Rising Road Hazards: Accidents Involving Tractor-Trailers Carrying Humans and Farm Equipment in Odisha

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ABSTRACT

The mechanization of agriculture in Odisha has improved productivity but increased safety risks. Tractors, tractor-trailers, and other farm machinery, often operated without proper training or safety measures, are major contributors to accidents, injuries, and fatalities. Common causes include rollovers, overloading, unsafe passenger transport, and collisions on narrow or uneven roads. These incidents result in significant human, social, and economic losses, particularly among small and marginal farmers. Although regulations such as the Odisha Dangerous Machines (Regulation) Rules, 2008, aim to improve safety, enforcement gaps, limited training, and poor infrastructure persist. This study highlights patterns and impacts of machinery-related accidents and recommends preventive strategies, including mandatory inspections, operator training, safety retrofitting, improved rural infrastructure, awareness campaigns, and strengthened emergency response. Implementing these measures can reduce accidents, protect livelihoods, and support sustainable agricultural modernization in Odisha.

INTRODUCTION

Agriculture remains the backbone of rural India, employing a large proportion of the population and forming the foundation of the rural economy. Rapid mechanization—the increased use of tractors, tractor-trailers, threshers, power

tillers, and other equipment—has improved productivity but also increased safety hazards (ICAR, 2023). Unlike commercial vehicles, agricultural machines are often operated without proper safety mechanisms or maintenance. Many are used for non-agricultural transport, such as carrying goods or passengers, leading to unsafe practices like overloading and riding on trolleys (RDO, 2023).

In Odisha, where terrain ranges from coastal plains to hilly regions, risks are amplified due to poor road infrastructure, limited safety awareness, and inadequate operator training (Planning & Coordination Department, 2024). Tractor overturns, collisions, and machinery entanglements remain common causes of injuries and fatalities (Government of Odisha, 2008). Therefore, safety awareness and stronger regulatory enforcement are urgently needed.

1. Overview of Agricultural Accidents in India

1.1 National Scenario

- **High proportion of tractor-related incidents:** according to the Indian Council of Agricultural Research (ICAR) and various national-level surveys, tractor-related accidents account for **over 30% of all agricultural accidents in India** (ICAR, 2023). This highlights the significant role of tractors and tractor-trailers in farm-related injuries and fatalities, particularly in states with high levels of mechanization.

- **Large number of annual accidents:** surveys conducted across multiple states have estimated that **over 2.6 lakh agricultural machinery-related accidents occur every year** in India (Ministry of Finance, 2023). These accidents result in approximately **19,000 deaths annually**, in addition to a large number of non-fatal injuries that cause long-term disabilities and financial hardships for farming families. The actual figures may be even higher due to underreporting in remote rural regions (Ravikumar et al., 2017).

- **Common causes and accident types:** among the reported cases, **tractor rollovers** are identified as the most frequent and deadly type of accident, often caused by overloading, uneven terrain, or loss of control on slopes (Watanabe & Sakai, 2021). Other significant causes include **entanglement with moving machinery parts** such as rotavators and threshers, as well as **collisions with other vehicles** or obstacles on rural roads. Lack of operator training, poor maintenance, and absence of safety guards or protective gear further contribute to these incidents (Singh & Verma, 2019).

- **Need for safety interventions:** these alarming statistics emphasize the urgent need for **comprehensive safety education, operator training programs, regular machinery inspection, and strict enforcement of safety standards**. Promoting the safe use of agricultural machinery can help reduce accident rates and protect the lives and livelihoods of farmers across India.

