ROAD IMPROVEMENT AND SAFETY: A CASE STUDY FROM THE WESTERN REGION OF BOTSWANA

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ABSTRACT

Western Botswana is the least developed region in the country. Before independence the Government of Botswana had intentions of linking the region to the South Eastern and Eastern Regions, as a way of stimulating development there. At that time, this idea received low government priority as a result of the relatively small and widely scattered population and the poor economic potential of the larger part of the region. Fortunately, the need to link Namibia, Botswana and South Africa, within the SADC regional context, made the construction of the Trans Kalahari Highway (TKH) and other roads both technically and economically feasible.

There is a common assumption currently in Botswana that road improvement reduces the rate of traffic accidents. This assumption, however, is presently not backed by data. It is partly for this reason that a study was conducted along selected roads in the Western Region, firstly to establish the validity of the assumption and secondly to determine the causes and effects of the road accidents on rural development. Using the " before and after" and the "with and without" scientific methods of enquiry, the results showed that the assumption is not valid. This also invalidates the related assumption that road improvement saves on accident costs in benefit-cost calculations. The findings suggest that improvement of roads may or may not significantly increase the rate of traffic accidents, with, consequently, varying implications for rural development.

Key words: Western Botswana, Trans Kalahari Highway, "before and after", "with or without", traffic accidents, rural development.

1. INTRODUCTION

Road transport is the dominant mode of transport in Botswana and therefore a very important ingredient to development. It has been used as a strategy especially in rural development programmes to link the rural to urban areas to stimulate development. Despite the enormous benefits of road improvement, associated with it are some disbenefits such as traffic accidents, which are assumed by the Roads Department of Botswana to decline following road improvement. This assumption, however, is presently not backed by data. The World Health Organisation (2004) has indicated that every year more than 1.17 million people die in road accidents around the world, of which about 70 per cent occur in developing countries. It postulates that the number of people killed and injured on the world's roads will rise by more than 60 per cent between 2000 and 2020. It further estimated that at least a million more will die and 60 million will be injured during the next 10 years in developing countries unless urgent action is taken. It is partly for this

reason that a study was conducted along selected roads in the Western Region; Kang-Ghanzi (section of the Trans Kalahari Highway (TKH), Werda-Tsabong and Tsabong-Middlepits, firstly, to establish the validity of the assumption of an inverse relationship between road traffic accidents and road improvement and secondly, to determine the causes of road accidents and their impact on rural development in the Western Region of Botswana.

1.1 Brief profile of study area

The Western Region is one of the four planning regions of Botswana. It comprises of the Kgalagadi and Ghanzi Districts and is located in the western part of Botswana. It covers an area of 224, 850 km^2 and accounts for about 38.65 per cent of the total land area of the country. It shares boundaries with Ngamiland to the north, Central District to the east, the Republic of South Africa to the south and Namibia to the west.

Wildlife abounds in the study region. The Kgalagadi Transfrontier Park (formerly Gemsbok National Park), Mabuasehube Game Reserve and Central Kalahari Game Reserve (CKGR) are found in the study region. Wildlife species found in the region includes kudus, gemsbok, hartebeests, wildebeests, springbok, duikers, steenbok, ostriches, foxes, leopards, hyenas, jackals, lions and baboons. There are wildlife management areas (WMA) in the region where hunting and livestock rearing are controlled. Wildlife utilization in the management areas is mainly for subsistence hunting and eco-tourism.

