Mansoura Engineering Journal

Volume 26 | Issue 2 Article 1

6-1-2001

Understanding the Relationship between Gross Population and Traffic Accidents in Jordan.

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UNDERSTANDING THE RELATIONSHIP BETWEEN GROSS POPULATION AND TRAFFIC ACCIDENTS IN JORDAN

توضيح العلاقة بين الكثافة السكانية و حوادث المرور في الأردن

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خلاصة :

إن الازدياد المستمر في عدد حوادث الطرق في العقد الأخير في الأردن قد تسبب في ازدياد أعداد الوفيات والجرحى. ويعزى الوضع المروري الحرج بالأردن إلى عدة أسباب منها: غياب سياسة واضحة لإستخدام الأراضي تربط بين هذا الإستخدام ونظام النقل، بالإضافة إلى غياب نظام نقل عام آمن يمكن الإعتماد عليه، وتركيز العمل ودوائر الدولة في العاصمة ومراكز المحافظات. تبحث هذة الورقة في العلاقة بين الكثافة السكانية وعدد حوادث الطرق لمختلف محافظات الأردن. ولقد توصل الباحثان إلى أن الحوادث المرورية العالية ذات الحدة القليلة قد وقعت في المحافظات ذات الكثافة السكانية العالية، بينما كانت الحوادث المرورية الأقل عدداً وذات الحدة الأعلى في المحافظات ذات الكثافة السكانية المنخفضة. ولقد توصلا أيضا إلى أن حافلات نقل الركاب قد اشتركت في حوادث مرور بنسبة أعلى من نسبتها من مجموع السيارات المسجلة. ومن التوصيات في هذه الورقة إيجاد سياسة واضحة لإستخدام الأراضي للمساعدة في تشكيل نظام نقل في الأردن الأمر الذي يساعد في تحديد الأهداف والغايات التي تساهم في تقليل حوادث النقل وحدتها في الأردن.

BSTRACT

Jordan has experienced in the last decade a continuous increase in the number of accidents, which has resulted in a high number of fatalities and injuries. There are many reasons behind this critical traffic situation in Jordan. Some of these reasons are the lack of well-defined land use policies that relate the development pattern and density to transportation, the unsafe and unreliable transportation system, and the concentration of jobs and governmental services in the center of the capital and governorates.

This paper studies the relationship between the gross population density and the total number of accidents for the different governorates in Jordan. It was concluded that the people of the governorates with high gross population density are involved in more accidents with low severity indices than those of the governorates with less gross population density. On the other hand, the people of the governorates with less gross population densities are involved with fewer accidents but with high severity indices. It was also found that buses are involved in more aceidents than their share of total traffic. This paper recommended, among otherthings, a development of land use policy to shape the future transportation system in Jordan and consequently set the goals and objectives to reduce the number of accidents and their severity.

Key Words: Population Density, Traffic Accidents, Scverity Index

Accepted April 18, 2001

INTRODUCTION

Transportation has always been closely related to the shape of settlement and the use of land. Jordan as one of the developing countries lacks defined land use policies that control the development patterns and directly impact the transportation system.

The absence of well-defined land use policies has resulted in scattered development without any control or interference from the local and central government. It should be pointed out that the way we set our activities has a great effect on the transportation system. Concentrated and high- density land use is better than dispersed and low - density activities.

As a result of unplanned and random land development, the private cars become the predominant mode in transportation in Jordan. The number of registered vehicles in Jordan has jumped from 232,367 in the year 1986 to 297,634 vehicles in the year 1996 with an increase of 28 % [1]. The price that society pays as a result of lack of land use policies and in an auto-dominated environment is in the form of injury and loss of life. The total number of accidents in Jordan rose from 13,436 accidents in the year 1986 to 33,784 accidents in the year 1996 with an increase of 151 % in eleven years [1].

The purpose of this study is to examine the implications of density of population on accidents. Recommendations center around formulating a relationship between the population density and transportation' accidents in Jordan.

