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Rural Road Links: A Review on Current Research Projects & Initiatives Aimed at Reducing Vehicle Crash Fatalities on Rural Roads

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Abstract:

Rural America accounts for a smaller and more dispersed portion of the nation's population, yet it comprises a considerable portion of the transportation system. Rural areas account for approximately 83 percent of the land in the U.S and their roads account for 80 percent of the total U.S. road mileage and 40 percent of the vehicle miles traveled. Fatalities on rural roads surpass those in urban areas, even though urban areas are more densely populated and consequently, have a higher traffic flow. In 2001 alone, fatal crashes on rural areas accounted for 61 percent of all traffic fatalities, 39 percent of the vehicle miles traveled, and 2 percent of the population (2001 Accident Facts). Due to the high number of traffic fatalities on rural roads many organizations, including university traffic safety centers and federal organizations, have focused some of their research and time to reducing fatalities and improving road safety in rural areas.

Although most of the document focuses on non farm motor vehicles, a small section has been allocated for farm vehicle accidents, including transportation vehicles that get farm workers to and from their jobsites. This document presents some of the more significant current research/ technologies being implemented and studied in the area of rural traffic safety to address fatalities in these areas, contains suggestions for further research, and identifies any gaps in existing knowledge and research wherever possible.

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at Reducing Vehicle Crash Fatalities on Rural Roads.**



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Introduction

Rural America accounts for a smaller and more dispersed portion of the nation's population, yet it comprises a considerable portion of the transportation system. Rural areas account for approximately 83 percent of the land in the U.S and their roads account for 80 percent of the total U.S. road mileage and 40 percent of the vehicle miles traveled. Fatalities on rural roads surpass those in urban areas, even though urban areas are more densely populated and consequently, have a higher traffic flow. In 2001 alone, fatal crashes on rural areas accounted for 61 percent of all traffic fatalities, 39 percent of the vehicle miles traveled, and 2 percent of the population (2001 Accident Facts). Due to the high number of traffic fatalities on rural roads many organizations, including university traffic safety centers and federal organizations, have focused some of their research and time to reducing fatalities and improving road safety in rural areas. Although most of the document focuses on non farm motor vehicles, a small section has been allocated for farm vehicle accidents, including transportation vehicles that get farm workers to and from their jobsites.

This document presents some of the more significant current research/technologies being implemented and studied in the area of rural traffic safety to address fatalities in these areas, contains suggestions for further research, and identifies any gaps in existing knowledge and research wherever possible.

Background

When it comes to vehicle crashes, rural areas have a higher preventable mortality rate than urban regions. This is due to a number of factors such as: driver behavior, excessive speeds and lack of speed enforcement (the predominant underlying cause of road fatalities), access to emergency services, longer distances traveled, remoteness of areas, animals crossing roads, road conditions/maintenance, road design, weather, lack of lighting on roads, and infrastructure.

Driver behavior greatly influences the fatality rate on rural roads. Drivers tend to think they are “safer” on rural roads since they are less congested with traffic, forget they have to share the roads with farm vehicles and animals, and tend to speed since they know that speed enforcement is lax. Speeding reduces the reaction time drivers have to avoid crashes, which not only increases the likelihood of crashing but also increases the severity of crashes that occur. It increases the distance needed to stop a vehicle and in addition, speeding drivers may not be able to judge distances accurately, which puts other vehicles and pedestrians at greater risk. Speeding, however, is a somewhat complicated issue to assess due to the nature of rural roads (sparse, desolate areas) and rural county capabilities. These characteristics make enforcement a complex task.

Fatalities are more prevalent in rural areas not only due to vehicle speed, but also because emergency services are not always administered in time due to the long distances that must be traveled to and from the crash scene. Other factors such as road design and conditions also affect fatality rates. Rural roads may be straight, narrow, curvy, hilly, or icy imposing a greater risk for drivers since these conditions influence driver behavior and vehicle control. Lack of signage and non controlled intersections also contribute to driver behavior and consequently rural road fatalities. Infrastructure is another parameter in the rural road fatality equation since rural towns have not always had the resources or means by which to address rural road accident prevention strategies. However, this trend is changing. The increasing number of fatalities due to the factors mentioned has drawn more attention to rural roads and organizations are focusing on applications and solutions to reduce fatalities on these scenic yet deadly roads.