The study area is the least populated region in the country. It is characterised by low and sparsely distributed population. Although the region constitutes over 30 per cent of Botswana's land area, its population accounts for only 4.5 per cent of the country's total population. The 2001 population census indicates a total population of 74,530 at a growth rate of 2.9 per cent per annum, which is higher than the national growth rate of 2.4 per cent. Out of the total population in the study area about 78 per cent live in the rural settlements. The dominant economic activity in the region is agriculture, which employs about 36.9 per cent of the labour force. This sector is diverse and encompasses crop production (very limited), cattle rearing, poultry farming, small stock keeping and, of late, horticultural farming. It is primarily practiced on a subsistence basis and mostly rainfed. Livestock rearing is the predominant agricultural activity due to the poor climatic and edaphic conditions, which do not favour arable farming. The Department of Town and Regional Planning (2003) indicates that nearly 40 per cent of the Western Region is zoned for livestock production. Tourism is another important economic activity being promoted in the region. Community Based Natural Resource Management projects have been created in some WMAs of the study area to promote wildlife conservation allied to tangible community benefits. Ghanzi District Council, (2003) indicates that with the exception of some tourism activities in game farms and in the CKGR, there is hardly any commercial tourism within the district. DTRP (2003) also reports that the exploitation of wildlife and tourism is undeveloped. Hunting and gathering of veld products are still practiced and represent an important supplementary income source for some households (Kgalagadi District Council, 1997). The unemployment rate is observed to be increasing in the region. It increased from 16.5 per cent in 1991 to 20.3 per cent in 2001. This is higher than the average national rural unemployment rate of 18.9 per cent (MFDP, 2003).

The region is constrained by a number of factors, which according to Ghanzi and Kgalagadi District Councils (2003) are militating against their developmental efforts. These include low population which leads to small markets, low and erratic rainfall, poor soils, scarce fresh water, inadequate resource base for medium and large scale industries, shortage of qualified manpower, poverty, illiteracy, and HIV/AIDS. The causes of poverty

have largely been identified as *unemployment* and *under-employment* rendering people unable to earn sufficient income. According to the Central Statistics Office (1996) about 71 per cent of the people in the region were in poverty, and out of these between 30–40 per cent were in hard-core poverty.

1.2 Historical background of study roads

Before independence, the government had planned to improve the Lobatse-Ghanzi road (part of the TKH). This idea at that time received low government priority as a result of the relatively small and widely scattered population and the poor agricultural potential of a larger part of the Western Region (Environmental Services and Peer Consultants, 1998). In the early 1970's, after the independence of Botswana, interest in the road was revisited and a pre-feasibility study was commissioned. The study recommended construction of an all-weather road from Lobatse to Ghanzi (see Figure 1). This was again constrained by the shortage of fresh water supplies and suitable road construction materials as well as the computed low internal rates of return.

Following the independence of Namibia, interest in the road project was rekindled with the hope that access to Walvis Bay port would be enhanced (Environmental Services and Peer Consultants, 1998). In addition, the link between Walvis Bay, Windhoek and industries in South Africa's Gauteng region through the road project would also be enhanced, and the road trip would reduced by a distance of about 400km, when compared with the then only existing route, which is via Upington in South Africa and Keetmanshoop in Namibia. Viewing the construction of the road within the SADC regional context made it both technically and economically feasible, therefore giving it some credence. Following this new view, a decision was taken to construct the highway from Sekoma to Mamuno, now dubbed the Trans Kgalagadi Highway (TKH). The construction of the highway was divided into three lots, Sekoma–Kang, Kang-Ghanzi and Ghanzi–Mamuno. The construction of the 595km two-lane bitumen highway started in 1993 and was completed in 1998.

The Werda-Tsabong road is a secondary one. This road is linked to South African at Makopong and Werda. The road was initially constructed in July 1985 by the then Rural Roads Unit of the Roads Department. The remainder of the study road from Makopong to Werda was built between November 1987 and April 1992. The road has a bitumen surface. The Tsabong-Middlepits road also links Botswana to South Africa. Some sections of the road are earth surface whilst others are paved with calcrete, which is easily eroded, by wind and water. The road is in a bad state, and consequently, access to Middlepits demands caution, as the road surface is thick Kalahari sands. The Government of Botswana is yet to contract out the re-construction and bituminisation of this road.