THE POPULATION

The 1996 statistics yearbook [1] showed that the population of the different governorates were re-estimated for the years between 1979 and 1996 based on the 1979 and 1994 census. The number of returnee as a result of the Gulf crises were taking into account in estimating the annual growth rates between the years 1990 and 1992. Table 1 shows the percentages of annual growth based on the previous reference that was used in this study to re-estimate the population.

Table 1: The Annual Population Growth Rates

Year	annual growth (%)
1980 –1990	3.8
1990-1991	9.8
1991-1992	6.5
1992-1996	3.7

It is important to point out that the Hashemite Kingdom of Jordan consists today of twelve governorates as follows: Amman, Mafraq, Zarqa, Balka, Irbid, Ajlune, Jarash, Madaba, Karak, Tafiela, Ma'an, and Aqaba. Five of them were declared in the year 1994 as separate governorates. They were

originally parts of existing governorates. These governorates are Ajlune and Jarash that were separated from the Governorate of Irbid, Tafila was separated from the Governorate of Karak, Aqaba was seperated from the Governorate of Ma'an, and Madaba was separated from the Governorate of Amman.

Table 2: The Population of the Different Governorates of Jordan

Year	Population In the Different Governorates of Jordan							
	Amman	Mafraq	Zarqa	Balqa	Irbid	Karak	Ma'an	Total
1986	1150987	121876	436641	189850	663151	158671	113355	2834531
1987	1194725	126507	453233	197064	688351	164700	117662	2942242
1988	1240124	131314	470456	204552	714508	170959	122133	3054046
1989	1287249	136304	488333	212325	741659	177455	126774	3170099
1990	1336164	141484	506890	220393	769842	184198	131591	3290562
1991	1467108	155349	556565	241992	845287	202249	144487	3613037
1992	1562470	166541	592742	257721	900231	215359	153879	3848943
1993	1620281	171569	614673	267251	933540	223365	159573	3990252
1994	1680231	177917	637416	277146	968081	231630	165477	4137898
1995	1742400	184500	661000	287400	1003900	240200	171600	4291000
1996	1806869	191327	685457	298034	1041044	249087	177949	4449767
Area in Km^2	10239	26435	4080	1076	2435	5331	39746	89342

Therefore and due to the lack of available data for these new governorates before the year of their declaration, and due to the diffieulty in estimating their share in the eonsidered accident and other data between the years 1986 and 1996, it was found eonvenient in this study to keep this data as a part of the data of the governorates from where they were originated.

Table 2 shows the population of the seven governorates (that were existing before 1994) between the years 1986 and 1996. The total population of Jordan in the year 1986 was caleulated to be 2,771,894 and increased to 4,4491,767 in the year 1996 with a rate of growth of 60.5 % in a period of eleven years.

POPULATION DENSITY

Population density is the most common measure of population concentration. Gross population density refers to the total population of an administrative or politieal jurisdiction divided by the total land area within its boundaries. The population density of developed land exeludes from the denominator the land that is not in urban use.

This gross population density will be used in this paper rather than the population density of developed land because of laek of information on urban and rural land areas in Jordan. In spite of the fact that travel occurs mostly between buildings, and takes plaee in streets and other right of way, in Jordan as most of the developing countries, a large number of trips take place between small towns, villages, and the center of governorates every day. This is because of the concentration of jobs and governmental services in the major cities, mainly the centers of the governorates. Jordan likc the rest of the world has experienced growth of its suburban areas.

The new urban form is arising due to the astounding land price, lack of parking spaces. and the higher taxes. Suburban population growth has paved the way for growth of business in the suburban areas. Jordan in the last eleven years has experienced an establishment of business and factories just outside the borders of the major cities. For example, a traveler from Amman to the south will notice new factories along the highway that did not exist few years ago. The major industrial cities are not limited to Amman City any more. While there was only Sahab Industrial City near Amman few years ago, other big industrial-city was built in the north near Irbid, Al Hassan Industrial City, and a new industrial-city near Karak in the south is already under construction.

