

Assessment of fire safety status of commercial buildings in Gorkha municipality city area, Nepal

Ramesh Bhatta¹, Khet Raj Dahal^{2*}, Sagar Sedhain³, Prakash Gyawali⁴

¹Lumbini International Academy of Science and Technology (LIASST), Lalitpur, Nepal, rem.bh333@gmail.com

²Lumbini International Academy of Science and Technology (LIASST), Lalitpur, Nepal, dahal.khetraj@gmail.com

³Lumbini International Academy of Science and Technology (LIASST), Lalitpur, Nepal, sagarrise42@gmail.com

⁴Lumbini International Academy of Science and Technology (LIASST), Lalitpur, Nepal, gyawaliprakash01@gmail.com

Abstract

Fire is one of the recurring hazards in Nepal and can cause substantial loss of life, property, and economic resources, particularly in densely developed commercial areas. This study assessed the fire safety status of functional commercial buildings in the Gorkha Municipality city area, evaluated their compliance with the Nepal National Building Code (NBC) 107:1994, and identified measures for improving fire safety management. The study focused on commercial buildings above five storeys and larger than 1,000 sq. ft. and adopted a mixed quantitative and qualitative research approach. Primary data were collected through questionnaire surveys, interviews, field observations, and focus group discussions, while secondary information was obtained from relevant literature, codes, reports, and documents. Three commercial buildings – Hotel Gorkha Garden, NPI Hospital, and Hotel Gorkha Palace – were assessed as case studies against NBC 107:1994. The Relative Importance Index (RII) was used to rank major fire safety problems and mitigation measures. The findings indicate that fire safety in the studied commercial buildings is only partially implemented. Inadequate fire detection and firefighting facilities and LPG, kitchen, and other specific fire hazards were ranked as the most pressing problems, followed by unsafe electrical installations and high fire loads. Approximately more than half of the surveyed buildings lacked an adequate number of fire extinguishers, while deficiencies were also identified in electrical protection, evacuation routes, exit arrangements, signage, emergency communication, and fire-engine access. The case studies further demonstrated incomplete compliance with NBC 107:1994, particularly regarding outward-opening exit doors, door locks, sliding or overhead doors, and the availability of firefighting facilities. The study concludes that the identified weaknesses are systemic and require coordinated action at both building and municipal levels. Priority measures include improving fire detection and firefighting facilities, ensuring electrical safety, providing adequate emergency exits, strengthening evacuation preparedness and occupant awareness, improving signage and emergency lighting, conducting regular inspections and audits, and strengthening municipal monitoring and enforcement. The study recommends upgrading existing fire safety infrastructure, improving compliance with NBC 107:1994, strengthening institutional capacity, and updating fire safety provisions to support safer commercial buildings in Gorkha Municipality.

Keywords: Fire safety management; Commercial buildings; National Building Code; firefighting facilities; fire extinguishers

1. Introduction

Fire is a rapid oxidation process that releases heat, light, and various gases, resulting from a chemical reaction between oxygen and a combustible material [1]. Although fire has been used throughout human history for cooking, heating, and manufacturing, it becomes extremely dangerous and destructive when uncontrolled, posing risks to life, property, and the environment. Rapid urbanization, poor infrastructure, and inadequate implementation of existing building codes and regulations contribute to high fire risk in buildings in Nepal, with human error, arson, and faulty electrical installations recognized as major contributing factors, compounded by limited access to water and hydrants, lack of awareness, narrow roads, and poor coordination among firefighters [2].

With an Economic and Environmental Vulnerability Index of 24.7, Nepal is among the least developed nations in the world [3]. Its steep terrain, changing climatic conditions, complex geology, and continual seismic activity make it highly disaster prone; hills and mountains constitute around 83% of Nepal's total area [4], and the country ranks as the 20th most disaster-prone country in the world [5]. Hazards that regularly occur in Nepal include landslides, floods, earthquakes, fires, hailstorms, windstorms, thunder, drought, glacial lake outburst floods, avalanches, and epidemics [6]. According to the Ministry of Home Affairs, a total of 4,662 fire incidents were reported in Nepal between January 2025 and February 2026, resulting in 124 deaths, 730 injuries, and damage to 1,303 houses, affecting 5,340 families [7].

