

Tractor-trailers a Mode of Rural Transport: Associated Injuries and Preventive Measure

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Introduction

Agriculture is one of the most important sectors in India, as about 50% of countries population is dependent on this sector. It accounts for 14% of the gross domestic product. The population of the country is increasing rapidly and is expected to reach 1.66 billion people by 2050. This rising population demands huge food demand and productivity to feed people. The increment in production and productivity can be achieved with the help of improved crop varieties, cultivation practices and mechanization levels. Tractorization is one of the important components of farm mechanization because it is the primary power source for machinery operations and other uses. The farm power availability in the country increased from 0.28 kW/ha in 1960-61 to 2.761 kW/ha in 2020-21. The tractor is the main power source for increasing the pace of farm mechanization.

Tractor-trailer Population in India

Data on the tractor population from 1960 to 2020 is shown in Fig 1. The total registered number of tractors as of 31st March 2020 is 94,20,42, with a total registered % share of 2.89% among all registered vehicles. (Road transport year data book, 2020) these developments cause negative underside on injuries and health hazards if attention is not given to safety. The top five states in tractor population in the country are Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharastra and Gujarat, with a share of 16.16, 14.12, 12.99, 8.76 and 8.70, respectively. The tractor was the most commonly used power source on and off the farms throughout the year for operating different kinds of farm machinery and can also be used in connection with trailers system for haulage carrying and transportation in rural areas. Using tractors in transport accounted for about 60 percent of the average annual hours. The percentage share of the tractor population in different states of the country is shown in Fig 2 and Fig 3.

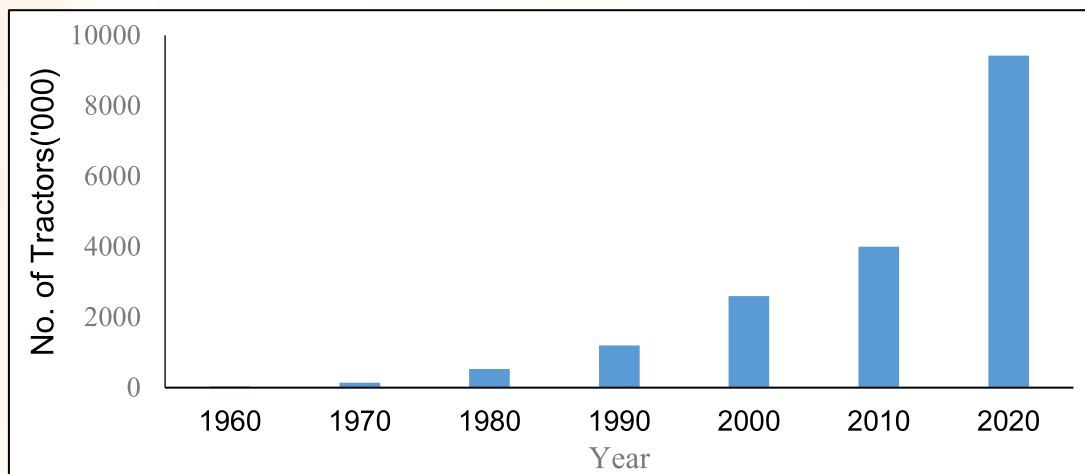


Fig 1. : Total population of tractors from 1960 to 2020. Source (Road Transport Year Book; 2020)