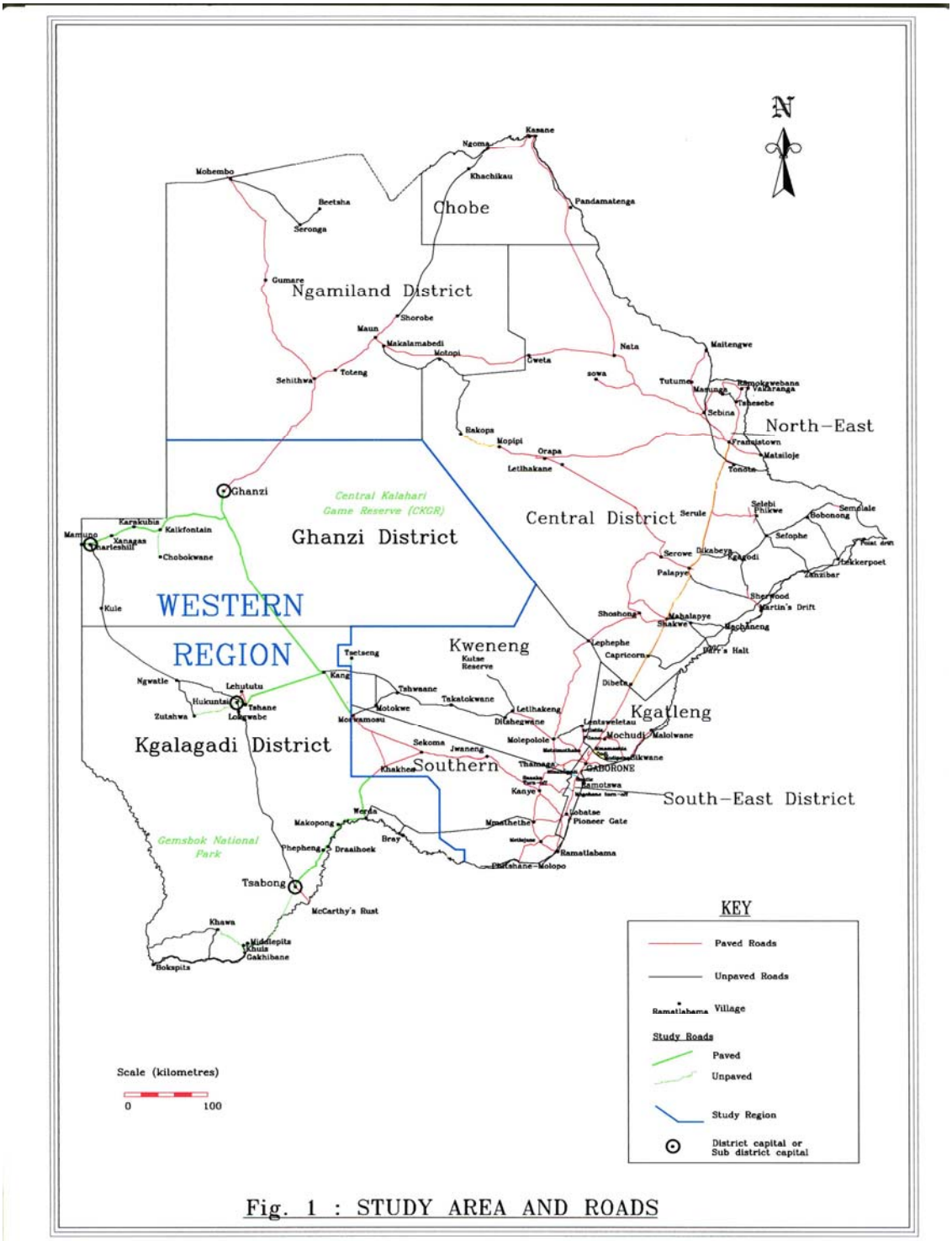

Fig. 1 : STUDY AREA AND ROADS

2. STUDY METHODOLOGY

A hypothesis was set that “Roads Improvement reduces road accidents” as assumed by the roads authorities. Appropriate statistical methods were used for testing. The scientific inquiry design of “Before” and “After” and the “With” and “Without” frameworks provided basis for soliciting data to ascertain the validity of the assumption (see Figure 2).