Fire safety refers to a set of practices and precautions aimed at preventing fire, minimizing associated risks, and ensuring the safety of people and property, requiring training and supervision programs, regular maintenance of machinery and equipment, and proper placement and maintenance of firefighting equipment [8]. When such practices are implemented systematically to prevent, mitigate, and respond to fire-related emergencies, it is termed fire safety management, whose primary goal is to protect life, property, and the environment through planning, education, training, and ongoing maintenance [8].

Commercial buildings are increasingly vulnerable to fire risk due to rising population and building density, weak institutional and financial capacity, inadequate warning systems, insufficient fire exits, weak local fire safety policies, and low fire awareness and training [8]. Gorkha Municipality lacks an adequate fire safety management system: there are no proper fire protection policies and regulations, awareness among locals is low, and buildings commonly have inadequate infrastructure, including insufficient fire-rated lift designs, absent fire suppression systems, poorly maintained fire exits and staircases, and limited firefighting capability and training. Although NBC 107:1994 addresses fire safety requirements for buildings [9], its compliance in Gorkha Municipality has not previously been assessed. This study therefore evaluates the current fire safety status of commercial buildings in the Gorkha Municipality city area, assesses their compliance with NBC 107:1994, and identifies measures to improve fire safety in building design and management systems.

The general objective of the research is to study fire safety in commercial buildings of Gorkha Municipality city area, with specific objectives to: (i) identify the current status of the fire safety management system in commercial buildings; (ii) assess the compliance status of selected commercial buildings against NBC 107:1994; and (iii) suggest improvements for fire safety in commercial building design and fire safety management systems.

Commercial buildings are inherently vulnerable to fire risks due to a combination of high occupant loads, dense concentrations of people unfamiliar with the building layout, complex mixed-use spatial arrangements, and extended vertical travel distances that complicate evacuation and rescue operations. Furthermore, the presence of extensive interior furnishings, synthetic display materials, and stock inventories creates elevated fire loads that can rapidly accelerate flame spread. Building design serves as the foundation for passive fire safety, directly influencing both occupant survival and external emergency response. Proper architectural planning—such as fire-rated compartmentation, adequate corridor dimensions, and compliant outward-opening exit doors—contains fire spread and facilitates safe self-evacuation, while seamlessly integrating active suppression systems. Conversely, poor design elements like narrow corridors, blocked stairwells, and restricted external access severely impede fire engine navigation and rescue operations.

If these systemic fire safety deficiencies remain unaddressed, the consequences include catastrophic loss of life and injury from toxic smoke accumulation and delayed evacuations, severe economic and business disruption from structural destruction, and heightened municipal vulnerability as urban commercial density increases. The findings, checklists, and compliance assessments developed in this study can be directly utilized by municipal authorities, building owners, and structural engineers as a practical baseline framework for conducting routine fire safety audits and guiding phased building retrofitting, such as modifying exit doors and upgrading electrical installations. Furthermore, by establishing the first comprehensive empirical evaluation of commercial fire safety and NBC 107:1994 compliance in Gorkha Municipality, this research serves as an essential baseline for local

government bodies to draft robust municipal fire safety bylaws, establish formal building registries, and prioritize urban infrastructure improvements such as road widening and hydrant installations.

The scope of this study was limited to field-based assessments, visual observations, stakeholder interviews, and questionnaire surveys, meaning no destructive or non-destructive laboratory testing of structural materials was conducted. Additionally, the research did not perform specialized engineering tests to evaluate exact fire-resistance ratings, such as exposing concrete columns, beams, slabs, or partition walls to simulated fire loads for 30, 60, 90, or 120 minutes to determine precise structural stability thresholds under high-temperature exposure. Future research can overcome these limitations by incorporating advanced numerical fire modeling, such as computational fluid dynamics smoke and egress simulations, and empirical laboratory testing on structural building components while expanding the geographical scope to compare findings across multiple hilly municipalities in Nepal.