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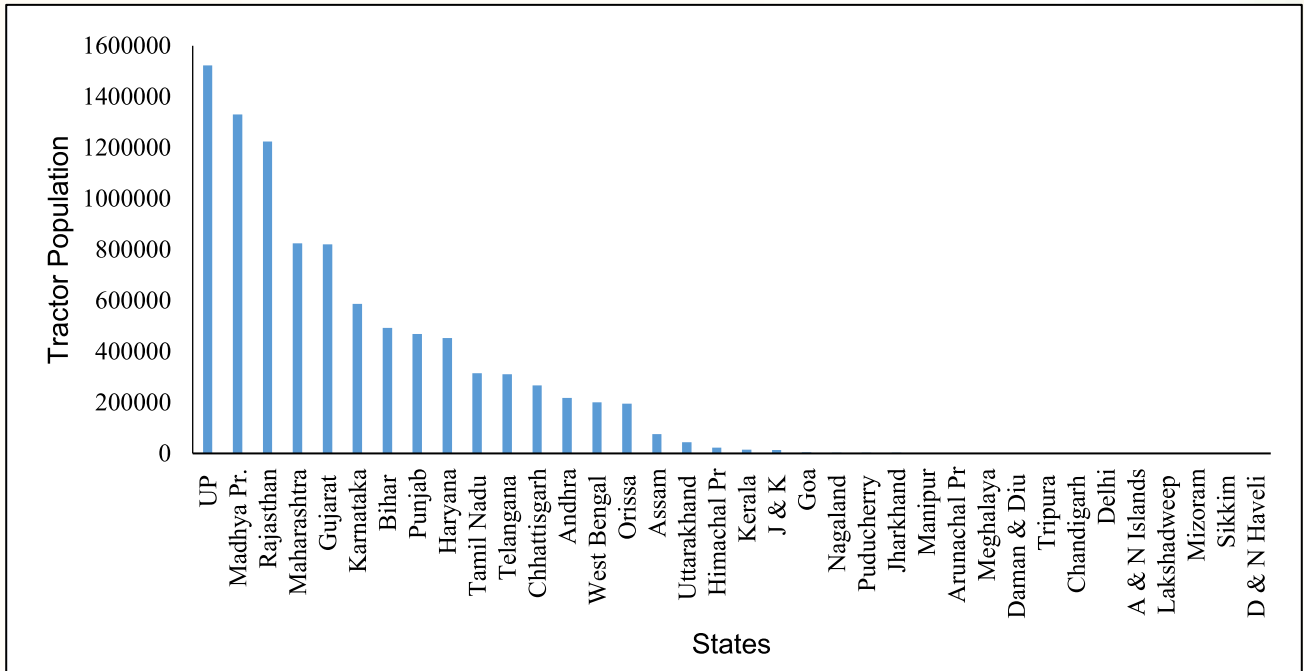


Fig 2. Tractor population in different states of the country up to 31st March 2020

