997	Total
Intersection, Cross	28	34	39	22	43	41	207
Intersection, T	12	8	12	7	15	14	68
Intersection, Y	1	1	0	0	0	1	3
Intersection, multiple	0	0	0	0	1	0	1
Intersection, roundabout	1	0	2	1	1	0	5
Bridge, Causeway	5	4	8	7	4	2	30
Railway Crossing	0	2	3	1	3	1	10
Merge Lane	0	0	1	0	0	0	1
Not applicable	59	46	56	51	43	52	307
Total	106	95	121	89	110	111	632

There were 284 cases of intersection accidents during the study period. Of these 73 per cent occurred at cross intersections.

6.6 Accidents Classified by DCA Code

The majority of accidents occurred at intersections when the two vehicles tried to cross the junction perpendicular to each other. The next most commonly occurring accident is the rear end collision caused between two vehicles travelling in the same direction and the right rear accident when the driver tried to avoid a rear end by swerving to the right. The frequency of head-on collisions is also significant.

6.7 Accidents Classified by Traffic Control

A majority of accidents in the Burdekin district occurred at uncontrolled intersections or on straight roads. The predominant cause of such accidents is the failure to give way to the vehicle approaching from the right. Better system of driver education and installation of more road signs will appear appropriate.

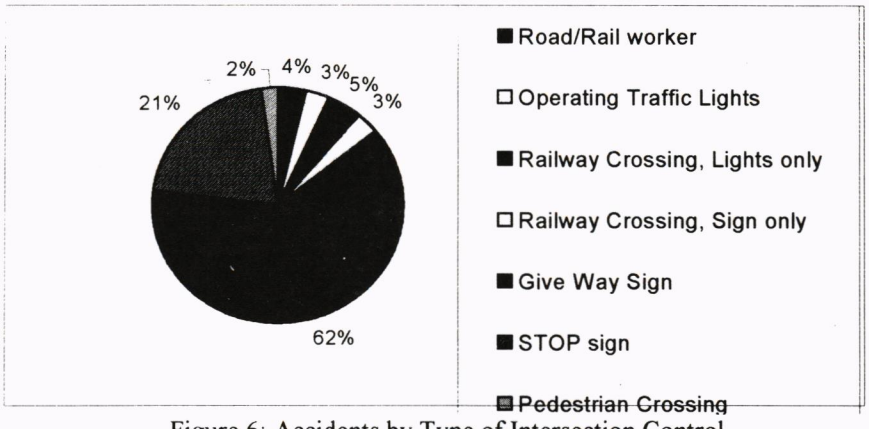

Figure 6: Accidents by Type of Intersection Control

Of the controlled intersections, the highest proportion of accidents occurred at intersections with "Give Way" sign, as shown in Figure 6. The research has shown that the predominant cause of these crashes is the failure of the driver to see the oncoming or turning vehicle until it is too late.

6.8 Accidents by Location

Of the top ten accident locations, eight were at intersections. All ten locations were on National Highway 1 (Bruce Highway) and accounted for 77 accidents over the study period. The number of accidents at each of the ten "black spots" varied between 6 and 11.

6.9 Accidents by Unit Type

Cars / station wagons were involved in 76 per cent of all accidents in the district. This is consistent with the large number of cars and station wagons in the vehicles registered.

6.10 Contributing Circumstances

Table 18 shows the distribution of accidents based on the contributing circumstances.

Table 18: Accidents and Contributing Circumstances

Contributing circumstances	Number of crashes	Major categories *
Lighting conditions	26	Sunlight glare (11)
Weather conditions	16	Rain (10)
Road conditions	42	Wet slippery road (12) Gravel/dirt road (10)
Driver violation of traffic law	422	Failing to give way (165) Undue care and attention (107) Alcohol-related (45) Disobey stop sign (24) Follow too closely (19)
Vehicle defect	21	Tires (12)
Driver condition	71	Inexperience (28) Fatigue (10)
Other conditions	34	Uncontrolled animal on road (18)

**The numbers in parentheses show the number of accidents attributed to each contributing factor.*

As expected, the majority of accidents were caused by improper driver behaviour. The results are exhibited in Figure 7.