Table 1.Common Causes

Major Causes	Description	Risk Factors
Overturning / Rollovers	Tractor or trailer overturns on slopes or curves	Uneven terrain, overloading, poor steering
Overloading	Exceeding safe weight limits	Raises center of gravity, braking failure
Unsafe Passenger Transport	People riding in tractor trolleys	No seating or safety features
Poor Maintenance	Lack of brakes, reflectors, lights	Increases likelihood of loss of control

Lack of Training	Untrained drivers	Inexperienced handling
Poor Infrastructure	Narrow, hilly roads	High accident probability

2. Agricultural Accidents in Odisha

2.1 Mechanization Trends

- **Rapid growth in agricultural mechanization:** Over the past decade, Odisha has witnessed a **significant rise in the adoption of farm machinery and power-driven equipment**. The state's agricultural sector has moved from traditional manual and animal-based farming methods to more mechanized operations, primarily driven by the need to enhance productivity, reduce labor dependency, and ensure timely completion of agricultural tasks (Department of Agriculture & Farmers' Empowerment, n.d.). Government initiatives promoting farm mechanization through subsidies and credit schemes have further accelerated this trend, making tractors, power tillers, threshers, and harvesters more accessible to small and marginal farmers.

- **Decline in bullock use and shift to machinery:** A **31% reduction in bullock use between 2012 and 2020** clearly reflects Odisha's growing reliance on mechanical power for agricultural operations (Sahoo, 2023). Farmers increasingly prefer tractors and power tillers due to their efficiency in land preparation, sowing, and harvesting. This transition indicates modernization in farming practices but also introduces new safety challenges related to machinery operation and maintenance.

- **Dual use of tractors in rural areas:** In many rural parts of Odisha, tractors are **not limited to agricultural purposes** (OdishaTV.in, 2025). Farmers and local operators frequently use them for **non-agricultural activities** such as sand and construction material transportation, carrying goods, or even transporting passengers. While this practice helps supplement farmers' income, it also **increases the risk of accidents**, as tractors and trailers are not designed for passenger movement or heavy commercial loads. The combination of inadequate road infrastructure, untrained drivers, and unsafe operational practices has made tractor-related accidents a growing concern in the state.

Table 2. Recent Reported Accidents in Odisha

Year	District	Description of Accident	Consequences
2025	Jajpur	Sand-laden tractor overturned on embankment	1 killed, 2 injured
2025	Gajapati	Tractor carrying rice fell 10 ft off ghat	12 injured
2024	Kandhamal	Tractor overturn while climbing ghat	1 dead, 1 injured
2024	Nuapada	Car collided with tractor at night	4 youths killed
2023	Ganjam	Tractor carrying protestors overturned at curve	2 dead, 17 injured

2.2 Observed Patterns in Odisha

- **Frequent accidents on ghat roads and embankments:** A significant number of agricultural accidents in Odisha occur on **ghat roads, sloped terrains, and river embankments**, where tractors and trailers are commonly used for transporting crops, sand, and other materials (Planning & Coordination Department, 2024). These routes are often narrow, uneven, and poorly maintained, making it difficult for drivers to maintain stability, especially when

carrying heavy or unbalanced loads. The absence of proper road design and safety barriers further increases the risk of vehicles skidding or overturning on steep curves.

- **Overloading and unsafe passenger transport: Overloading of tractor-trailers** remains a widespread issue in rural areas. Many farmers use trailers to carry not only agricultural produce but also construction materials or large groups of people, particularly during social or community events (RDO, 2023). This **unauthorized passenger transport** significantly raises the chances of fatal accidents, as trailers are not built for human carriage and often lack safety features such as side railings or seats.

- **Poor infrastructure and lack of safety measures: Inadequate road infrastructure**, including the absence of guardrails, uneven surfaces, and unpaved village roads, contributes heavily to the occurrence of accidents. During the rainy season, slippery surfaces and weak embankments make driving conditions even more hazardous.

- **Night-time visibility issues:** A notable number of collisions occur **during night-time operations**, highlighting the lack of proper **lighting systems, reflectors, and warning signals** on tractors and trailers. Many vehicles operate with faulty or absent headlights, making them barely visible to oncoming traffic.

- **Predominance of overturning and loss of control:** The **majority of reported incidents involve vehicle overturning or loss of control** rather than high-speed crashes. Factors such as uneven terrain, sharp turns, sudden braking, and mechanical failure are common causes. These patterns emphasize the need for operator training, improved road infrastructure, and enforcement of load and passenger safety regulations across Odisha.