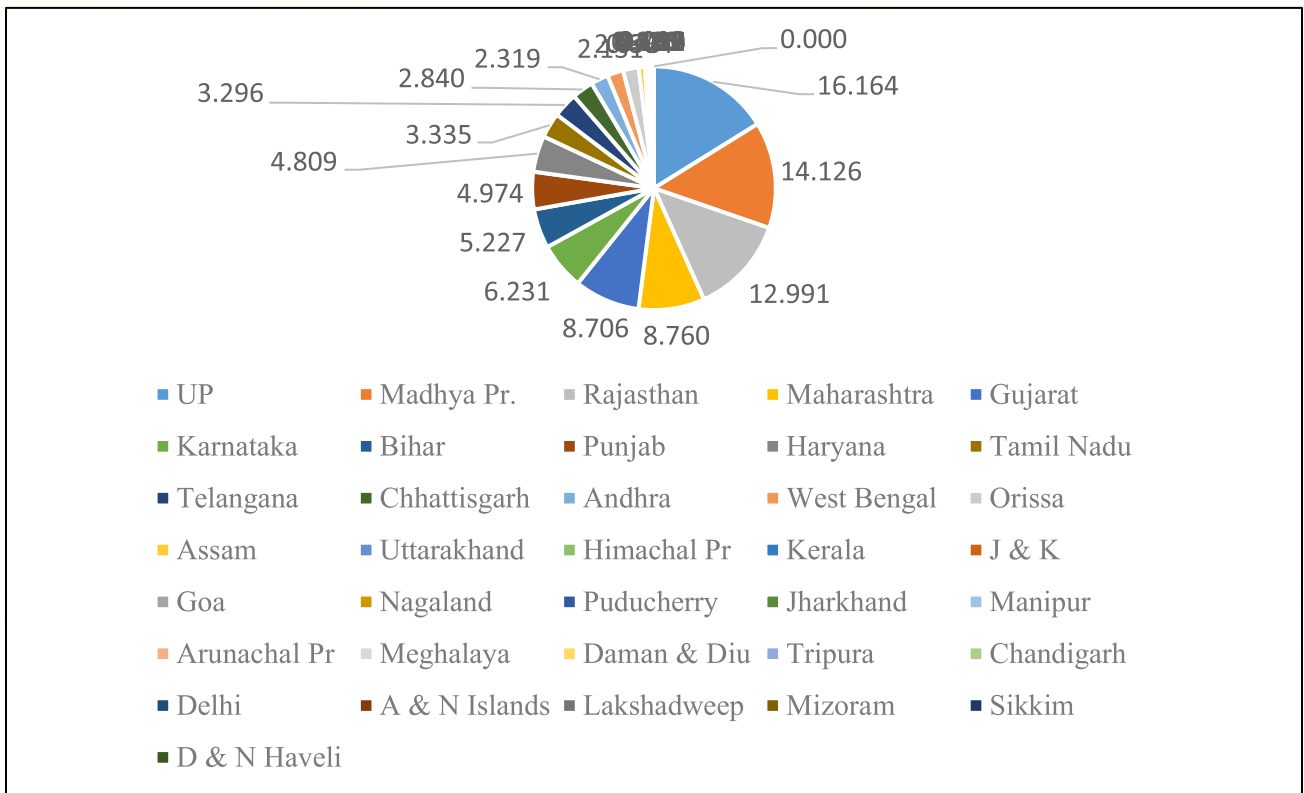


Fig 3. Percentage share of tractors in different states of the country on 31st March 2020

Majorly, tractors are hitched with single-axle (unbalanced or semi-trailer) and double-axle (balanced) trailers for haulage carriage and transportation in rural areas. An unbalanced or single-axle trailer (is a two-wheeled trailer attached to the tractor's rear with a drawbar hitch. A part of its weight is transferred to the tractors rear wheel and rests on its wheels. Such tractors are quite popular throughout the country, requiring the special skill of tractor drivers for steering and reversing. The load capacity of the single-axle trailers shall not be more than 5 tonnes (BIS, standards for Agricultural tractor trailer specification, 2000). If these tractor-trailer combinations are used in road transportation, overload for haulage transportation (more than recommended by BIS) causes accidents due to collision, side and over turnings and various reasons (lack of facilities provided in tractor-trailer combination for road transportation).

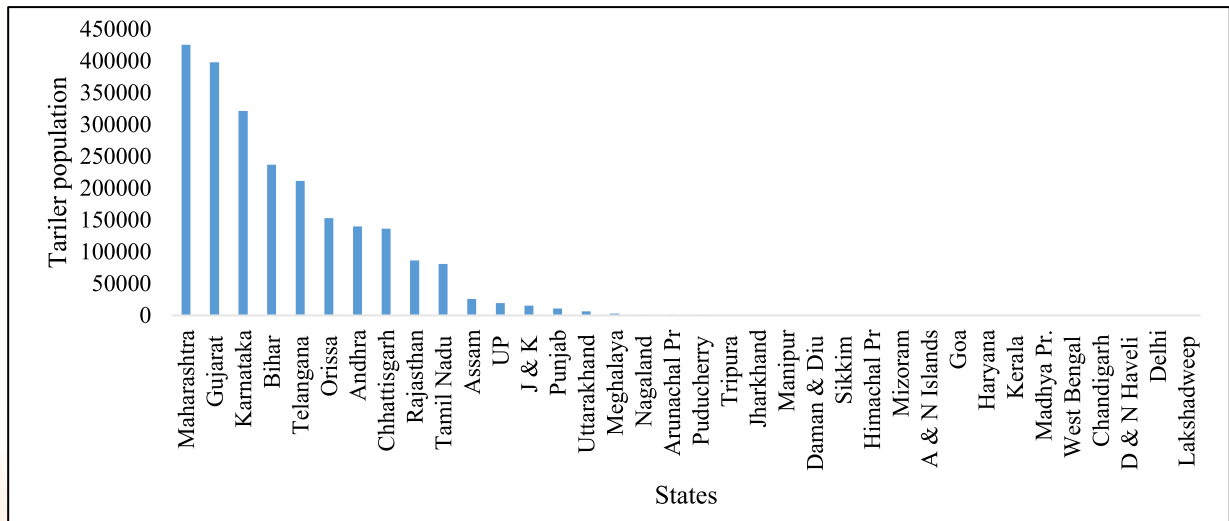


Fig 4. : Trailer population in different states of the country up to 2020.