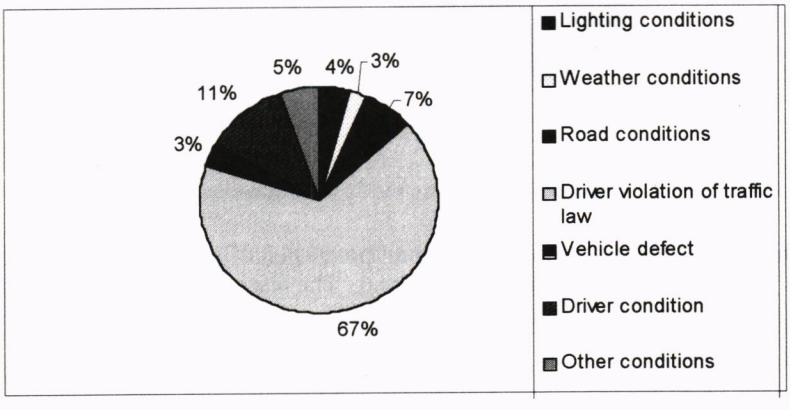

Figure 7: Accidents and the Contributing Factors

Comparing the contribution of factors to accidents and fatalities, it is interesting to see that

- ❖ while alcohol/drugs are contributing factors for about 9% of all crashes, they account for over 30% of fatal crashes
- ❖ fatigue accounts for 2% of all crashes but 6% of fatal crashes
- ❖ speeding is the main cause for 4 % of all crashes but 14% of fatal crashes

Thus alcohol, speeding and fatigue increase the risk of fatality in case of a crash by 300-400%.

The violation of traffic rules, driver negligence, road conditions, and vehicle defects result in comparable proportion of accidents in rural area as in the State as a whole.

About two-thirds of all accidents in the Burdekin district were caused by drivers disobeying traffic rules. For whole of Queensland, this proportion is about 40%.

7. DISCUSSION AND CONCLUSIONS

In this study the road accident characteristics of a rural district have been investigated and compared to the State road crash data. Long-term trends in accident frequency and rate have been studied and comparison of key measures of accident situation has been made between the whole State, the capital city of Brisbane and the rural district of Burdekin.

As a result of several safety initiatives introduced since early 70's, the fatality rate in the State has dropped significantly – from 31.7 fatalities per 100,000 population in 1971 to 11.5 in 1996. The fatality rate expressed as a function of number of vehicles has dropped from 8 fatalities per 10,000 vehicles to 1.8 during the same period.

For each 100 crashes, there are approximately two fatality crashes, 17 required hospitalisation, 20 required medical treatment, 10 suffered other injuries, and about half of all crashes resulted in property damage only.

There is a wide disparity in the number of fatalities per 1,000 accidents between the rural district and the capital city. Accidents in rural district result in four times as many fatalities as the capital city. The State average is twice the urban value but half of the rural value. Fewer proportion of accidents (48%) in the capital city involve casualties (or higher proportion of property damage only accidents) than in rural area (53%).

The number of road accidents per 1,000 population is higher in the capital city with over 7 accidents compared to rural district with about 5 accidents per 1,000 population. The number of casualties per 1,000 population is also higher in the capital city reflecting the higher accident frequency. However, the number of casualties per accident is lower in the capital city compared to the rural district. There are almost three times more fatalities per 100,000 population in rural area compared to the capital city. The 1991-96 average figures for the State, capital city and rural district are 13.1, 7.7 and 20.0 respectively.

The accident frequency in the Burdekin district has significant variations from year to year but there is no clear trend. There are far more accidents in July to December than in the first half. No plausible explanation has been found for this pattern.

Over half of all accidents occurred at intersections. Of all intersection accidents, over 73 per cent occurred at cross intersections. The majority of accidents occurred when two vehicles tried to cross the intersection perpendicular to each other. The next most commonly occurring accident is the rear end collision caused between two vehicles travelling in the same direction, and the right rear accident when the driver tries to avoid a rear end collision by swerving to the right.

The number of crashes per 10,000 vehicles is much lower in the Burdekin district when compared to the capital city or the whole State. There is also a remarkable difference in

the number of fatalities per 10,000 vehicles, with rural value being twice the corresponding capital city figure.

Of the ten top accident locations, eight were on intersections and two on bridges.

8. ACKNOWLEDGEMENTS

The analysis of Burdekin district data was carried out by Shaji Sugathan as part of his thesis project for the degree of Bachelor of Engineering at James Cook University under the supervision of the author.

9. REFERENCES

Australian Bureau of Statistics, various Bulletins, AGPS, Canberra, Australia

Government Statistician's Office (1999), pers. comm. 11 Jan. 1999, Brisbane, Australia

Jordan, C.,(1996) Strategic Management in the 90's, *Road and Transport Research*, 6(1), p. 4-17

Queensland Transport, "Queensland Road Safety Action Plan, 1997-98" Catalogue No. PBS 0290, Brisbane, Queensland, Australia

Queensland Transport (1999) pers. comm. 12 Jan. 1999, Brisbane, Queensland, Australia

Queensland Transport, Road Traffic Crashes in Queensland, 1991-96, Brisbane, Australia