This analysis highlights the importanee of the travel between the rural and suburban areas and the center of the governorates, and also between the major cities and Amman, the capital of Jordan. It also presents importance of the gross population density on the travel in Jordan. Table 3 shows the gross population densities for the different Governorates in Jordan for the years 1986 to 1996 in persons/ km^2.

Table 3: The Gross Population Density in the Different Governorates of Jordan.

Year	Population Density (Person/km^2)						
	Amman	Mafraq	Zarqa	Balka	Irbid	Karak	Ma'an
1986	112	4.6	107	176	272	30	3.0
1987	117	4.8	111	183	283	31	3.0
1988	121	5.0	115	190	293	32	3.0
1989	126	5.2	120	197	305	33	3.0
1990	130	5.4	124	205	316	35	3.0
1991	143	5.9	136	225	347	38	4.0
1992	153	6.3	145	240	370	40	4.0
1993	158	6.5	151	248	383	42	4.0
1994	164	6.7	156	258	398	43	4.0
1995	170	7.0	162	267	412	45	4.0
1996	176	7.0	168	277	428	47	4.0

The population density for Jordan has risen from 30 person / km^2 in 1986 to 49.8 person / km^2 in 1996 [1]. Ma'an has the lowest density of 4.0 person / km^2 in 1996, while Irbid has the highest density of 412 person / km^2 for the same year. It is important to show by examining table 2 that about 80% of the population of Jordan lives in three governorates, Amman, Zarqa, and Irbid, which have only 19% of the total area of Jordan.

It is important to point out that 65.5 % of the population of Jordan lives in the center of the governorates that contribute only to 0.82 % of total area of Jordan [1]. As a result of this high concentration, the centers of the governorates experience a much higher density than the rest of the governorates. For example, the city of Irbid has a density of 10,987 person / km^2, while the Governorate of Irbid has only 428 person / km^2 [1].

There are two main reasons for the unbalanced distribution of population between the different governorates and the cities of the same

governorates. The first reason as mentioned earlier is the concentration of jobs, governmental offices, and business in the center of the governorate, and the second reason is the complete absence of land use policy in Jordan.

One of the major relationships of the study of transportation is the connection between land use and transportation. The trip-making patterns, modal usage, and volume are largely related to the spatial distribution of land use. On the other hand, the pattern of land use is affected by the degree of accessibility provided by the transportation system. So this interaction is very important for the overall understanding of transportation system. Figure 1 shows this interaction more explicitly [2]. The relationship between land use and transportation is a circular one and can take years to complete a single cycle (figure 2) [3].

The modal usage is directly related to the development patterns and density. The dispersed development patterns and low density encourage the use of private cars, while concentrated patterns and low density are suitable for shuttle busses. However, the dispersed development patterns and high density support the usage of mini busses. On the other hand concentrated development patterns and high density are suitable for rapid transit and taxis. A study prepared by the Real Estate Research Corporation compared the costs of low-density urban sprawl with those of high-density planned development [4]. The study has shown that the high-density planned development would reduce among others, the automobile air pollution by 50 %, the land costs for streets by 40 %, and energy consumption by 44 %. This emphasizes the fact that the type of development has a great effect on the usage of mode of transportation and consequently on the occurrence and severity of accidents.

