

Assessment of Fire And Life Safety In Rural Settlements In India

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Abstract

Fire incidents pose a significant threat to life and property in rural India, particularly in residences. Despite strides in urban fire safety, rural areas continue to face frequent fire incidents, posing significant risks to lives and properties. This paper presents a thorough review of existing literature on fire safety assessment in rural Indian settlements focusing on unique vulnerabilities specific to this context. In rural settings, various factors contribute to the increased risk of fire outbreaks, including the prevalent use of traditional building materials, unregulated cooking practices, inadequate electrical infrastructure, unsafe storage practices, and human behavior patterns. Understanding these factors is crucial for developing effective fire prevention strategies tailored to rural environments. By identifying primary fire causes, stakeholders can explore relevant prevention measures and interventions to enhance safety in rural settlements. This paper aims to fill the gap in the literature by examining the multifaceted nature of fire safety in rural India and proposing actionable insights for stakeholders. It emphasizes the importance of community involvement, innovative strategies, and policy implications in addressing fire safety challenges. By fostering collaboration among government agencies, local communities, and non-governmental organizations, sustainable solutions can be developed to mitigate the risks associated with fire incidents in rural areas. This study also underscores the critical need for tailored approaches to rural fire safety and promotes enhanced safety standards in building design, infrastructure development, and public awareness campaigns. By incorporating local knowledge, cultural practices, and community participation into fire safety initiatives, stakeholders can effectively address the unique challenges faced by rural settlements in India, ultimately saving lives and protecting property.

Keywords: Life safety, fire safety, rural settlement, fire risk

INTRODUCTION

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Background

Rural settlements in India face significant challenges in ensuring fire and life safety for their inhabitants due to limited access to resources and infrastructure. According to various literature, regardless of advancements in urban fire safety measures, rural areas remain vulnerable to frequent fire incidents, resulting in substantial loss of life and property (NCRB, 2022) [1]. Rural India faces a distinct set of challenges regarding fire safety in residential buildings. Traditional construction materials like wood, hay, and thatch are highly combustible. Densely packed housing layouts and narrow pathways can hinder escape routes and firefighting efforts. Furthermore,

limited access to fire stations and emergency services in remote villages creates a delayed response time. This paper focuses on these unique vulnerabilities and proposes strategies for mitigating fire risks.

In addition, socio-economic factors such as poverty and inadequate access to healthcare exacerbate this vulnerability, complicating emergency response efforts [2]. However, there is a significant lack of research focusing on fire and life safety assessment in rural India, with existing studies predominantly centred on urban areas [3] [4]. Hence, there is a need to assess the challenges and vulnerabilities related for fire and life safety in the rural settlements, so that potential solutions and mitigation measures can be developed and provided including the awareness to the stakeholders involved in rural fire safety initiatives.

A comprehensive review of existing literature on fire and life safety assessment in rural India has been conducted. Through an analysis of key findings and insights from previous studies, the study focuses on identifying the issues/problems in the existing fire safety measures in rural settlements which acts as instrumental in getting a thorough insight and understanding of the challenges and opportunities associated with fire safety in rural settlements.

Existing Fire Safety Measures in Rural Settlements

Despite the challenges, efforts have been made to improve fire safety through various interventions, including community awareness programs, training workshops, and the establishment of volunteer firefighting brigades [5]. In addition, Government schemes aimed at enhancing rural infrastructure and providing access to clean water indirectly contribute to improving fire safety standards [6]. However, the effectiveness of these measures is limited by resource constraints and inconsistent implementation.

It is imperative to note that these programs should aim to instill safe practices in everyday life, such as proper storage of flammable materials and electrical safety. Additionally, the residents should be equipped with knowledge on how to respond to a fire emergency, including evacuation procedures and basic fire extinguisher use [7].

According to various literature and previous fire incidents in rural areas, it is revealed that the effectiveness of these existing measures is often limited by two key factors. Resource constraints can hinder the implementation and scope of these programs. Additionally, inconsistent implementation across different regions in India creates a disparity in the level of fire safety preparedness [8]. These limitations should be addressed to improve and enhance fire and life safety in rural areas to mitigate the potential risks in case of any fire emergency.