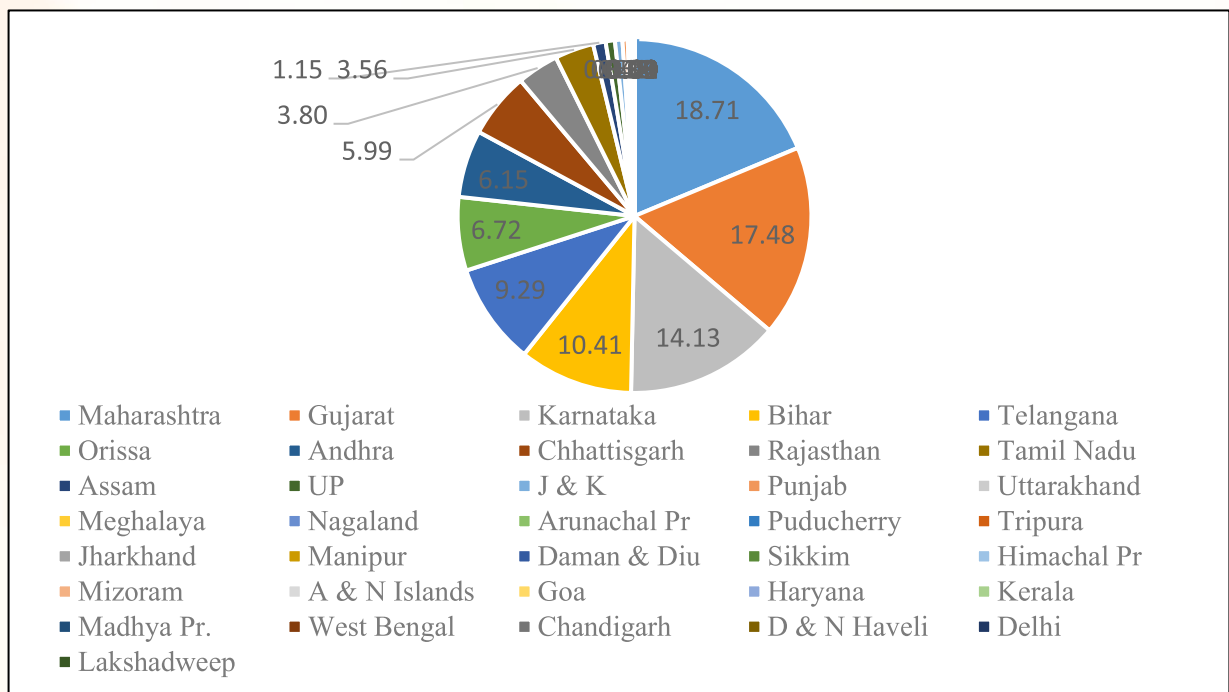


Fig 5. : Percentage share of trailers in different states of India.

The total number of registered tractor-trailers (single-axle and double-axle) as on 31st March 2020 was 22,74,803, with a % share of total registered vehicles in a total of 0.70%. The share of 'Other vehicles', including tractors, trailers, three-wheelers (passenger)/Light Motor Vehicles (LMVs) and other miscellaneous vehicles increased from 1.3 percent in 1951 to 6.9 percent in 2020. Among this population of trailers, trailers currently used in the country are 1695388. (Road transport year data book, 2020). The trailer population in different states of the country and their percentages are shown in Figs 4 and 5. The top five states with the highest populations of trailers in India are Maharashtra with 425534 with a total share percentage of (18.71 %) followed by Gujarat 397620 with a total share percentage of (17.48%), Karnataka 321415 with a total share percentage of (14.13 %), Bihar 236793 with a total share percentage of (10.41%) and Telangana 211340 with a total share percentage of (9.29%) respectively.

Therefore, from the above views, this study aimed to understand how tractor and trailer populations present in different states and the number of injuries (including fatalities) over the years with the tractor-trailer as a transportation means. The limitations of tractor trailers as transportation means and suggestions for low-cost mitigation strategies for injuries during transportation with these combinations are explained.

Limitation of tractor-trailers

- No brakes
- Lacks suspension system
- No sitting system for passengers; can cause exposure to higher vibrations, noise and dust.
- Does not have rear visibility; or side indicators
- Less conspicuous: lack of rear indicators, SMVE
- Trailer is towed by a tractor; improper hitching causes side turning and overturning.
- During haulage transportation, it covers a wide area of roads, causing difficulty for other vehicles in visibility and movement.
- Towing two trailers in
- No safety devices

Some tractor-trailer accident incidents during road and haulage transportation are shown in Figures 6 and 7.