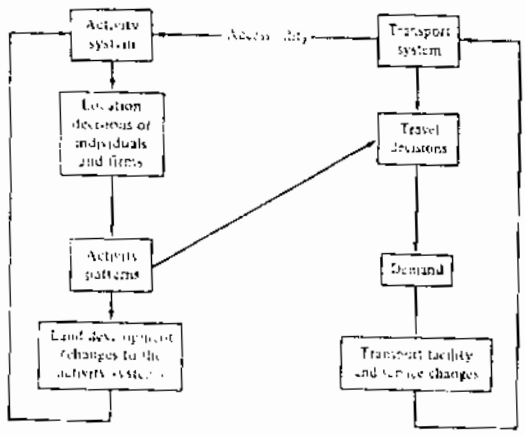


Figure 1 Land Use-Transportation Interaction

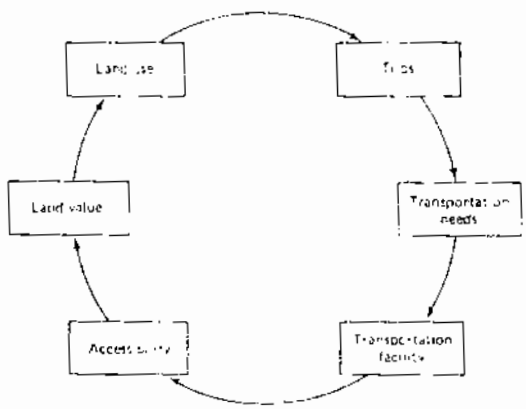


Figure 2 Land Use Transportation Cycle

ACCIDENT ANALYSIS

Jordan has experienced in the last decade an increased number of accidents especially in the high-density areas. The available road network in the major cities could not accommodate the increased numbers of vehicles that resulted in reducing the capacity of the streets and consequently increasing the number of accidents.

Although, traffic accidents are a worldwide problem, Jordan leads most of the developing countries in the number of accidents and fatality rates in comparison to its share of population and vehicles. The World Health Organization (WHO) statistics show that the fatality rate in Jordan reached about 16.2 per 10,000 vehicles in 1996, while it was only (1.4 - 4.0) person per 10,000 vehicles in developed countries for the same year [5].

Table 4 shows the total number of accidents, injuries and fatalities in the different governorates in Jordan. The total number of accidents has jumped from 13,436 in 1986 to 33,156 accidents in 1996 with an increase of 148 % in just eleven years, while the total number of fatalities has risen from 280 in 1986 to 494 persons in 1996 with an increase of 76 %.

Table 4 and figure 3 show that the total accidents in high - density areas are more than those of low-density areas. Table 5 and figure 4 show that the severity index (total fatality / total accidents) is higher in low-density than those of high-density areas. Comparing tables 3, 4, and 5 shows the fact that the Governorates of Amman, Zarqa, Balqa, and Irbid that have high gross population density, also have a high number of accidents and low severity indices. On the other hand, the rest of the governorates that have a low gross population density have a low number of accidents and high severity indices.

Table 6 shows the total vehicles in the different governorates for the years 1986-1996. It shows that the governorates that have a high gross population density i.e. Amman, Irbid, Balqa, and Zarqa, have a higher number of total vehicles. The increased number of private cars and the small percentage of bus sharing in daily trips have resulted in a high number of accidents in high- density areas (tables 3 and 4). However, the severity indices were low in these areas because of a lower speed of vehicles in already congested streets (tables 3 and 5). By examining the types of accidents for the years 1993 - 1996, it was found that around 44 % of accidents lie under three categories; close-up driving, disallowing priorities to vehicles, and disallowing priorities to pedestrians [1]. These types of accidents usually occur in high-density areas.

Table 7 exhibits the accidents and fatality rates per 10,000 registered vehicles for different Jordanian governorates. It also presents the risk indices (RI = % accidents in group involvement divided by % population in group) for the same governorates. The table shows that the Governorate of Amman, Irbid, and the Balqa, which have gross population density, experienced lower accident rates than those governorates with less gross population density such as Ma'an and Karak.

In general, it is fair to say that the Jordanian governorates that have a low gross population density have higher accident rates than those of high

gross population density except for the Governorate of Zarqa. Table 7 also highlights that the fatality rates for the high gross population- density governorates are as much lower as those governorates of low gross population-density. The risk index ealculation shows that the people of Amman Governorates are involved in more accidents than their percentage of population since the Risk Indiees are all greater than one.