Fire accidents in rural areas in india

Instances of significant fire disasters in rural regions of India encompass a spectrum of tragedies, spanning from the inferno in Uttarkashi village to the devastation of shanties in Gurgaon, the conflagration of huts in Merrut, the Kumbakonam School Fire in Tamil Nadu, and the Mandi Dabwali Fire Tragedy in Haryana. These calamities have resulted in substantial loss of life, underscoring the urgent need for enhanced fire safety measures in rural areas. These fire accidents have been further discussed below:

- According to the report by The Indian Express, 50 Shanties Destroyed in Gurgaon Village Blaze (Figure 1) A burst of LPG gas on May 20 reduced 50 shanties to ashes, resulting in a significant loss of livelihood. Fortunately, there were no casualties reported.
- In the other accident of Uttarkashi Village Blaze, (Figure 2) Times of India reported that, a devastating inferno razed 39 houses in Sawadi village, Mori district, Uttarkashi. This incident adds to a troubling trend in the district, with 8 similar instances recorded between 2006 and

2013, destroying 263 houses. The remote location of the village delayed the fire department's response, prolonging the devastation.



Figure 1. Gurgaon Village Blaze (Source: Tribune India)



Figure 2. Fire in Uttarkashi Village (Source: Times of India)

- In the fire incident of the Jahidpur village in Meerut, (Figure 3) as reported by Free Press Journal, 100 Huts were engulfed by a fire originating from a firecracker at a wedding procession. Despite efforts by the local police and the public, the fire department arrived late due to logistical challenges.



Figure 3. Fire in Jahidpur village, Meerut (Source: Times of India)

- In the fire incident at Kumbakonam School Fire, (Figure 4) Tamil Nadu, a fire broke out in a crowded school complex in Kumbakonam, resulting in the tragic loss of 94 young lives. The lack of open space, cramped classrooms, and inadequate safety measures exacerbated the

casualty count. With no disaster management plan in place, rescue efforts were hampered, leading to this devastating outcome.



Figure 4. Kumbakonam School Fire, Tamil Nadu (Source: Firstpost)

- In a major fire tragedy at Mandi Dabwali, Haryana, (Figure 5) a fire engulfed a bamboo pandal during an annual school function in Mandi Dabwali, claiming 300 lives, mostly school children, and injuring 100 others. The absence of sufficient exits and safety protocols compounded the disaster, highlighting the critical need for improved safety standards in public gatherings. This incident does not relate to an example of fire in the rural settlement per se, however, the arrangement of the function was somehow similar to those of rural areas.



Figure 5. Fire tragedy at Mandi Dabwali, Haryana, (Source: NFSC study desk)

Fire and Life Safety Challenges in Rural Settlements

Rural settlements in India face a numerous challenge as far as fire and life safety is concerned, primarily stemming from limited access to resources and infrastructure. Unlike urban areas, rural communities often lack adequate firefighting equipment, trained personnel, and reliable access to water sources, exacerbating their vulnerability to fire incidents [9]. Moreover, the prevalence of traditional building materials and construction techniques in rural areas can increase the risk of fire spread, as these materials may lack fire-resistant properties [10]. Below are the key fire and life safety challenges (not limited to) in rural settlements:

- *Limited Access to Emergency Services:* Many rural areas lack adequate fire stations, firefighting equipment, and trained personnel, leading to delayed response times during fire incidents.
- *Inadequate Infrastructure:* Rural settlements often have poorly constructed houses made of highly flammable materials such as thatch, bamboo, or wood, which increases the risk of fire outbreaks.

- *Lack of Awareness and Education:* There is often a lack of awareness among rural populations regarding fire safety measures, including proper handling of flammable materials, safe cooking practices, and the importance of fire extinguishers.
- *Poor Electrical Safety:* Many rural areas have outdated electrical wiring and insufficient electrical infrastructure, which can lead to short circuits and electrical fires.
- *Open Cooking and Heating:* Traditional cooking methods using open flames or rudimentary stoves pose a significant fire hazard, especially in crowded rural households.
- *Limited Water Supply:* Rural areas frequently face challenges related to water scarcity or inadequate water supply, which hampers firefighting efforts.

Lack of Building Regulations and Enforcement: Building codes and regulations are often not enforced rigorously in rural areas, resulting in the construction of unsafe structures that are more susceptible to fire hazards [11].

- *Uncontrolled Land Use Practices:* Slash-and-burn agriculture, commonly practiced in rural areas, can lead to uncontrolled wildfires, especially during dry seasons.
- *Inaccessibility during Monsoon Season:* In many rural areas, heavy monsoon rains can lead to flooding, making it difficult for fire trucks and emergency services to reach affected areas.
- *Limited Financial Resources:* Rural communities often lack the financial resources to invest in fire safety infrastructure, such as fire alarms, smoke detectors, and fire extinguishers.
- *Cultural and Behavioural Factors:* Cultural practices such as storing large quantities of flammable materials like straw, hay, or firewood indoors pose additional fire risks.
- *Geographical Challenges:* Some rural areas are situated in remote or hilly terrains, making it difficult for firefighting vehicles to access affected areas quickly

It is imperative to note that assessing as well as addressing these challenges requires a multi-faceted approach that considers the unique and peculiar characteristics of rural settlements. Understanding and evaluating these challenges will be instrumental in providing innovative solutions as per the specific needs of rural communities. This might include initiatives like community-oriented fire prevention schemes and the adoption of eco-friendly construction techniques. Such measures are imperative for curbing fire hazards and elevating safety protocols in rural areas.