Fig 6. Tractor-trailer accidents glimpse during transportation in rural areas



Fig 7. Tractor-trailer during transportation of overloaded haulage purpose

Tractor-Trailers associated injuries and fatalities

Mainly the tractor-trailer combinations used for transporting farm inputs, produce, construction materials and people in low-income countries. These are associated with many injuries, and most of them are unreported. The data collected from secondary sources on tractor-trailer injuries are collected and reported in the present article.

The fatalities and injuries due to the tractor-trailer combination from 2014-2020 are shown in Fig 8. These two figures showed that a maximum of 12,028 persons were injured and 5720 persons lost life. The percentage share of death rates due to tractor-trailers among all the other modes of death rates is shown in Fig 9. During Coronavirus affecting years 2020- 21, there was a decrease in death rates. Even though the increase in tractorization and utilization of trailers can enhance the ease of agricultural activities, rural transportation can help increase production but can cause injuries and disability if proper attention and care are not given.

The total number of persons (offenders and victims) during tractor-trailer transportation during 2014-2021 in different states is shown in Fig 10. It was observed that Uttar Pradesh had the highest number of offenders and victims throughout this period, followed by Madhya Pradesh, Rajasthan, Andhra Pradesh and Maharashtra. Interestingly, there are higher accidents (offenders and victims) in the states with the higher number of tractors and trailer populations. So, preventive measures are necessary to initiate in this sector to reduce injuries.

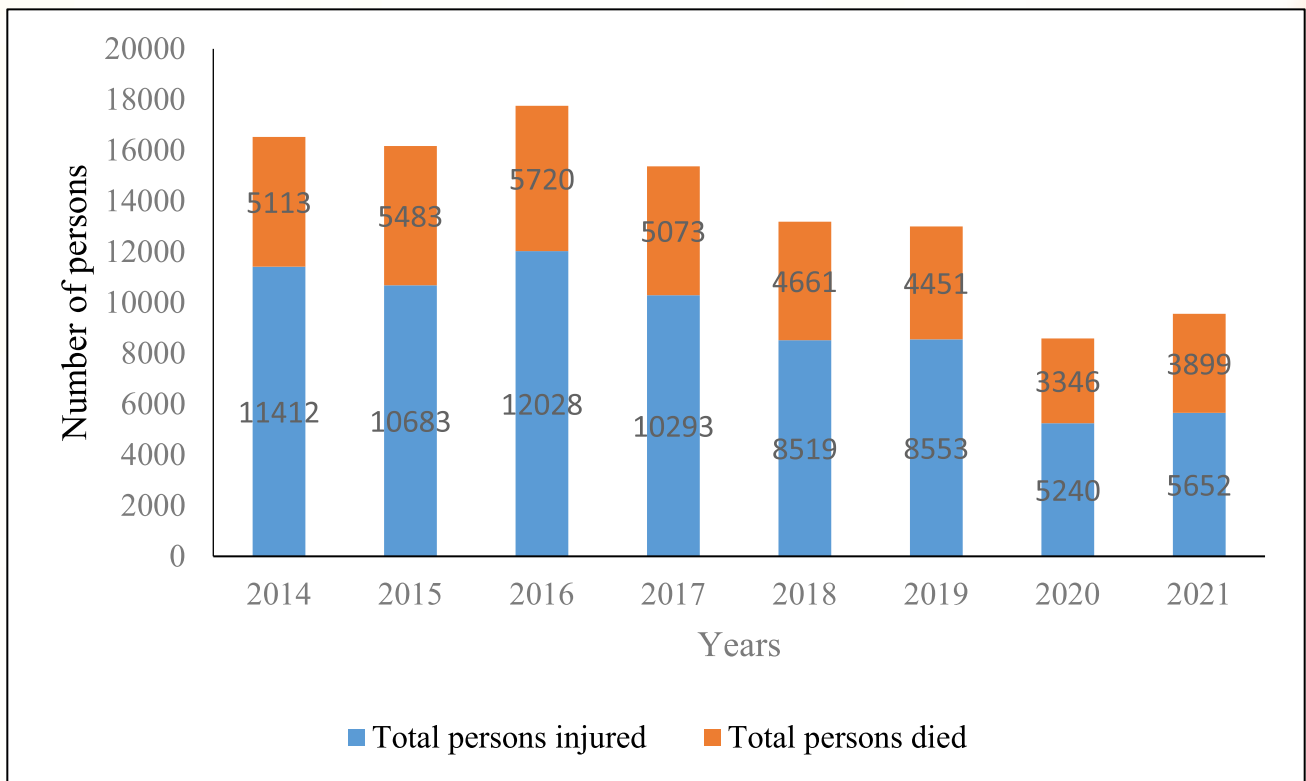


Fig 8. Number of persons injured and died in road accidents due to tractor from 2014-2021. Source: (Accidental Deaths & Suicides in India, (National Crime Records Bureau; Ministry of Home Affairs)