Information Gathering Methodology

Information was gathered via the internet, library databases such as TRIS, Melvyl, TOXLINE, and Medline, review of journal articles, contacting local/state authorities, and a secondary analysis of the data gathered.

Keywords used in the search:

- Rural safety
- Farm road safety
- Rural roads
- Collisions on rural roads
- Farm roads
- Tractor safety
- Pedestrian safety in rural areas
- Funds for rural traffic safety
- Rural traffic safety
- Agricultural traffic safety
- Farm vehicle safety
- Rural ITS
- Rural road design
- Raiteros
- Children safety on rural roads

Farm Vehicles

When focusing on rural road vehicle accidents there can be a break down between farm and non-farm (motor) vehicle accidents and each one must be treated differently and separately. Farm vehicles include vehicles such as tractors and means of transportation by which farm workers get to and from their job sites every day, which is for the most part done by raiteros - van operators who charge farm workers \$4 to \$6 daily for rides to work.

Tractor accidents are the leading cause of farm fatalities (California Farm Bureau Federation). According to an epidemiological study done in 1996, rural farm vehicle crashes were greater than non-farm vehicle crashes on paved roads and on roads with non-hard surfaces. Among fatal farm vehicle accidents, 58% collided with non farm vehicles; drivers were older (42 years old was the mean age) and were most likely males. Issues underlying tractor accidents/fatalities include roll-over, extra riders, collisions with other vehicles/sharing of public roads, power takeoff entanglements, contact with overhead electrical wires, and mechanical aptitude. In order to address accidents involving tractors many public campaigns have been launched by states like Florida, Minnesota, California (UC Davis Farm Safety Program), and Texas to train and educate farm vehicle drivers on the dangers of tractors.

Accidents involving the raiteros deal more with noncompliance of vehicles that do not have any seat belts for riders and are sometimes modified to fit 20-50 people. Current regulations allow for van modification variability. A van can carry more than nine farm workers if it is inspected by the CHP (California Highway Patrol) for safety and is insured; however if farm workers are charged a fee for transportation, the driver must register as a farm-labor contractor (FLC) with federal and state governments. Even though regulations exist, illegal operation of agricultural labor vehicles exists. Drivers don't always register as an FLC and this places farm workers at a greater risk since the vehicles are noncompliant and unsafe. Many farm workers make private arrangements with raiteros so the compliance of those vehicles is questionable. Some educational campaigns have also been launched to alert farm workers on this matter and reporting of illegal/unlicensed vehicles is encouraged.

Federal

In general, federal funding for roads and highways depends on Congress' agenda. More money is usually allocated to those issues Congress considers as high priority such as seat belt use and preventing impaired driving. Funds are usually distributed to those initiatives that will make the most impact in terms of injury/fatality rates, thus projects that target bigger populations are of greater priority and are allocated more funds. Nevertheless, there are initiatives to impact rural roads in addition to seat belt use and preventing impaired driving. One such project is the First There, First Care: Bystander Care for the Injured Campaign. This campaign addresses the gap between distance and response time to the site of the crash and the medical facility where victims will receive emergency care. It is designed to educate trainers in instructing people in rural communities to provide care if they witness an accident. Many projects have also focused on driver behavior and attitudes and how this influences accidents, road design (number of lanes and their impact), crash models, and intersection safety in rural roads, among many others. Other initiatives include:

- *Partners for Rural Traffic Safety Action Kit Guide* – a publication designed to educate rural community leaders on how to conduct a seatbelt use campaign, measure its success, etc. This is a joint initiative between the National Highway Traffic Safety Administration (NHTSA) and National Rural Health Association (NRHA) for seatbelt campaigns in rural areas.
- *The Rural Transportation Initiative*- a project formulated to ensure that rural areas and small communities share in the mobility, economic, and social benefits that many USDOT programs provide. This project aims to enhance the capacity of rural America to play a more integral role in the planning and decision-making that shape transportation systems. In addition to this, it provides an array of technical assistance and grant programs to enable communities to plan, develop and improve air, surface, and water transportation infrastructure. One of the goals of this program is to reduce the human and material costs that are unintended consequences of the operation of the transportation systems in rural areas by improving safety.

