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ReCAP is pleased to present the second edition in a series of blog-posts on trends in the road sector, affecting the development and implementation of low volume roads and rural transport services in Africa and Asia. Our blogger is Professor Wynand Steyn, who is professor of civil engineering at the University of Pretoria (UP), South Africa. He is responsible for all pavement and pavement material related undergraduate and post-graduate courses at UP. He has spent 19 years with the South African Council of Scientific and Industrial Research (CSIR) in various technical and managerial positions. His interests are in pavement engineering, vehicle pavement interaction, accelerated pavement testing and pavement materials and instrumentation.



He is author or co-author of 21 journal papers, 14 book chapters, co-editor of 4 books and proceedings and 74 conference papers. He is involved in various South African (SATC, CAPSA, SARF etc.) as well as international conference committees (GeoChina series, APT series, ICTI series).

## **Effects of Rural Road Conditions on Agricultural Cargo: a Way to Enhance the Visibility of Rural Road Research**

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### **Introduction**

Rural roads characteristically carry relatively low volumes of traffic. In the typical national Gross Domestic Product (GDP) context, their role is often not viewed as being of major economic importance. Rural roads are seen more in terms of an accessibility-provider rather than a mobility-provider in the bigger context of a country's transport infrastructure. It is generally accepted that their importance for the local communities lies mainly in the provision of access to health and educational opportunities. Their economic role is typically, at best, seen as providing access for labourers to the labour markets in larger towns and cities.

However, in the major agricultural producing areas of a country, the role of these rural roads is not only to provide access, but also to facilitate mobility in terms of the transportation of agricultural cargo to viable markets. It is a well-known and appreciated fact that the road condition affects the operations and costs of vehicles using the transportation infrastructure. Most Vehicle Operating Cost (VOC) models provide an indication of road roughness effects on fuel consumption, additional damage to vehicle and tyre wear. These models, however, typically do not include the effect of road conditions on the condition and potential damage to the transported cargo. Riding quality of a road (defined as the smoothness of the ride experienced by a vehicle on a road) is used as the primary indication of the quality of a road - mainly due to findings that the most of the deterioration in the road structure ultimately translates into a decrease in the riding quality of the road.

## Extending the assessment of the negative implications of bad rural roads beyond Vehicle Operating Costs

In normal conditions, the protection of goods is mainly provided by the packaging used to transport the cargo. In the case of agricultural transport, packaging is often not a solution to the problem, as the use of older vehicles operated on mostly rural roads with lower riding quality levels is a main contributor to cargo damage. A number of projects that investigated and quantified the effects of riding quality on low volume roads on selected damage levels of tomatoes, revealed new insights into the issue of cargo damage as a result of poor rural road conditions. In these studies (performed by the University of Pretoria, California Department of Transportation, University of California, Davis and others), vehicle and cargo responses to road conditions were measured during operations on a range of rural routes. Damage and failure levels for the tomatoes during transportation were determined and these damage levels were used to calculate typical costs to the agricultural suppliers due to road conditions.

Various studies correlating the road riding quality and the vibrations, accelerations and responses in vehicles and cargo have also been conducted. These studies mainly concluded that a decrease in the riding quality of a road is a major cause of increased vibrations and subsequent structural damage to vehicles and cargo. This leads to direct negative economic effects to the producer/farmer, such as increased transport costs, loss of market value of the transported cargo and reductions in revenue.

A typical relationship between the road condition (expressed in terms of International Riding Quality (IRI)) and truck and cargo response (in terms of Coefficient of Variation (CoV) of vertical accelerations) is shown in Figure 1. It shows the direct relationship in occurrence of increasing riding quality and truck and cargo response through the cumulative occurrence of these two factors measured on a rural road. The relationship is not only focusing on the riding quality and truck and cargo response, but also the *time spent* on the specific road (as longer trips would typically cause more damage to the cargo). Studies have shown that losses of up to 8 % in income can be incurred due to tomatoes fetching lower prices (being damaged) or not being sold at all (failed), due to damage caused by transport over rough roads.

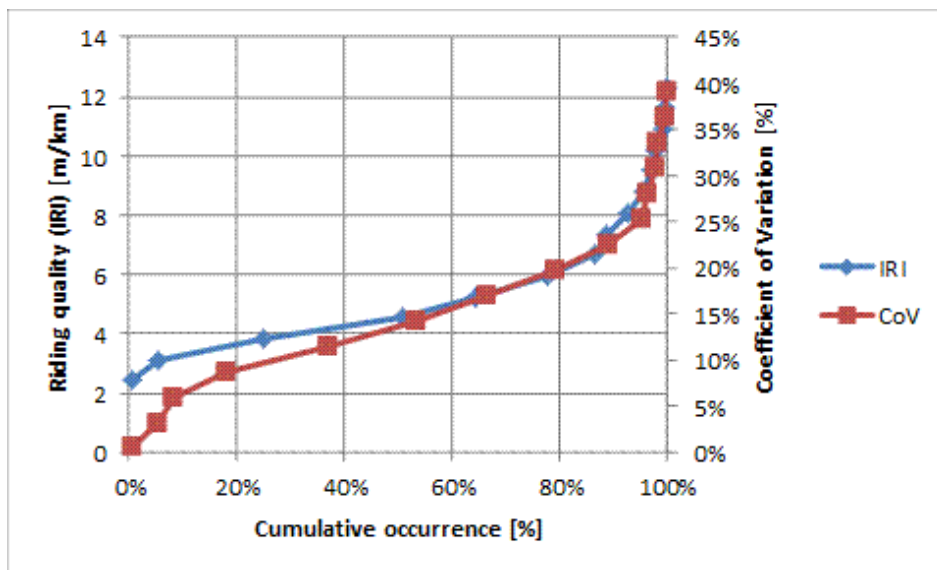


Figure 1: Cumulative occurrence of riding quality and CoV for rural route

### **Potential use of the research results**

The overall objective of the management of riding quality on rural agricultural access routes is to enable the road owner to manage the risks of decisions related to the management and preservation of the pavement network in an improved way as the potential effects of such decisions will be quantifiable in economic terms. The type of information collected from agricultural cargo road quality studies can assist road owners to develop (a set of) cargo performance measurement indicator(s): this may be a combination of the expected damage and failure of cargo on the routes for a specific county or region, combined with the lower speeds that trucks typically travel on rougher routes to indicate the potential economic effects of the road network of which the roughness is less than optimal.

The data can further be used to define and design policies on the provision and maintenance of agricultural routes by *road owners and agencies*, as the data provide for a quantifiable method to establish the additional cost of routes that are in an unacceptable condition. *Road users* can use these types of data to conduct an evaluation of the level of maintenance costs that they can absorb through their own contributions to ensure lower damage levels to their cargo. Lastly, knowledge of the levels of road condition that are most damaging to the cargo in a certain region can lead to the development of a collection of road condition triggers and warning levels (in the Pavement Management System) that should alert the *road owner* in a timely manner of decreasing riding quality levels and subsequent expected increase in cargo damage.

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