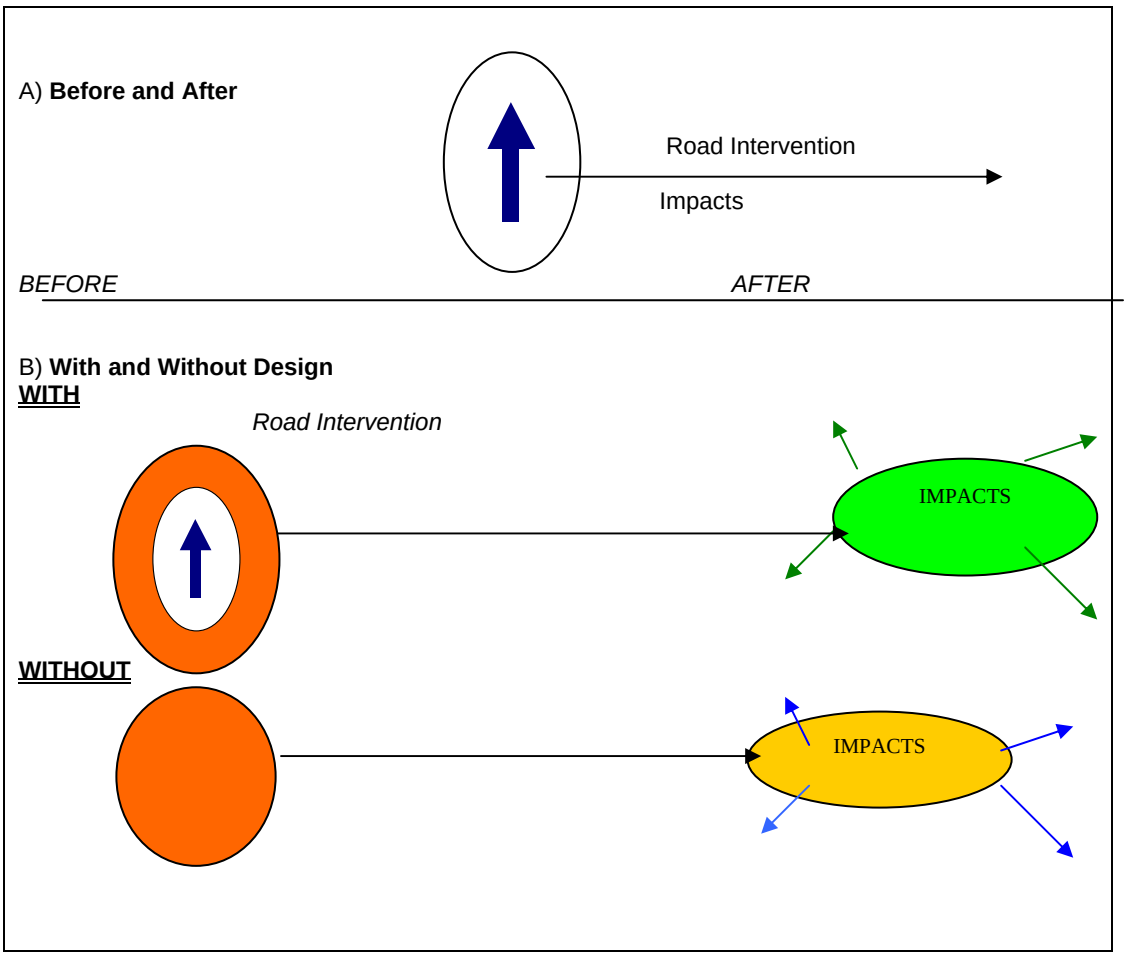

Figure 2 Research Design
Source: Archer 2000

The "before and after" design was employed along the Kang-Ghanzi road (section of TKH). On the other hand the "with" and "without" design allows the measurement of impacts by comparing two different localities or research units, one as a study unit and the other as a control. The intervention is on the study unit whilst the control has no intervention.

The "with and without " design was used along the Werda–Tsabong roads which are the improved roads and thus the "with" and the Tsabong–Middlepits Road was the "without". The impacts along the 'with" was for the study unit or road whilst those along the unimproved, "the without", was for the control. In ascertaining the safety of the roads, the same questions were posed to respondents along all the three case study road corridors.