The lack of reliable, safe, and comfortable public transportation system opened the door widely for the large usage of private cars. Most of the bus services in Jordan run on fixed routes but not on fixed time schedules. A study on evaluating the public transportation performanee in greater Amman has shown that the sharing of buses in daily trips was only 14% of total trips, while the sharing of private cars is 51%. The study has found that the waiting time for bus arrival during peak hours reaehed up to 60 minutes. This time exeludes the time the passengers spend in the bus till it fully occupied. The waiting time during off – peak reached up to two hours for some routes. This has resulted in unreliable bus serviee for the commuters [6]. Most of public transportation fleets in Jordan are owned and run by private sectors, whose major goal is maximizing profits at the expense of good services, bus-owners usually lease buses to drivers so as to guarantee the profit by the end of the day. This caused frequent violation of traffic laws by drivers so as to assure the required profit. which resulted in higher bus involvement in accidents than their share in traffic. The available data show that the percentage of buses was 0.35, their contribution to the total aecidents was 13% while their involvements in the accidents has reaehed 8% [1]. This highlights that buses are involved and contributed to accidents in higher ratio than their percentage of total traffic. It is important to remember that since buses are eonsidered as high occupaney vehicle (HOV), the number of people killed and injured is much higher in a bus accidcnt than private ear.

Table 4: Total Accidents in the Different Governorates in Jordan

Accident Data	Governorate							
	Amman	Mafraq	Zarqa	Balqa	Irbid	Karak	Ma'an	Total
1986								
Total Accidents	7181	284	1812	802	2061	579	717	14436
No. Of Injuries	3284	298	1155	533	1584	543	419	7816
No. Of Fatalities	71	15	29	24	63	42	36	280
1987								
Total Accidents	8927	247	1749	858	2064	546	824	15215
No. Of Injuries	3842	192	1136	637	1568	571	430	8376
No. Of Fatalities	106	13	34	25	74	45	44	341
1988								
Total Accidents	10148	281	1825	931	2335	616	1012	17148
No. Of Injuries	4492	288	1117	695	1664	557	533	9346
No. Of Fatalities	87	10	39	24	74	46	40	320
1989								
Total Accidents	10623	241	2051	918	2384	551	883	17651
No. Of Injuries	4399	246	1307	537	1517	458	468	8932
No. Of Fatalities	105	13	48	21	70	33	21	311
1990								
Total Accidents	9985	378	2037	932	2427	588	805	17152
No. Of Injuries	4673	386	1309	624	1758	533	544	9827
No. Of Fatalities	86	10	36	20	74	32	31	289
1991								
Total Accidents	10506	441	2425	829	2644	637	694	18176
No. Of Injuries	4343	386	1582	531	1778	593	418	9631
No. Of Fatalities	103	22	51	26	71	27	25	325
1992								
Total Accidents	11746	496	266	1024	2880	642	812	20264
No. Of Injuries	4410	433	1455	678	1931	570	570	10047
No. Of Fatalities	102	26	49	20	66	26	41	330
1993								
Total Accidents	14615	542	2928	1191	3193	762	918	24149
No. Of Injuries	5041	552	1609	725	2115	615	547	11204
No. Of Fatalities	111	28	58	30	81	39	36	383
1994								
Total Accidents	16155	457	3243	1301	3330	847	920	26253
No. Of Injuries	5253	419	1764	689	2405	795	614	11939
No. Of Fatalities	107	14	51	28	94	39	41	374
1995								
Total Accidents	17789	516	3336	1563	2625	903	991	27723
No. Of Injuries	5526	431	1876	873	1922	869	566	12063
No. Of Fatalities	103	22	68	45	67	41	32	378
1996								
Total Accidents	20527	640	3737	2007	4111	920	1214	33156
No. Of Injuries	6331	469	2216	1143	2972	822	711	14664
No. Of Fatalities	144	16	89	33	101	54	57	494