Potential solutions and approaches

The aspects of potential solutions and approaches have been explored to address fire safety challenges in rural Indian settlements, also focusing on low-cost technologies for early fire detection, community-based training programs, and sustainable construction materials. By examining the previous fire incidents and literature, following strategies has been suggested:

- **Promoting Fire-Resistant Construction:** Encouraging the use of fire-resistant materials like bricks, concrete, and treated wood in new constructions and retrofits for existing buildings. Encouraging the adoption of such materials constitutes a proactive measure to mitigate fire hazards in rural settlements.
- **Community-Based Fire Safety Programs:** Raising awareness through educational campaigns and workshops in rural communities on fire prevention, escape plans, and basic firefighting techniques. Community involvement is essential for the success of fire safety initiatives in rural settlements. Education and awareness campaigns, participatory decision-making processes, and the utilization of traditional knowledge and practices will be beneficial towards promoting community resilience to fire incidents.
- **Improving Firefighting Infrastructure:** Investing in establishing more fire stations in rural areas and equipping them with appropriate vehicles and personnel. This involves strategic investments in the establishment of additional fire stations strategically located across rural areas, supplemented by adequate personnel and specialized firefighting vehicles
- **Promoting Affordable Fire Safety Equipment:** Making basic fire extinguishers and smoke detectors readily available and affordable for rural residents. Ensuring access to basic fire

safety equipment is a pivotal aspect of enhancing fire preparedness in rural settlements. This initiative involves making essential tools such as fire extinguishers and smoke detectors easily accessible and economically feasible for rural residents.

DISCUSSIONS

This study proposes a multifaceted approach to address fire safety concerns in rural areas, emphasizing the importance of proactive measures and community involvement. Firstly, it suggests promoting the use of fire-resistant construction materials such as bricks, concrete, and treated wood in both new constructions and retrofits for existing buildings. This proactive step aims to reduce the vulnerability of structures to fire hazards, thereby minimizing the risk of widespread damage in rural settlements.

Further, community-based fire safety programs in rural areas is vital to educate residents about fire prevention and response. Through workshops and participatory approaches, these programs aim to develop effective strategies and skills, blending traditional knowledge with modern methods to foster community resilience.

It is imperative to understand the need to enhance firefighting infrastructure in rural areas by establishing strategically located fire stations equipped with personnel, specialized vehicles, and modern equipment. This investment aims to improve firefighting capabilities, enabling prompt responses to fire incidents and reducing potential damage.

CONCLUSION

This paper emphasizes the need for targeted fire prevention strategies by identifying the primary causes of fire in rural settlements. Promoting fire-resistant building materials, educating communities about safe cooking practices and electrical use, and encouraging proper storage of flammable materials are crucial steps towards a safer rural India. The significance of making basic fire safety equipment, such as fire extinguishers and smoke detectors, is of essence and should be readily available and affordable for rural residents. Ensuring access to these essential tools empowers individuals to take proactive measures in the event of a fire, thereby bolstering overall fire preparedness and response capabilities in rural settlements.

The initiatives proposed in this study aims to create a comprehensive framework for enhancing fire safety in rural areas, emphasizing collaboration between stakeholders, community engagement, and strategic investments in infrastructure and resources. By implementing these measures, rural communities can mitigate fire risks, minimize losses, and build resilience to fire incidents.

Recommendations

The recommendations for enhancing fire safety in rural areas include developing tailored education programs, incentivizing the use of fire-resistant materials, promoting safe electrical practices, improving access to affordable safety equipment, and collaborating with local authorities to manage waste effectively. Following are the key recommendations (not limited to):

- Develop and implement fire safety education programs tailored to the needs of rural communities.
- Encourage the use of fire-resistant alternatives for roofing and building materials through subsidies or microloans.
- Promote safe electrical practices through workshops and awareness campaigns.
- Improve access to affordable fire extinguishers and smoke detectors for rural households.
- Collaborate with local authorities to ensure proper waste management to reduce fire risks associated with burning debris

In addition, 'Policy interventions' are critical for addressing systemic challenges and promoting fire safety in rural areas. All the stakeholders need to understand the policy implications arising from the

review findings and provide recommendations for policymakers, government agencies, and other stakeholders involved in rural fire safety initiatives. Suggestions for future policy interventions and programs will be outlined to guide decision-making and resource allocation efforts.

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