Qualitative and quantitative data were required to test the hypothesis and also to find the contributory causes of the accidents along the study roads and how they affect rural development. The data were collected from both primary and secondary sources. One hundred and forty (140) households were interviewed along the corridors of the study roads. Accident data were collected from the Department of Road Transport and Safety and the Central Statistics Office in Gaborone.

3. RESULTS AND DISCUSSION

Available accident data along the study roads as provided by the Department of Road Transport and Safety is presented in Table 1. Using the "with" and "without" cases of Werda-Tsabong and Tsabong-Middlepits roads for illustration (see Table 1), it is realised

that there is a significant difference between the observed number of accidents along the improved and the unimproved roads (t=3.2 and p=0.00). However, the" before" and "after" cases along the Kang-Ghanzi road (TKH road), showed that there was no significant difference in the number of accidents to indicate that road improvement minimises traffic accidents or brings about improved safety as reported by the Roads Department (2002) and Hilling (1996). In addition, road improvement does not make any savings on accident costs as reported by the Roads Department (2001). This finding indicates and confirms that the number of road accidents does not decline with road improvement.

Table 1. A Comparative Assessment of Road Accidents

Year	Werda-Tsabong "With"	Tsabong-Middlepits "without"	Kang-Ghanzi	
			Before	After
1993	-	-	15	
1994	-	-	30	
1995	23	10	24	
1996	34	16	37	
1997	21	30	35	
1998	29	17	Road Completed	
1999	43	28		27
2000	24	19		23
2001	47	21		22
2002	27	22		31
2003	44	13		32
Mean	*32.4*	*19.6*	*28.2*	*27*

Data Source: Department of Roads Transport and Safety, 12/02/04

All the households interviewed along the improved roads ("with" and "after") corroborated the findings above. They reported that road accidents are very rampant along the study roads as shown in Table 2. This impact was ranked high using the Road Impact Index, while those along the unimproved road (Tsabong-Middlepits) ranked road accidents as low. Road accident is the 11th leading cause of death in the world and the second in Botswana. It accounts for 2.1 per cent of all deaths globally indicating that, about 1.2 million people die every year from road accidents (UN, World Bank and WHO, 2004). Road traffic injuries are therefore a public and development problem.

Table 2. Factual Community Negative Impacts Observed by Households

a. **Tsabong – Middlepits (Without)**

Impact	R (%)	M	D	SS	C	RII
A lot of Road Accidents	13.3	5	5	4	14	1.9 (L)

b. Werda –Tsabong (With)

Impact	R (%)	M	D	SS	C	RII
A lot of Road Accidents	100	5	5	4	15	15 (H)

d. Kang – Ghanzi (Before and After)

Impact	R (%)	M	D	SS	C	RII
A lot of Road Accidents	100	2	5	5	15	15 (H)

Where Consequence of Impacts is determined by considering the:

- M = Magnitude /Severity of Impacts
- D= Duration of the Impacts
- SS = Spatial Scale or Extent
- R- Responses by beneficiaries

So that

Consequence © = severity + duration + spatial scale
Road Impact Index (RII) = C x % Responses

Ratings
High Road Impact Significance if **RII > 11**
Moderate **Road Impact Significance if** RII = 6 to 10
Low Road Impact Significance if **RII < 5**

Source: Archer, 2005

Regarding the contributory factors of the road accidents, varied causes were identified. These included overspeeding resulting in rollover, misjudgement resulting in head-on collision, cattle and wildlife either crossing or lying on the road. The households were quick to identify livestock and wildlife as the predominant contributory factor of road accidents along the TKH. The livestock find the roads and the trees within the road reserve genial to rest. The boreholes drilled for the construction of TKH that are within 2km of the road alignment and provides a watering source have also attracted livestock to get closer to the road thereby raising the probability of traffic accidents. Wildlife also contributes to road accidents especially at night when they cross the roads, which are unfenced to keep their migration routes open.