Table 5: The Severity Indices of the Different Governorates of Jordan

Year	Severity Index In the Different Governorates of Jordan						
	Amman	Mafraq	Zarqa	Balqa	Irbid	Karak	Ma'an
1986	0.01	0.05	0.02	0.03	0.03	0.07	0.05
1987	0.01	0.05	0.02	0.03	0.04	0.08	0.05
1988	0.01	0.04	0.02	0.03	0.03	0.07	0.04
1989	0.01	0.05	0.02	0.02	0.03	0.06	0.02
1990	0.01	0.03	0.02	0.02	0.03	0.06	0.04
1991	0.01	0.05	0.02	0.03	0.03	0.04	0.04
1992	0.01	0.05	0.02	0.02	0.02	0.04	0.05
1993	0.01	0.05	0.02	0.03	0.03	0.05	0.04
1994	0.01	0.03	0.02	0.02	0.03	0.05	0.04
1995	0.01	0.04	0.02	0.03	0.03	0.05	0.03
1996	0.01	0.03	0.02	0.02	0.02	0.06	0.05

Abu Soud [7] showed that 67.6 % of accidents occurred within the borders of major cities in 1978, this percentage reached 81.9 in 1984. However, the total accidents that occurred in urban areas have also reached 89 % of total accidents in 1993 [8].

One of the reasons behind the severe and low number of accidents in low- density areas is the small number of private cars and high usage of public transportation in these areas. Usually, higher speeds can only be attained in low density rather than high-density areas. Mr. Shagrawi [9] pointed out in his study that a percentage of fatalities due to speeds in 1996 was 20.6 % of total fatalities in Jordan.The passing of the major highways through small towns expanded along the highways is another reason for the high severe accidents in low- density areas. The interactions at these towns between pedestrians and vehicles at one side, and moving vehicles and slowing down vehicles trying to stop on the other side have resulted in high severe accidents [7]. Examples of these towns are many as Mafraq, Abu Alanda, Baqa, and Qutranah. The weak enforcement of traffic laws by police outside the capital city has resulted also in more severe accidents in the less dense areas. While the speed violation tickets issued by the police directorates were 90575 tickets in Amman in the year 1996, however, they reached in Ma'an only 164 tickets, 37 in Mafraq, and 133 in Zarqa [9].

Table 6: Total Number of Registered Vehicles of the Different Governorates.

Year	Governorates						
	Amman	Mafraq	Zarqa	Balqa	Irbid	Karak	Ma'an
1986	191649	1441	6540	2716	26534	733	1749
1987	199590	1677	6772	2926	27481	1974	1796
1988	205403	1922	7023	2980	28249	2181	1832
1989	207034	1942	7033	3006	28367	2218	1847
1990	209973	2013	7060	3030	28549	2298	1854
1991	163929	5036	10522	13277	40054	7356	7344
1992	177527	6267	12406	11873	38775	7728	7926
1993	175153	4856	9566	12820	41672	6145	5272
1994	179524	5336	11422	11174	33396	6218	6348
1995	182425	6168	10751	11894	41072	6768	6155
1996	201379	6875	11170	14663	42701	7314	6213