2. Study area

Figure 2.1 and 2.2 shows the map of the study area. The research area is Gorkha District, located in the western part of Nepal. The study focuses on commercial buildings within Gorkha Municipality city area that are above five storeys, larger than 1,000 sq. ft., and constructed within the last five years. As per the electronic building permit records of Gorkha Municipality, a total of 676 such commercial buildings had been constructed since fiscal year 2075/2076 to 2079/2080. Three commercial buildings were purposively selected as detailed case studies: Hotel Gorkha Garden, a seven-storey hospitality facility in Gorkha-6, Gorkha Bazar; Hotel Gorkha Palace, a six-storey hospitality building also located in Gorkha-6; and NPI Hospital, a seven-storey healthcare facility in Gorkha Bazar, Ward No. 6, serving a regional population that includes bedridden patients and intensive-care occupants.

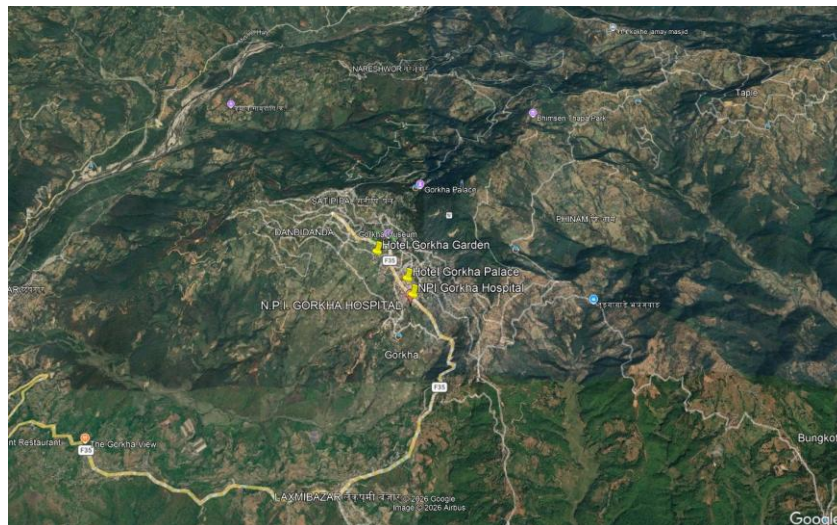


Figure 2.1. Google Map of Gorkha District showing the locations of the case-study buildings



Figure 2.2. Location map of Gorkha District within Gandaki Province, Nepal (Source: Survey Department / MoFALD, 2017)

3. Materials and Methods

3.1 Study population and sample Size

The survey population comprised building owners, operational managers, employees, and occupants of the identified commercial buildings, with three respondents taken from each of the 676 buildings, giving a total population of 2,028. The sample size was calculated using Israel's finite population correction formula [10], $n = n_0 / (1 + (n_0 - 1)/N)$, with $n_0 = Z^2pq/e^2$, assuming a 95% confidence level ($Z = 1.96$), $p = q = 0.5$, and a margin of error $e = 10\%$. This yielded a required sample size of approximately 92–93 respondents, distributed by purposive sampling as summarized in Table 3.1.

Table 3.1: Population and sample distribution of respondents

S.N.	Respondent Category	Number of Samples
1	Building Owner	10
2	Technical Representatives	37
3	Occupants/Employees	46
	Total	93

3.2 Data collection and analysis

Primary data were collected through questionnaire surveys, semi-structured interviews, field observations, and focus group discussions (FGD) with building owners, technical representatives, occupants, employees, and concerned municipal authorities. Secondary data were obtained from NBC 107:1994 [9], relevant acts [11], guidelines, and published literature. A five-point Likert scale (1 = strongly disagree to 5 = strongly agree) was used in the close-ended structured questionnaire, and the internal consistency of the scale was verified using Cronbach's alpha reliability test.