The proportion of accidents related to wildlife and domestic animals to the total accident type recorded in the districts increased from 18.7 per cent in 1993, prior to the construction of the TKH, to 36 per cent after construction in 2000 in Ghanzi Road District (Ghanzi District). Similarly, the proportion increased from 22.4 per cent to 32 per cent in the Tsabong Road District (Kgalagadi District) over the same period. This is the predominant contributory factor to road accidents in the study area and therefore of grievous concern. Other types of road accidents recorded are head-on collisions and rollover resulting from overspeeding. In Ghanzi District head-on collisions declined from 4.9 per cent to 2.5 per cent while rollover due to over speeding increased from 18.7 per cent to 20 per cent between 1993 and 2000. In the Kgalagadi District, all the other causes of road accidents apart from wildlife and livestock are observed to have declined. Head-on collision dropped from 8.9 per cent to 2.1 per cent and roll over from 21.8 per cent to 15 per cent. Despite the reduction in head-on collision in the Kgalagadi District a fatal accident (head-on collision) along the TKH was recorded on the 5th December 2004. This accident exposed the lack of emergency services provided along the TKH. The response time to the accident scene by medical officers was 10 hours. For such an international road, emergency first aid services should be provided at strategic places along the road.

As alluded to earlier, livestock is the mainstay of the economy of the study areas, the frequent killing of the animals through road accidents affects the livelihoods of households, especially poor rural farmers (see Box 1) as they lose their very source of subsistence.

Box 1 Killing of Cattle through Road Accidents

The road is killing our livestock, which is the backbone of our local economy and our main source of livelihood. There is not a day that a cattle is not killed. The road must be fenced like other roads because I have heard that SADC have supplied the capital. It is the government that is frustrating us but we are losing our cattle daily, that is why many people in the village think the road has not benefited them at all.

Truckers have also developed a bad tendency of after killing our cattle, they cut off some parts especially the hind legs, this is deliberate and something must be done about it.

By Phuduhudu, VDC Treasurer 12/12/03

I acquired 6 cattle through ALDEP in 1998. They increased to 9 in 2003 and one was hit and killed by a vehicle 2 weeks ago.

By Kebogile Makolobe –Phepheng
Source: Field Survey (Tsabong –Werda) 8/11/03

Wildlife are mostly involved in road accidents along the TKH when they cross the road as they migrate from the former Gemsbok National Park (GNP) to Central Kalahari Game Reserve (CKGR) to Schwelle where they lick mineral salts from pans during winter. The Department of Wildlife and National Parks indicated that the zone between 10 km south of Kang and about 90 km north after the village is a major migratory corridor for the wildlife. The most affected wildlife along the TKH is wildebeest, hartebeest, and steenbok, which are more migratory. Others include ostrich and guinea fowl.

Using the “before” and “after” scientific enquiry method, to ascertain the contribution of road improvement on the impacts on wildlife, it is observed that along the TKH the killing of wildlife through road accidents soared from virtually nothing prior to road improvement (construction) to as many as 37 reported killed in 1999, a year after the road construction (see Figure 3). Ever since, the subsequent years have seen wildlife being fatally knocked down along the road. This supports the well-documented findings on the impacts of roads on wildlife, which have indicated that when traffic volumes increase, small roads can represent a significant source of mortality affecting populations of wildlife (Rosen and Lowe, 1994; and Fowle 1996). Rudloph *et.al.* (1998) reports that as in the case along the TKH, individual animals are killed trying to cross a highway or denied access to critical habitats, local populations are likely to fail or be substantially reduced. The Department of Wildlife points out that they however suspect more of the wildlife being killed by road accidents but most drivers do not report the incidences (under reporting).

Wildlife is a tourist attraction; loosing it unnecessarily through traffic accidents would have dire consequences on the tourist trade as this would result in a decline in wildlife populations . The wildlife being killed is protected by law under the Forest Act and National Wildlife Conservation Act. It is observed that there is a significant difference in the number of wildlife killed before and after road improvement ($t= 2.60$, $p=0.015$, t critical $=1.86$ $df=8$). We can therefore conclude that the road improvements have significantly raised wildlife mortality due to traffic accidents.