Table 7: Accident Rates, Fatality Rates and. Risk Indices *

Accident Data	Governorate						
	Amman	Mafraq	Zarqa	Balqa	Irbid	Karak	Ma'an
1986							
Accident Rate	375	1971	2771	2953	777	7899	4099
Fatality Rate	3.71	104.10	44.34	88.37	23.74	573	205.83
Risk Index	1.32	0.49	0.88	0.89	0.66	0.77	1.33
1987							
Accident Rate	447	1473	2583	2932	751	2766	4588
Fatality Rate	5.31	77.52	50.21	85.44	26.93	228	245
Risk Index	1.44	0.38	0.75	0.84	0.58	0.64	1.35
1988							
Accident Rate	494	1462	2599	3124	827	2824	5524
Fatality Rate	4.24	52.00	55.53	80.54	26.20	211	218.34
Risk Index	1.46	0.38	0.69	0.81	0.58	0.64	1.48
1989							
Accident Rate	513	1241	2916	3054	840	2484	4781
Fatality Rate	5.10	66.94	68.25	69.86	24.68	148.80	113.70
Risk Index	1.48	0.32	0.75	0.78	0 58	0.56	1.25
1990							
Accident Rate	476	1878	2885	3076	850	2559	4342
Fatality Rate	4.10	49.68	51.00	66.00	26.00	139.25	167.21
Risk Index	1.43	0.51	0.77	0.81	0.60	0.61	1.17
1991							
Accident Rate	640	876	2298	624	660	866	945
Fatality Rate	6.28	43.69	48.47	19.58	17.73	36.70	34.00
Risk Index	1.42	0.56	0.87	0.68	0.62	0.63	0.95
1992							
Accident Rate	662	791	2147	862	743	831	1024
Fatality Rate	5.75	41.49	39.50	16.85	17.10	33.64	51.73
Risk Index	1.43	0.57	0.85	0.75	0.61	0.57	1.00
1993							
Accident Rate	834	1116	30.61	929	766	1240	1741
Fatality Rate	6.33	57.66	60.63	23.40	19.44	63.47	68.29
Risk Index	1.49	0.52	0.79	0.74	0.57	0.56	0.95
1994							
Accident Rate	900	856	2839	1164	997	1362	1449
Fatality Rate	5.96	26.24	44.65	25.10	28.15	62.72	65.0
Risk Index	1.52	0.40	0.80	0.74	0.54	0.58	0.88
1995							
Accident Rate	975	837	3103	1314	639	1334	1610
Fatality Rate	5.65	35.67	63.25	37.83	16.31	60.85	51.50
Risk Index	1.58	0.43	0.78	0.84	0.40	0.58	0.89
1996							
Accident Rate	1019	931	3346	1369	963	1258	2051
Fatality Rate	7.15	23.27	79.68	22.51	23.65	73.83	91.74
Risk Index	1.52	0.45	0.73	0.90	0.53	0.50	0.92