The Relative Importance Index (RII), a widely used non-parametric technique in construction and facilities-management research [12], was applied to rank the major fire safety problems, their causes and effects, and the corresponding mitigation measures. RII was computed as $RII = \Sigma W / (A \times N) = (5n_5 + 4n_4 + 3n_3 + 2n_2 + n_1) / [5(n_1 + n_2 + n_3 + n_4 + n_5)]$, where W is the weighting assigned by each respondent, A is the highest weight (5), and N is the total number of respondents. RII values range from 0 to 1 (0 not inclusive); higher values indicate greater relative importance. In addition, each of the three case-study buildings was assessed on-site against the exit and firefighting-facility requirements of NBC 107:1994 using a structured observation checklist covering stair type, doorways, fire escape, signage, and the availability of portable and fixed firefighting equipment.

4. Results and discussion

4.1 Demographic characteristics of respondents

Of the 93 respondents, the largest age group was 41–50 years (32%), followed by 30–40 years (26%), 50–60 years (21%), 21–30 years (20%), and 16–20 years (1%). By education, 45% held a bachelor's degree, 28% had completed higher secondary (+2)/diploma, 15% held a master's degree or above, and 12% had completed SLC. Regarding engagement with commercial buildings, the majority of respondents (62%) had 1 to 5 years of experience, followed by less than 1 year (20%) and 5 to 10 years (18%). By position in the building, facility managers formed the largest group (32%), followed by building owners (28%), employees (22%), and occupants (18%).

4.2 Case study: compliance assessment with NBC 107:1994

Three commercial buildings were assessed against the exit requirements of NBC 107:1994 through field observation, covering stair type, doorways, fire escape, and signage.

- Hotel Gorkha Garden (7 storeys, 3 exits assessed): all three exits were enclosed, opened at street level, met minimum doorway width/height requirements, opened directly to the ground, remained free of obstruction, and had proper, visible, illuminated signage. However, door locks were not prohibited at any exit, Exit 3 did not open directly to the stairway, none of the exits opened outward, and Exit 2 and Exit 3 had sliding or overhead doors.
- NPI Hospital (7 storeys, 2 exits assessed): both exits were enclosed, opened at street level, met doorway requirements, opened directly to the ground, remained unobstructed, and had proper signage. However, door locks were not prohibited at either exit, neither exit opened outward, and Exit 2 had a sliding or overhead door.
- Hotel Gorkha Palace (6 storeys, 1 exit identified): the single exit was enclosed, opened at street level, met doorway size requirements, and opened directly to the ground. However, the door opened inward rather than outward, used a sliding/overhead mechanism, lacked prohibition on door locks, and completely lacked proper, visible, or illuminated signage – making it the least compliant of the three buildings.

Regarding firefighting equipment, Hotel Gorkha Garden and NPI Hospital were both equipped with dry-powder, carbon-dioxide, and sprinkler/hose-reel pressurized water extinguishers, an emergency communication system, an emergency fire disaster kit, population warning methods, a fire hydrant, open evacuation spaces, and a fire

assembly point, though both lacked Halon extinguishers, wet-chemical extinguishers, fire blankets, and emergency shelters. Hotel Gorkha Palace, in contrast, possessed only Halon extinguishers and lacked all other firefighting equipment, emergency communication systems, evacuation spaces, and assembly points, confirming that it was the weakest of the three case-study buildings in both exit compliance and firefighting readiness.

4.3 Major fire safety problems in commercial buildings (RII ranking)

The Relative Importance Index was used to rank ten major categories of fire safety problems in the surveyed commercial buildings. Inadequate fire detection and firefighting facilities and LPG, kitchen, and other specific fire hazards were jointly ranked highest (RII = 0.92), followed by unsafe electrical installations and high fire loads (RII = 0.90), inadequate emergency exits and evacuation routes (RII = 0.83), and poor fire-engine accessibility (RII = 0.82). The complete ranking, together with the leading causes and effects identified for each problem category, is presented below.