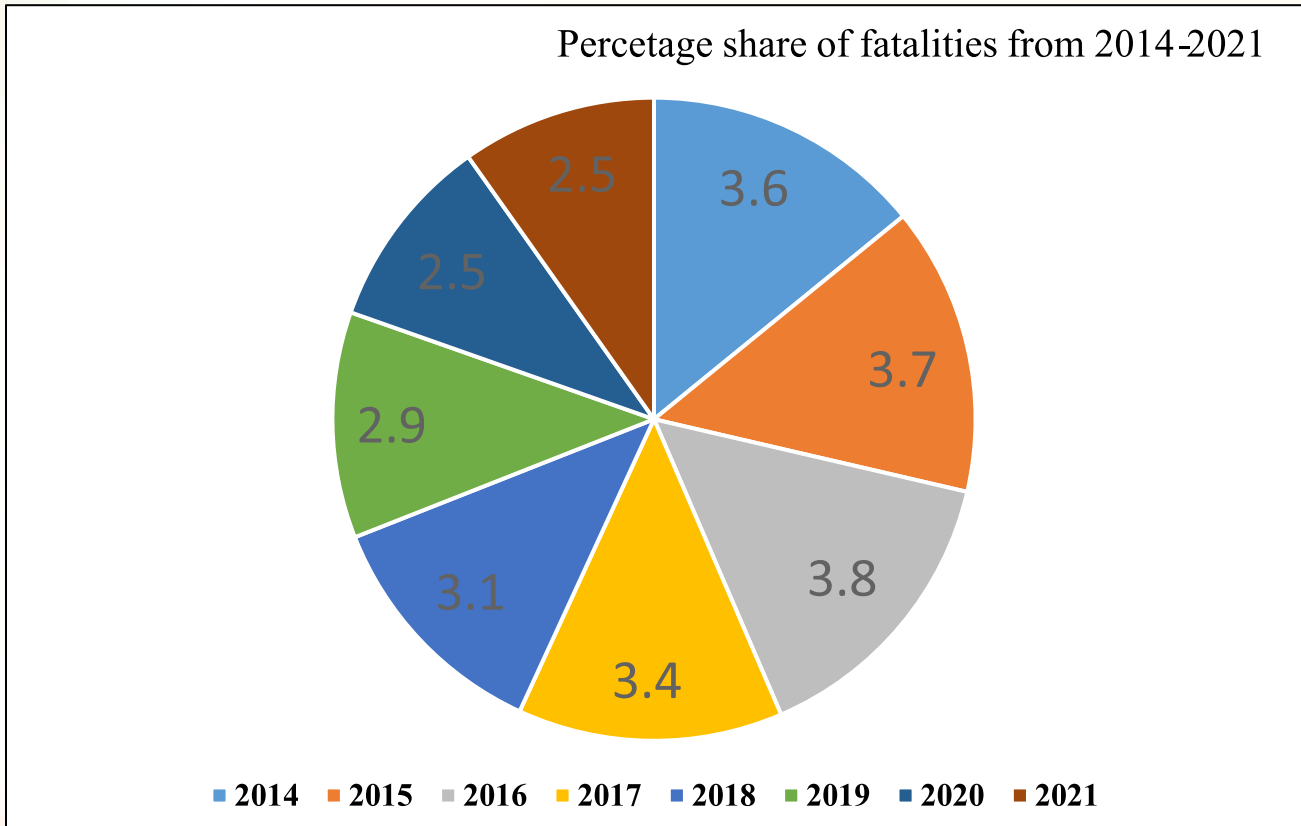


Fig 9. Percentage share of death rates due to tractors among all accidents from 2014-2021. Source: (Accidental Deaths & Suicides in India, (National Crime Records Bureau; Ministry of Home Affairs)