*Accident rates and Fatality Rates per 10,000 Vehicles

Figure 3: Total Accidents in the Different Governorates of Jordan

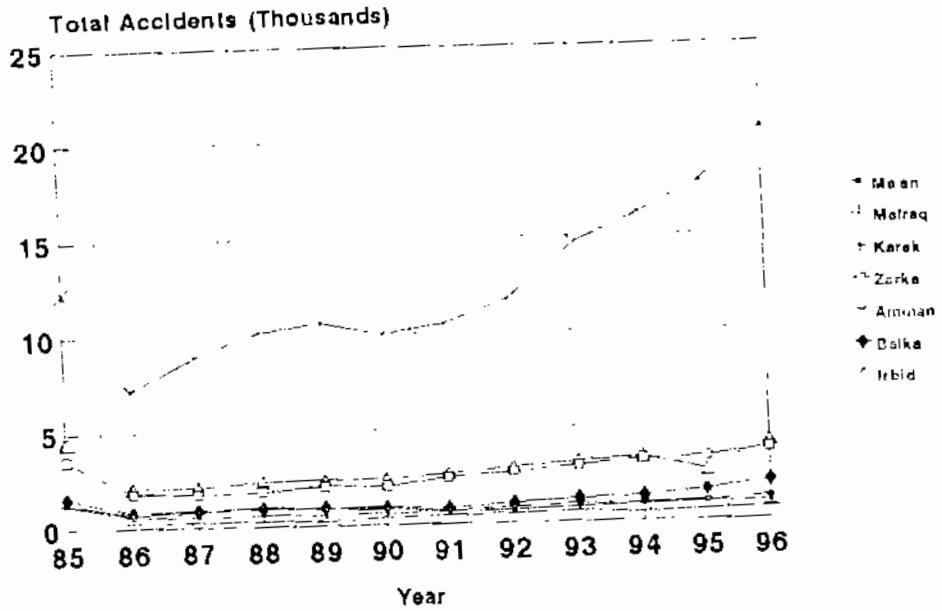
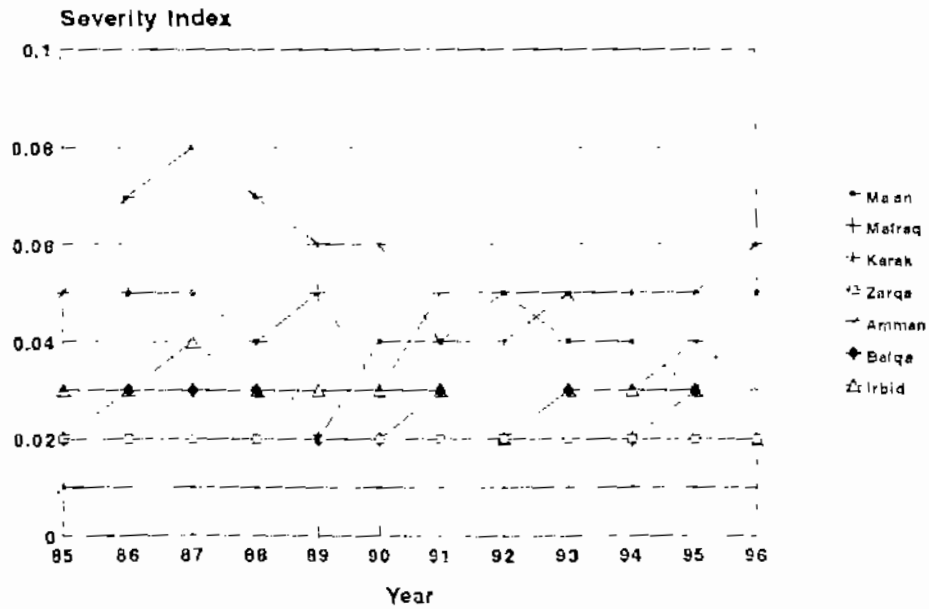


Figure 4: Severity Index in the Different Governorates in Jordan



CONCLUSION

Based on the analysis and findings presented in the study, the following conclusions can be drawn:

1. Jordan could be divided into two groups:
   i. group I includes governorates with low gross population density. these are Karak, Ma'an . and Mafraq.

   ii. group II includes governorates with high gross population density: these are Amman. Irbid, Balqa. and Zarqa.

2. Group I has lower number of accidents, higher severity indices. higher accident rates per 10,000 registered vehicles, and higher fatality rates than the governorates of group II except for the governorate of Zarqa which has a high accident rate.
3. A concentrated, high-density settings are better than dispersed and low development patterns from the transportation safety point of view.
4. A complete absence of well-defined land-use policies is a major cause of traffic accidents.
5. High speed driving is a major reason for the high severe accidents in low-density areas.
6. Buses are the most dangerous mode of transportation in Jordan.
7. Weak police enforcement of traffic laws in low dense areas has resulted in high severe aceidents.

RECOMMENDATIONS

The following recommendations are suggested based on the results of the study:

1.Establishment of National Transportation Council to regulate. set policies, and control the transportation system in Jordan.
2. Development of land use policies, which control the land development type, size, and loeation to set the relationship with the transportation system in order to meet the already defined goals and objectives.
3. A thorough investigation of bus operation in Jordan is needed to find the best solution for the dilemma of high bus involvement in aecidents.
4. Transportation System Management (TSM) eoneepts must be examined to improve the safety, efficiency, and productivity of bus services and the entire urban transportation system.
5. Development of database for all related transportation information.

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