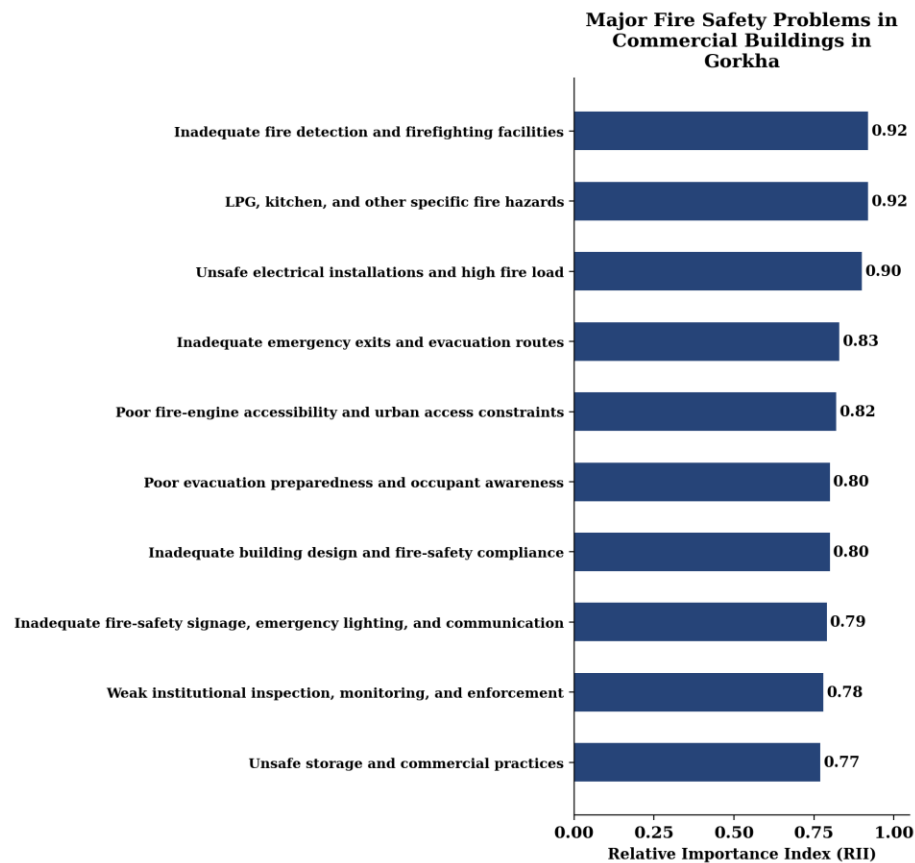


Figure 4.1 Major Fire Safety Problems in Commercial Buildings in Gorkha (RII ranking)

4.4 Inadequate fire detection and firefighting facilities

Inadequate fire detection and firefighting facilities ranked as the top problem (RII = 0.92). Lack of awareness among building owners and occupants (RII = 0.90) and insufficient financial investment in fire-safety systems (RII = 0.83) were the leading causes, resulting in delayed detection and response to fire incidents (RII = 0.83) and rapid spread and increased intensity of fire (RII = 0.75).

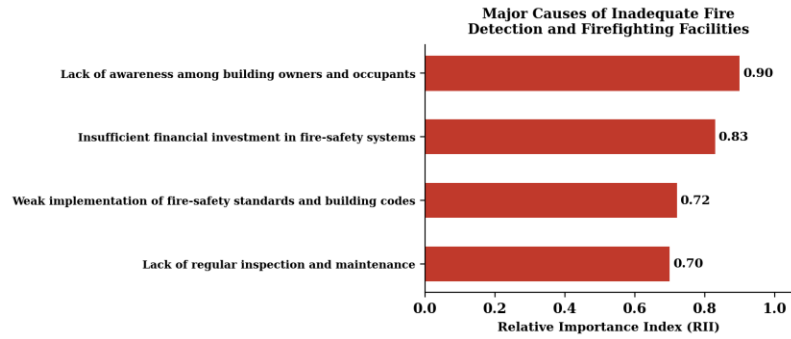


Figure 4.2. Major Causes of Inadequate Fire Detection and Firefighting Facilities