The fact that wildlife and livestock movements contribute significantly to traffic accidents, particularly along the TKH, has presented a dilemma between road development, on the one hand, and wildlife conservation and cattle development, on the other. This has dovetailed into a controversial issue on the fencing of the TKH road, as that would affect the migration of wildlife; on the other hand, not fencing is allowing cattle and wildlife to stray onto and cross the roads thereby contributing to accidents. Gibeau and Heuer, (1996) report that the fencing of the Trans Canada Highway has had a significant effect on the movements of grizzly bears and preliminary genetic findings suggest major fractionation of the landscape. Other highways in the country, such as the Francistown-Gaborone Road, have been fenced to prevent cattle from straying onto the roads. These highways however do not pass through any major wildlife territory. The above observation demonstrates the uncomfortable relationship between road development and wildlife as land available for green spaces not only diminishes but also road improvement kills the wildlife.

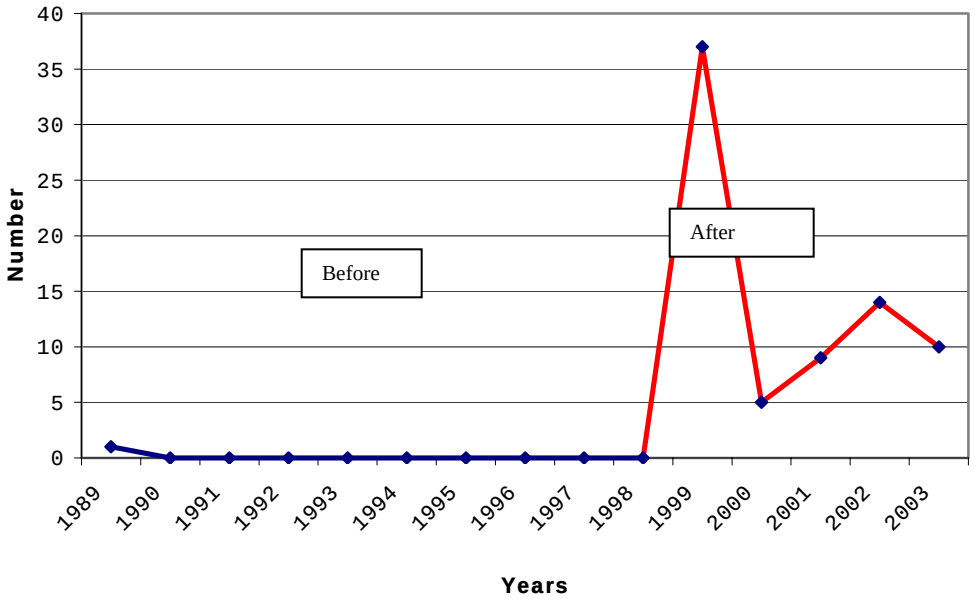

Figure 3 Number of Reported Wildlife Killed Along the TKH (link to text)

Road improvement has also had significant impact on human casualties. It is observed to have escalated after the construction of the TKH as depicted in Figure 4. Prior to the construction of the TKH, on the average about 250 casualties (between 1992 and 1997) were recorded in a year in both the Kgalagadi and Ghanzi Districts. After the completion of the construction of the road it soared to about 561 casualties per year on the average with the highest casualty of 1,502 recorded in 1999, a year after the construction of the TKH. The difference is significant at t=2.6, p=0.03, df=7. The number of fatalities was also observed to increase following road improvement. Prior to the construction of the TKH, on the average about 18 fatalities were recorded in the study districts, however following the completion of the TKH it increased to about 28 (t=2.1, p=0.05 df=7) with the highest number of fatalities of 52 also occurring in 1999 a year after road improvement. Of the casualties minor injuries were the highest recorded, which also peaked in 1999 after road construction (see Figure 4). In all the instances above, both wildlife and human casualties peaked immediately after the TKH was opened. The only plausible reason could be that animals, drivers and beneficiary rural communities had not adjusted to new the development.

The modal time periods of which accidents have been observed to occur have also been observed to change from between 10h00-12h00 and 14h00-16h00 prior to road construction to between 18h00 –22h00 after road improvement. This indicates that the road improvement has encouraged night travelling with its consequent effect of accidents.