- *Rural Enhancement of Access and Care for Trauma (REACT) project-* This project was designed as an intervention to enhance timely access to trauma care and improve emergency medical care delivered by rural health personnel.
- *Crash Models for Rural Intersections: Four-Lane by Two-Lane Stop-Controlled and Two-Lane by Two-Lane Signalized-* the aim of this study was to develop three crash models relating to three types of rural intersections (three-legged intersections with major four-lane roads and minor roads that are stop-controlled, four-legged intersections with major four-lane roads and minor two-lane roads that are stop-controlled, and signalized intersections with both major and minor two-lane roads).
- *Safety Applications of Intelligent Transportation Systems (ITS) in Rural Areas:* this project involved the analysis of existing and planned technology applications designed to improve safety in rural areas.

California Rural Road Initiatives

Once federal funds are allocated to the state, the Office of Traffic Safety is responsible for developing a Highway Safety Plan (HSP) in order to reduce traffic collisions and deaths, injuries, and property damage resulting from collisions. The HSP serves as California's application for federal funds available to states under the Transportation Equity Act for the 21st Century (TEA-21- for more on this please see Appendix B). Money is allocated to different programmatic areas which consist of: occupant protection, pedestrian and bicycle safety, police traffic services, alcohol and other drugs, community-based organizations program, emergency medical services, roadway safety, safe communities, and traffic records. Grants are awarded for projects designed to address federally designated traffic safety priority areas within the program areas mentioned. (See Appendix for a look at the number of grants by county.)

Caltrans handles and funds research in most rural safety issues via the Western Transportation Institute (WTI), which is located in Montana State University. Caltrans is part of a joint California-Oregon collaboration - California-Oregon Advanced Transportation Systems (COATS) Showcase Projects - which is a multi-year, rurally-focused research project aimed at providing information that may improve the performance of current intelligent transportation systems (ITS) elements, and provide data to substantiate, maintain, or direct future deployment of ITS in northern California and southern Oregon (See figure 1). Showcase evaluations are done by WTI at Montana State University. Some of the evaluations currently active are:

- Operational Impacts of Weather and Lane Closures on Rural Highways,
- Development of Weather Severity Index,
- ITS Maintenance Evaluation,
- Public Safety and Communications, and
- Communications Improvements for Rural Field Devices



Figure 1. COATS Study Area Boundaries

(Source: <http://www.coe.montana.edu/wti/wwwshare/COATS/Intro/FigES-01.htm>)

Caltrans also has several specific projects to handle rural transportation, some of which may intersect with safety: snowplow & snow blower guidance and automation work (PATH & AHMCT), curve over speed dynamic warnings (Traffic Ops), rural TMC (Traffic Ops -- addressing safety only peripherally), and an integrated work zone efficacy project (addressing the effectiveness of VMS signs well in advance of WZ's).

In terms of rural road traffic safety applications for the agricultural population, some of the Caltrans projects are:

- *The Agriculture Industry Transportation Services (AITS) Pilot Project:* The goal of this project is implement efficient and safe transportation services for seasonal, residential farm workers in order to lessen the number of injuries and fatalities sustained by farm workers while traveling to/from agricultural work sites within Fresno, Kern, Kings, and Tulare Counties in the Central Valley. (Implementation is scheduled to end on 6/30/04.)
- *The Traffic Safety Education Program (TSEP):* This program is intended to deliver a broad driver/traffic safety educational program for the state's agriculture industry, including farm workers and their families, farm labor contractors, and growers in the San Joaquin Valley.