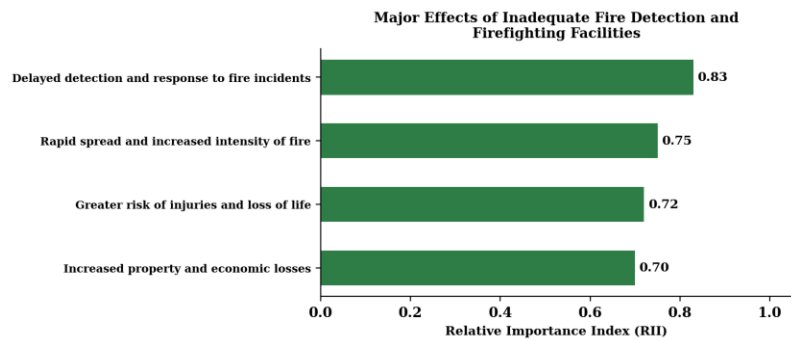


Figure 4.3. Major Effects of Inadequate Fire Detection and Firefighting Facilities

4.5 Unsafe electrical installations and high fire loads

Unsafe electrical installations and high fire loads ranked third overall (RII = 0.90), driven mainly by overloaded electrical circuits and unsafe wiring (RII = 0.90), leading to an increased risk of electrical fires and short circuits (RII = 0.90) and rapid intensification of fire (RII = 0.83).

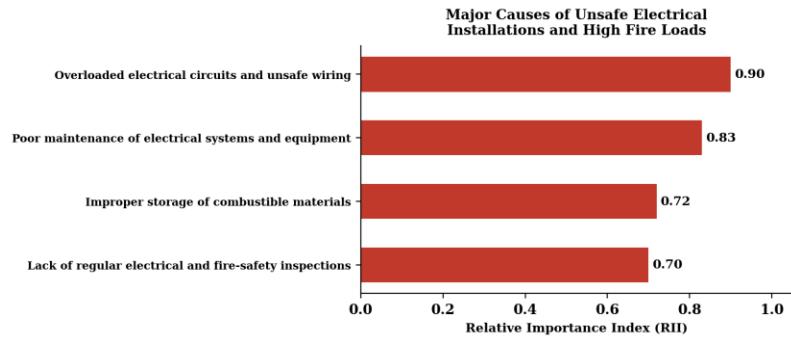


Figure 4.4. Major Causes of Unsafe Electrical Installations and High Fire Loads

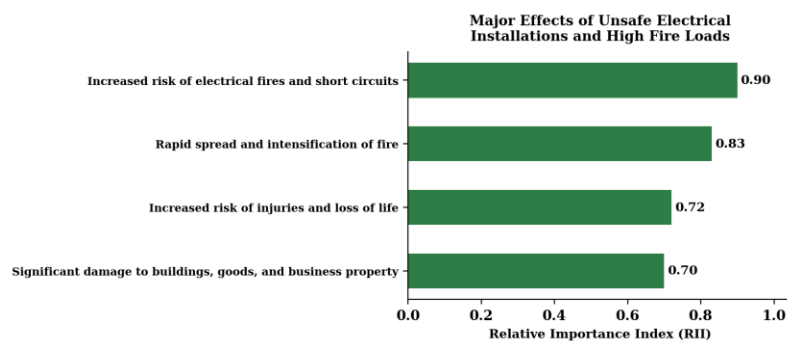


Figure 4.5 Major Effects of Unsafe Electrical Installations and High Fire Loads

4.6 Inadequate emergency exits and evacuation routes

Poor building design and insufficient emergency exits (RII = 0.90) were identified as the primary cause of inadequate emergency exits and evacuation routes, resulting in delayed evacuation during fire emergencies (RII = 0.90) and increased risk of injuries and fatalities (RII = 0.83).