3. Impacts of Machinery Accidents

3.1 Human and Social Impact

Agricultural machinery accidents have severe **human and social consequences**, particularly in rural areas where farming is the main source of livelihood. **High fatality and injury rates** are frequently reported among small and marginal farmers, tractor drivers, and agricultural laborers who often operate machinery without adequate training or safety equipment. Survivors of such accidents often suffer from **long-term disabilities**, including limb amputations or spinal injuries, which drastically reduce their ability to work and sustain agricultural productivity. The **loss of a primary earner** in rural households has far-reaching effects, leading to financial instability, psychological trauma, and disruptions in children's education. In many cases, families are forced into debt to cover medical expenses or vehicle repairs, further worsening their economic vulnerability.

3.2 Economic Losses

The **economic impact** of agricultural machinery accidents is equally significant. The losses include **direct medical expenses, vehicle repair costs, damaged produce, and loss of workdays** during critical farming seasons. At the national level, the **annual financial loss from such accidents is estimated to exceed ₹1,100 crore**, reflecting the widespread economic burden. In Odisha, frequent mishaps involving tractors and trailers—especially during **sand, crop, or goods transportation**—result in both **human casualties and material losses**. These accidents not only affect individual households but also hinder overall rural productivity and economic development, underscoring the

urgent need for preventive safety measures and farmer training programs.

4. Regulatory Framework and Safety Gaps

4.1 Existing Regulations

- The *Odisha Dangerous Machines (Regulation) Rules, 2008* were framed under the *Dangerous Machines (Regulation) Act, 1983*, a Central legislation aimed at ensuring the safe use of agricultural machinery. Notified on 31 January 2008, these rules came into force immediately to regulate the manufacture, distribution, sale, and use of dangerous agricultural machines, thereby reducing farm-related accidents and protecting farmers and rural workers.

- The primary objective of the rules is to ensure operator safety by standardizing the design and operation of high-risk agricultural machinery. They aim to prevent injuries and fatalities, enforce compliance with safety standards, regulate licensing of manufacturers and dealers, ensure accident reporting and compensation, and promote safer mechanization practices in Odisha.

- "Dangerous machines" under the Act include power threshers, power-operated chaff cutters, sugarcane crushers, and other notified equipment capable of causing serious harm. Such machines must conform to prescribed safety standards, including protective guards, safe feeding systems, and emergency mechanisms.

- Key provisions include mandatory licensing for manufacturers and dealers, adherence to safety specifications in machine design, modification of old machines to meet current norms, and regular inspections by authorized officers. Violations can lead to suspension or cancellation of licenses. The rules also mandate prompt reporting of accidents and provide compensation to victims or their families.

- Implementation is overseen by the Department of Agriculture and Farmers' Empowerment, with designated Controllers, Inspectors, and Licensing Authorities ensuring compliance at various levels.

- The rules are significant for enhancing farm safety, ensuring accountability among manufacturers, and providing legal protection for victims. However, challenges persist due to weak enforcement in remote areas, limited inspection capacity, lack of awareness among farmers, and the continued use of unregistered or unsafe machines. Strengthening monitoring and awareness is vital for the effective implementation of these safety measures.

4.2 Gaps in Implementation

1. **Lack of Routine Inspection of Farm Trailers:** Regular inspection of farm trailers is often neglected due to inadequate manpower and limited coordination between enforcement agencies. This leads to continued operation of unsafe or poorly maintained trailers on rural roads and farms.

2. **Widespread Use of Unregistered or Modified Trailers:** Many farmers use locally fabricated or modified trailers that do not comply with safety standards. These unregistered trailers often lack essential features such as proper braking systems, reflectors, and guards, increasing the risk of accidents.

3. **Limited Training Programs for Rural Operators:** Most rural machinery operators lack formal training in safe machine handling, maintenance, and emergency response. The absence of structured

training and awareness programs results in unsafe practices and higher accident rates.