Research at Other Universities

As fatalities on rural roads escalate, more attention is being directed towards efforts to resolve this issue and investigate underlying problems. Universities and traffic safety centers have been and are focusing some of their research on solutions that will help reduce the number of fatalities that occur on rural roads by addressing different areas such as road design, driver behavior, etc. The following is a summary of what other university traffic safety centers have done in the past and/or are currently working on:

Montana State University: Western Transportation Institute

This university center focuses on rural transportation issues and is actually affiliated with a joint project between the states of California and Oregon to perform research on rural road issues (See section on California Rural Road Initiatives for more information). Other projects currently active and/or recently completed are:

1. *Sacramento River Canyon Curve Warning Systems*: This project evaluated five various dynamic curve warning systems installed for advanced notification to motorists of alignment changes and speed advisories in the Sacramento River Canyon.
2. *Program for Advanced Rural Transportation Technology (PARTT)*: This project investigates the need for rural transportation technology and helps determine applicability of advanced transportation technologies presently under development in rural settings.
3. *California Vehicle-Highway Cooperative Systems: Rural Fleet Application Case Study*: The goal of this study is to develop a blueprint for the building of a prototype rural Vehicle-Highway Cooperative System in northern California.
4. *Impact of Personal Digital Assistants in Emergency Medical Services Providers' Response to Motor Vehicle Crashes*: The purpose of this project is to help determine the impact of personal digital assistants on EMS response to, and treatment of, injured motor vehicle crash victims.
5. *Assessing Needs and Identifying Opportunities for ITS Applications in California National Parks*: As indicated in the project title, the goal of this project is to identify potential ITS market packages and transportation needs for California national parks, using stakeholder outreach and visitor surveys at two case study locations: Golden Gate National Recreation Area and Sequoia and Kings Canyon National Parks.
6. *Assess Caltrans Road Weather Information System (RWIS) Devices and Related Sensors*: Caltrans has identified the need to evaluate the road weather information systems (RWIS) that have been installed in the state. This project will help Caltrans in determining how to improve its RWIS and to move towards a statewide linked network

Institute Texas A&M University: Texas Transportation Institute (TTI)

Due to the rural nature of the state of Texas (over 62 percent of Texas highways are rural two-lane roads), TTI has many research projects trying to address accidents and other transportation problems in rural roads. Some of the more prominent ones are:

1. Detection Control System (D-CS) (2003): This system was developed to improve the safety at high-speed rural intersections by reducing red-light violations and sudden stops by up to 70 percent. The idea behind this system is to prevent the light changing from yellow to red when vehicles are approaching the intersection.

2. Design Criteria for Improved Two-Lane Section Super 2 (2002): This project focused on design criteria for Super 2 lanes which allow motorists to safely and easily pass slower vehicles, improving traffic flow at a much lower cost than a traditional expansion of four lanes. Researchers reviewed three critical elements in this project: passing lane length and spacing, lane and shoulder requirements, and signing and marking strategies.

3. ITS Applications for Truck Traffic in Rural Areas (2001): This project is unique in that it is the first one targeted at truck traffic in rural areas. Through the use of a vehicle classifier connected to a personal computer, researchers developed a system that senses when a truck is approaching an intersection and relays detection to the computer. The computer then sends a message to the signal controller to take appropriate action, such as delaying a light change from green to red to give the truck time to clear the intersection safely.

4. Accident Mitigation Guide for Congested Rural Two-Lane Highways (2000): This project investigated lower-cost measures for improving safety and operations in rural two-lane highways; and provided strategies for accident prevention and reduction of rural congestion through a guide. The guide is intended to be utilized by transportation professionals to help them identify and select appropriate countermeasures for a designated site. It offers description, analysis, and effectiveness of countermeasures that could be used on the roadway, along the roadside, at an intersection, or separate from the road environment (i.e. public information/educational campaigns).

5. Use of Innovative Traffic Control Devices to Improve Safety at Short-Term Rural Work Zones (2000): In this project, researchers examined countermeasures that would increase driver awareness of the upcoming work zone, make workers more visible, or slow down traffic.

One of the research applications the University of Minnesota Intelligent Transportation System Institute focuses on is rural safety and within this area, there are many projects aimed at improving and addressing rural road conditions and safety. The following is a brief summary of some of the projects that are active:

1. *Real-time Collision Warning and Avoidance at Intersections*: This project aims to develop a system that can detect and prevent potential collisions in real time using video cameras and algorithmic techniques.
2. *Deer Avoidance Research: Use of Motion Detector Flashing Light*: This project evaluates the potential impact of new technology (motion detection information relative to the presence of deer in and around major highways) on driver behavior.
3. *Intersection Decision Support (IDS)**: The state of Minnesota is a partner with California and Virginia in a pooled consortium, the focus of which is the improvement of safety at intersections. This project is aimed at improving safety and mobility on rural intersections with a system that is deployable, easily maintained and cost effective. Project also includes development of surveillance technology and collision predictive algorithms applicable to all intersection types.
Note: UCB Traffic Safety Center is involved in urban IDS.
4. *Accident Analysis for Low-volume Roads*: This project involves the creation of a database to provide engineers with information regarding accidents at intersections to help them better determine impact of signage and seasonal variation along with other aspects that affect decisions made relative to intersections where frequent collisions take place.
5. *Reducing Crashes at Controlled Rural Intersections*: This project aims to look for solutions to safety-related issues present at rural intersections.
6. *Eliminating Driver Blind Spots at Rural Intersections*: This study seeks to determine the relationship between the size of forward field of view blind spots, the approach speeds of the two vehicles that could potentially collide at the intersection, and to gain a better insight of how changes in the two vehicle velocities may lengthen, shorten, or eliminate the blind spot as a function of these two approach speeds.

University of Iowa: Center for Transportation Research and Education

The University of Iowa Center for Transportation Research and Education has worked on several rural road related projects in the past, but currently most of their focus has shifted somewhat to cover research in the areas of road design/structure, materials, and traffic data collection. Their most recent rural road research project was done in 2001. Past rural road research projects have focused on analysis of shoulder surfacing criteria, safety impacts of increasing speed limit on rural interstates in Iowa, traffic management strategies for merge areas in rural interstate work zones, and transportation of rural elders and access to health care.

University of Massachusetts Institute of Technology: Center for Transportation Studies:

This university is currently working on “The Effect of Segment Characteristics on the Severity of Head-On Crashes on Two-Lane Rural Highway” and has worked on other rural road issues such as: rural pedestrian crash rate: alternative measures of exposure; and finding strategies to improve pedestrian safety in rural areas and transit training for urban and rural areas.

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<http://www.fhwa.dot.gov/hep10/state/ca.pdf>

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<http://www.ers.usda.gov/publications/aib753/aib753fm.pdf>

RURAL DEFINITION

In practice, the U.S. Department of Transportation defines rural in two ways: first, for highway functional classification and outdoor advertising regulations, rural is considered anything outside of an area with a population of 5,000; second, for planning purposes, rural is considered to be areas outside of metropolitan areas 50,000 or greater in population. This definition leaves a lot of room for significant differences within these categories.

<http://www.fhwa.dot.gov/planning/rural/planningfortrans/2ourrts.html>

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APPENDIX

Transportation Equity Act for the 21st Century and Funding Projections for California: (source: http://www.ots.ca.gov/tea21/what_is_tea.asp)

What is TEA-21, and How Does It Work?

Traffic safety funding for all states is allocated by formula within multiple sections under the Transportation Equity Act for the 21st Century, (more commonly known as TEA-21), and administered through the National Highway Traffic Safety Administration (NHTSA).

Once California receives its allocation, the California Office of Traffic Safety acts as a pass-through agency granting the funds to state and local agencies for traffic safety programs in priority areas including Occupant Protection, Driving Under the Influence (DUI), Community Based Organization outreach, Emergency Medical Services, Police Traffic Services, and Traffic Records, to name a few.

Under TEA-21, California has received anywhere from \$30 million to \$55 million annually in basic and incentive funding because of its population size, excellent traffic safety laws, high belt use rates and low collision rates in various categories.

The table below outlines OTS' estimated fund sources for 2003, which clearly shows that incentive funding, comprises a sizeable portion of the California allocation.

Funding Projections for California FFY 2003		
Fund Source	Fund Title	FFY 2003 (TEA-21)
402	Basic Highway Safety Program (based on population and roadway miles)	\$15,092,000
405	Occupant Protection Incentive Grants	\$2,010,000
410	Alcohol-Impaired Driving (Program funding ends in FFY 2002)	
157	Safety Incentive Grants for Use of Seatbelts	\$15,552,900
163	.08 BAC Illegal Per Se Law (Incentive)	\$11,000,000
2003 (b)	Child Passenger Protection Education	\$730,829
Totals	(Projected Estimates)	\$49,385,729