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Making minor rural road networks safer: The effects of 60 km/h-zones

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ABSTRACT

For safety reasons a maximum speed limit of 60 km/h has been applied to minor rural roads in the Netherlands since 1998. To support this structurally, a part of these roads have also received additional physical measures in a so-called "low cost design" that is expected to reduce the number of traffic casualties by 10–20%. This measure has been implemented as much as possible in an area oriented way. To measure the design's effectivity, road safety in 20 specific rural areas was studied for 5 years before changes were implemented and, on average, 3.5 years thereafter. The study examined 851 km of roads, and a control study was done on 2105 km of comparable roads with a speed limit of 80 km/h. Both the study and the control roads are managed by water boards. Results show that the measures implemented on the roads in the 60 km/h-zones had statistically significant effects ($p < 0.05$) on casualty accidents (−24% overall), especially at intersections (−44%). This high reduction is probably caused by the concentration of technical interventions at intersections. Both outcomes are somewhat higher than previously expected and are comparable with the outcome of a meta-analysis of safety effects on area-wide urban traffic calming schemes. However, the cost-effectiveness ratio of the 60 km/h zones measures (€33,000 per prevented KSI-casualty) is much more favourable than the ratio in urban 30 km/h-zones (€86,000 per prevented KSI-casualty).

1. Introduction

Traffic accidents are a large social problem worldwide. That said, the number of casualties differs considerably between countries. In 2007, for example, an average of 134 people per million inhabitants died in traffic accidents in Europe, ranging from 34 in Malta to 224 in Lithuania. In the same year Japan, Australia, and the USA had fatality rates of 50, 78, and 139 deaths per million inhabitants, respectively (IRTAD, 2009), while African countries scored around 300 deaths per million inhabits, with Eritrea having the highest number of fatalities with 484 deaths per million inhabitants (WHO, 2009). At 48 traffic deaths per million inhabitants in 2007, the Netherlands is considered as having favourable safety figures. Yet, the Netherlands and other countries with relatively high traffic safety figures continually want to improve their road safety. As part of this effort, *Advancing Sustainable Safety: the National Road Safety Outlook for 2005–2020* (Wegman and Aarts, 2006) was presented in the Netherlands as a follow-up to the *Sustainable Safety Program* of the 1990s (Koornstra et al., 1992). The aim of *Advancing Sustainable Safety* is to reduce the annual number of traffic injuries in the Netherlands by 30% and the number of casualties by 40% by 2020. In theory, *Sustainable Safety* considers the whole interaction between human, vehicle, and road, but to date, it has mainly been translated into juridical and physical measures for a safer road infrastructure.

Until now, literature on the impacts of *Sustainable Safety* has focussed on roads in built-up areas and on major rural roads, the roads that, with the relatively safe motorways, carry most traffic. However, these reports overlook the longest type of rural roads, i.e. the minor rural roads with mixed traffic (lorries, cars, bicycles, and pedestrians), even though the risk of road fatalities per million vehicle kilometres on these roads is high: more than 10 times higher than on motorways (Wegman and Aarts, 2006). To reduce this number, the *Sustainable Safety* concept has been implemented on minor rural roads, generally on an area-wide basis. Given limited budgets, these zones have received a so-called "low cost design" as a first step to improving their safety (Wegman et al., 2006).

The aim of this article is to answer the question if low cost technical measures on a network of minor rural roads within a structural, area-oriented approach improve traffic safety in a cost-effective way. This paper is based on data gathered in an evaluation study by the Association of Water Boards (Beenker, 2004) and also discusses the results of previous research presented within the context of innovative approaches to promote traffic safety (Jaarsma and Spaas, 2007). In the next sections we further introduce the minor

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Fig. 1. Illustration of technical interventions with a low cost design. Zone-boards with double stripe (above), edge markings instead of central markings (centre left) and red-painted, non-compulsory bicycle lanes (centre right), speed hump at road segment (lower left) and raised level at intersection (lower right). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

rural road network and explain the method of the evaluation study, followed by the results and a discussion.

2. Minor rural roads: a specific category of roads

2.1. Network and traffic characteristics

The Dutch rural road network comprises some 47,500 km of paved minor rural roads managed by municipalities (about 40,000 km) and water boards (about 7500 km). Daily volumes on these roads vary from a few hundred to a few thousand vehicles with an occasional volume of 5000 motor vehicles. Minor rural roads can be distinguished into access roads and collectors and consist of one carriageway with a pavement width between 2.5 and 5.5 m. In a few instances, the road may be as wide as 6.2 m. Most minor rural roads have only one lane for two-way traffic (Jaarsma and Beunen, 2005). Measurements on these roads in the 1990s show traffic frequently travelling at speeds above the then legal level of 80 km/h (Hway-liem, 1991; de Wilde, 1997).

Mixed traffic on minor roads and high speeds of motorised traffic result in a relatively high risk of casualty accidents: 0.51 per 10^6 vehicle kilometres. This is tenfold the risk level on motorways and threefold the risk level on rural highways (CROW, 2002). In absolute numbers 677 traffic fatalities were registered in the Netherlands in 2008, of which 63% in rural areas and 25% on minor rural roads. For seriously injured (treated in hospital) 9310 victims were recorded in the Netherlands, of which 40% in rural areas and 17% on minor rural roads, respectively (DVS, 2009). These data show that minor rural roads not only have higher accident rates but that the absolute numbers of casualties are also high.

2.2. Sustainable safety on minor rural roads

Since 1998, a speed limit of 60 km/h has been applied to minor rural roads in the Netherlands. This limit is currently used on more than 35,400 km of access roads. In contrast to the area's general speed limit, the area's lower speed limit must be explicitly signposted, either for a single road or for a zone (Fig. 1, upper-left panel). To support the 60 km/h speed limits and to improve overall road safety, effective speed management on minor rural roads has also been adopted. As such, speed reduction occurs on