4. **Weak Enforcement of Overloading and Lighting Rules:** Overloading of farm trailers and the use of vehicles without proper lighting or reflectors, especially during night transport, remain major safety concerns. Enforcement of these provisions under traffic and safety regulations is minimal, contributing to frequent road and field accidents.

Table 3. Prevention and Control Strategies

Strategy	Description	Implementation
Engineering Controls	ROPS, trailer brakes, lights, reflectors	Mandatory retrofit, government subsidies
Regulations	Strict enforcement of load limits and passenger rules	Traffic police, transport dept
Training	Safe driving, maintenance	Farmer training programs
Infrastructure	Guardrails, signage on ghats	Rural road development
Awareness	Local campaigns	Panchayats, schools, co-ops
Emergency Response	First aid & trauma care in rural areas	Health department

5. Suggestive measures

1. **State-Level Accident Registry:** Establish a centralized digital registry to record and analyze tractor and machinery-related accidents. This database will help identify high-risk areas, guide policy decisions, and monitor the effectiveness of safety interventions.

2. **Mandatory Safety Inspections:** Introduce compulsory periodic inspections for tractors, power threshers, and farm trailers to ensure compliance with safety standards and prevent operation of faulty or unregistered machinery.

3. **Ban on Passenger Transport in Trailers:** Strictly prohibit the use of agricultural trailers for carrying passengers. Enforce penalties for violations to prevent frequent fatal accidents caused by overloading and unsafe transport practices.

4. **Subsidies for Safety Retrofitting:** Provide financial incentives for farmers to retrofit existing machines with safety features such as Roll-Over Protective Structures (ROPS), functional brakes, reflectors, and lights.

5. **Infrastructure Upgrades:** Improve road design and signage on rural and ghat roads prone to accidents. Safe turnings, guardrails, and better lighting can significantly reduce tractor overturning and collision risks.

6. **Driver Training Programs:** Conduct structured driver and operator training sessions through **Krishi Vigyan Kendras (KVKs)** and local agriculture offices to promote safe handling and maintenance of machinery.

7. **Community Awareness Campaigns:**Use local communication channels such as radio broadcasts, *gram sabhas*, and village-level campaigns to spread awareness on machinery safety, accident reporting, and preventive practices.

8. **Faster Emergency Response Systems:**Strengthen rural emergency and medical response networks, especially in tribal and remote regions, to ensure timely assistance and reduce fatalities from farm machinery accidents.

CONCLUSION

The increasing use of **tractors and trailers** has transformed agriculture across India, making farming operations faster, more efficient, and less labor-intensive. However, this rapid mechanization has also introduced a

new range of **safety hazards**, particularly in rural regions where road conditions are poor and awareness of safe machinery operation is limited. In India—and especially in Odisha—**tractor overturning, unsafe trailer usage and overloading** have emerged as major causes of rural fatalities and serious injuries. These accidents not only claim lives but also lead to long-term disabilities, economic hardship, and emotional trauma for farming families.

Most of these incidents are **preventable** through a combination of proper engineering controls, operator training, regular vehicle maintenance, and the implementation of safety regulations. Enhancing **rural infrastructure**, such as constructing safer roads, installing guardrails, and ensuring proper lighting, can further reduce accident risks. A **coordinated effort between state and national authorities**, supported by agricultural extension services and local governance bodies, is essential to create a culture of safety in rural mechanized farming.

The **Odisha Dangerous Machines (Regulation) Rules, 2008** mark an important policy initiative aimed at improving farm safety in the state. These rules focus on regulating the use, sale, and maintenance of agricultural machinery to prevent accidents and ensure operator protection. However, **stronger enforcement, wider awareness campaigns, and financial assistance** for retrofitting existing machines with safety features are critical for achieving their intended impact. Effective implementation of these measures can significantly **reduce machinery-related accidents**, safeguard rural livelihoods, and promote the **sustainable modernization of agriculture** in Odisha.

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