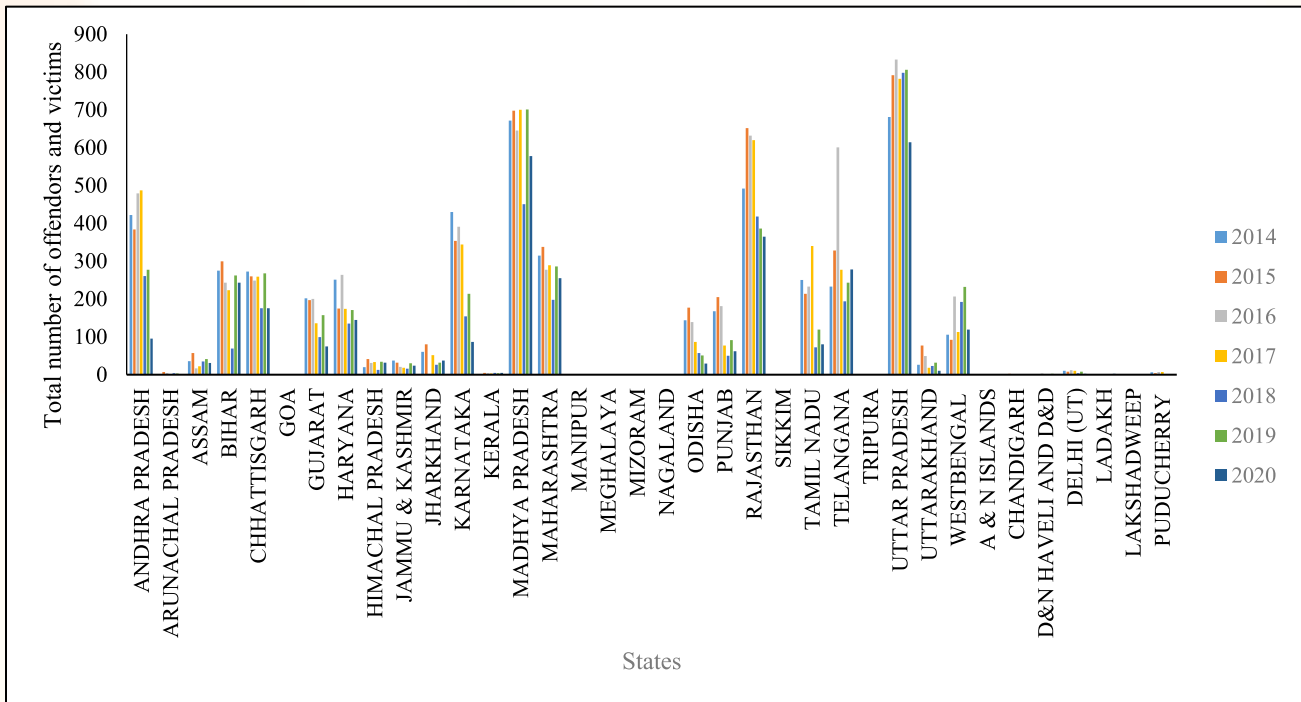


Fig 10. Total victims and offenders in different states of the country from 2014-2020

Preventive measures to mitigate tractor-trailer accidents during transportation

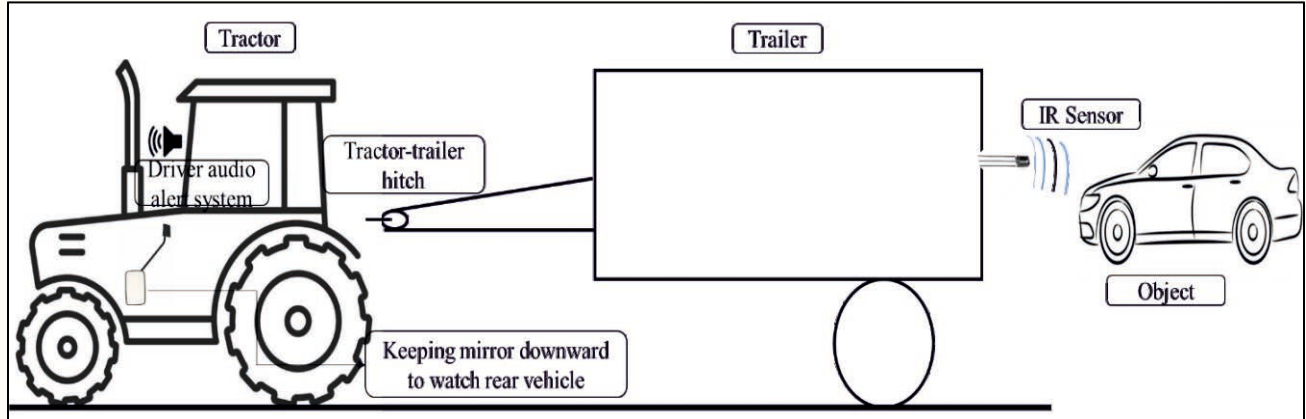


Fig 11. : Conceptual drawing for IR sensor-based audio signal alerting system and downward mirror technique