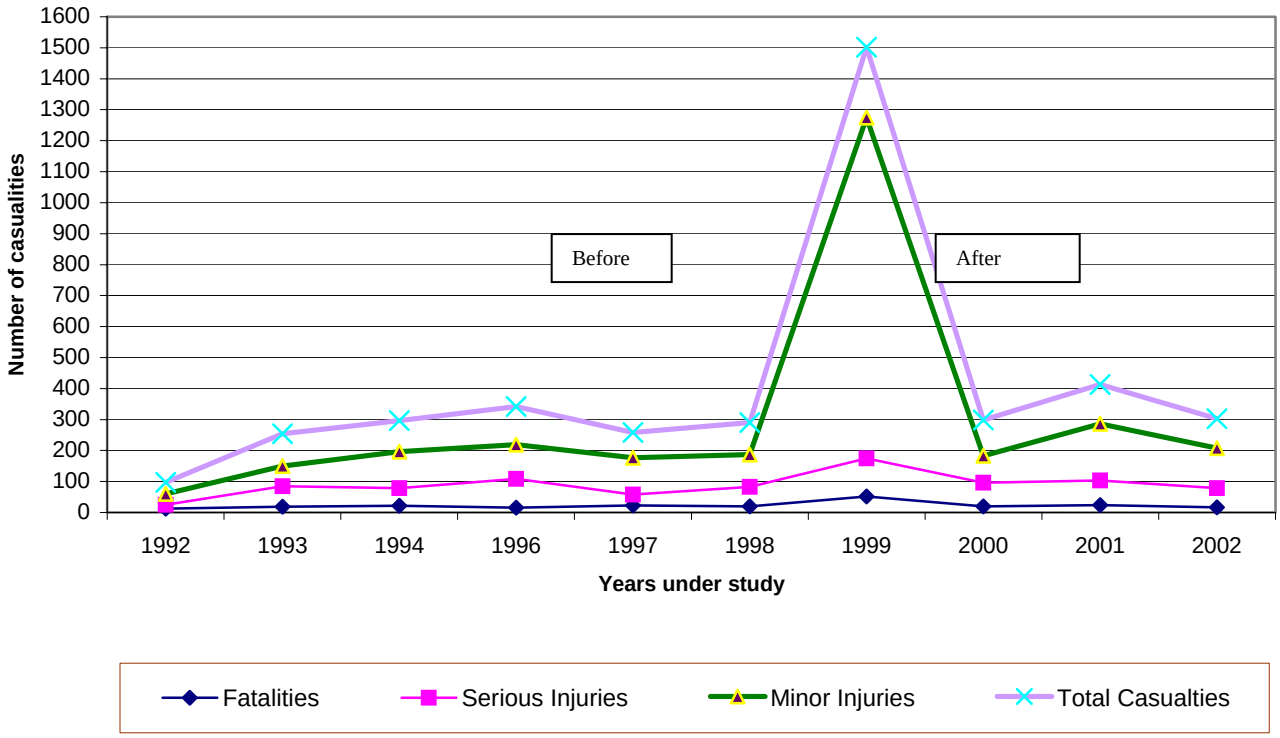

Figure 4 Road Casualties in the Kgalagadi and Ghanzi Road Districts

4. CONCLUSION

The foregoing presentation has shown that road improvement does not always reduce traffic accidents as assumed. The findings suggest that improvement of roads may or may not significantly increase the rate of traffic accidents, with, consequently, varying implications for rural development. Despite the positive impacts of the road improvement, road causalities also increase which causes economic loss and social distress to rural population. Understanding the environmental context of road improvement projects is therefore key for ensuring road safety. In addition to the complex relationship between the driver, motor vehicle and road, which causes road accidents, it is important to note that in areas dominated by wildlife protection and livestock rearing, road improvement could actually lead to escalated road traffic accidents. Strict road traffic education prior to road improvement and speed control monitoring may be indispensable in such areas. It is not enough simply to post warning signs alerting motorists of wildlife and livestock movements. Similarly, more facilities for travellers to rest or break their trips are required along the TKH.

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