Rear View Mirror (downward)

A straightforward approach to mitigating tractor-trailer accidents during transportation involves adjusting the mirrors downward. This technique proves particularly useful when hauling a fully loaded trailer; this can impede visibility towards the rear. By angling the mirrors downward, the tractor-trailer combination can observe the vehicle's rearward view, utilizing the ground clearance as a strategic vantage point. This practical adjustment enhances the overall safety of the haulage operation by compensating for reduced visibility caused by the heavy load.

Sensor-based approach

The compromised visibility at the rear of a tractor-trailer combination, resulting from overloaded trailers, poses a significant challenge to road transportation safety. This visibility hindrance, especially during turns and maneuvers, has been a leading cause of accidents. An infrared (IR) sensor-based system emerges as a practical and cost-effective solution. This innovative approach not only enhances safety but also proves economically viable. By strategically situating an IR sensor at the rear of the trailer, the system becomes adept at detecting nearby moving vehicles or stationary objects, particularly during turns or maneuvers. Upon detection, the sensor promptly alerts the tractor-trailer operator with an audible signal, effectively mitigating potential collisions and preventing accidents.

Other Interventions

- Enhancing the visibility of tractor-trailers: "SMVE at Rear marking plate a triangular shaped with truncated corners with a characteristic pattern faced with retro-reflective and fluorescent material or devices (Class 1); or with retro-reflective materials or devices only (Class 2).
- Placing of low-cost rear camera and display system at the operator.
- Provision of Rear (tail lights), blinkers and side Indicators
- Tarpaulin cover with fluorescent stripes/LED strips to make the covered trailer visible.

- Compressing the low-density fodder into blocks for lower volume,
- Careful during driving at sharp slopes, uneven, soft or slippery ground, alongside ditches or banks, and during turning or reversing.
- When traveling on public roads, keep on the correct side of the road. Use light signals to turn, stop or slow down.
- No overloading of the trailer to prevent tipping backward
- Removable guards for trailer when passengers are travelling

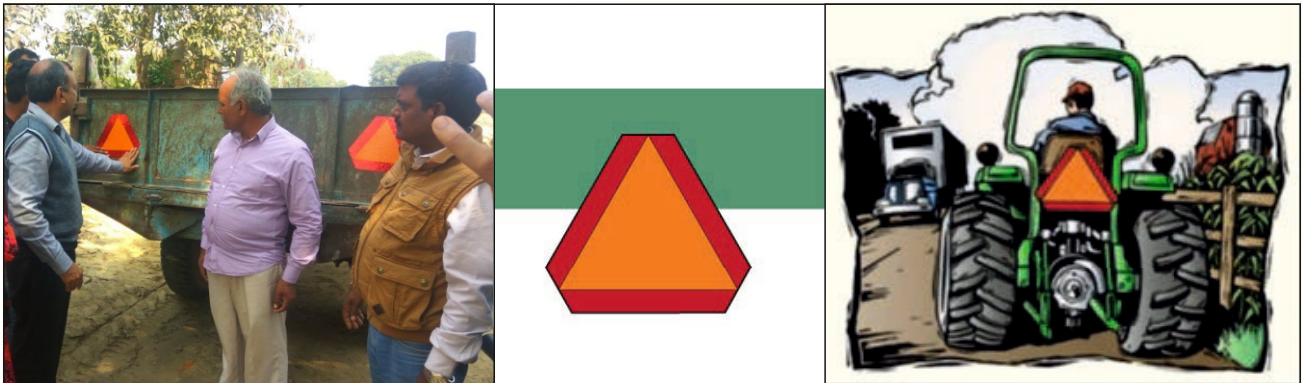


Fig 12. Slow moving vehicle emblem at the rear of tractor and trailer