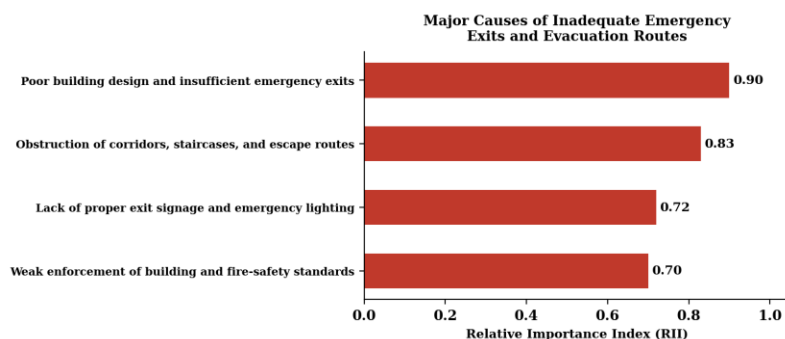


Figure 4.6. Major Causes of Inadequate Emergency Exits and Evacuation Routes

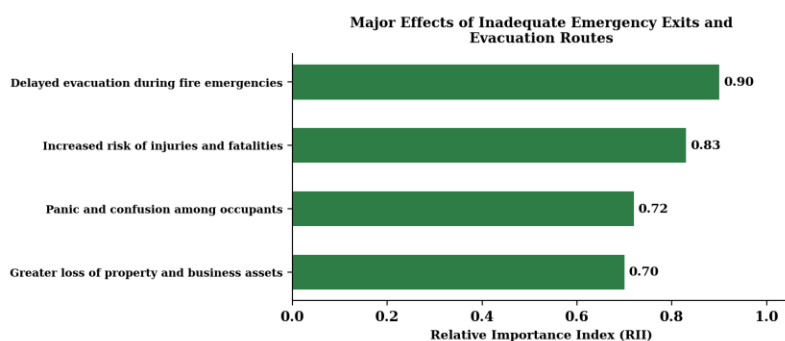


Figure 4.7. Major Effects of Inadequate Emergency Exits and Evacuation Routes

4.7 Poor evacuation preparedness and occupant awareness

Poor building design and insufficient emergency exits, together with obstruction of corridors, staircases, and escape routes, were the leading causes of poor evacuation preparedness (RII = 0.90 and 0.83 respectively), producing delayed and disorganized evacuation (RII = 0.90) and increased risk of injuries and loss of life (RII = 0.83).

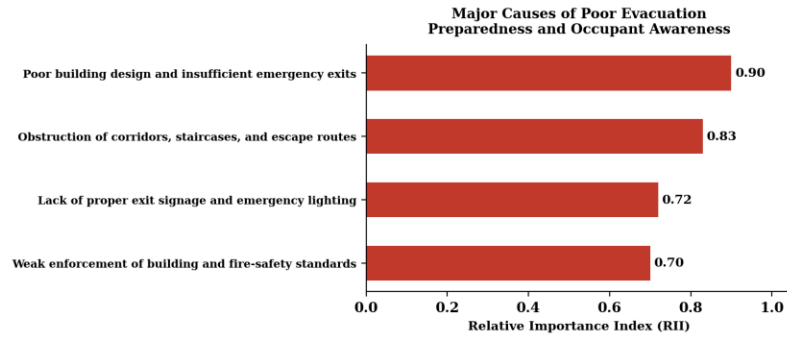


Figure 4.8. Major Causes of Poor Evacuation Preparedness and Occupant Awareness

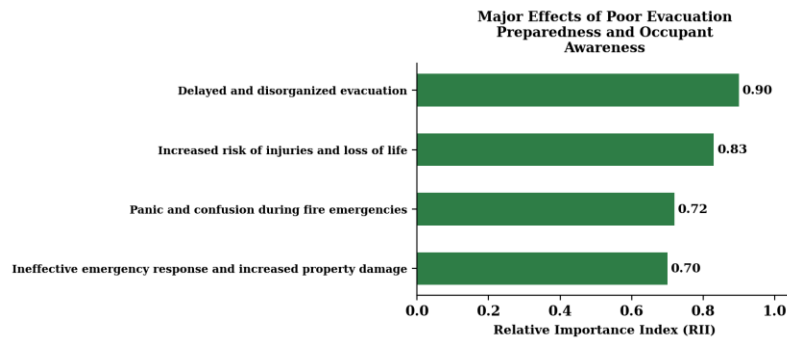


Figure 4.9. Major Effects of Poor Evacuation Preparedness and Occupant Awareness

4.8 Inadequate fire-safety signage, emergency lighting and communication

Lack of proper fire-safety signage and evacuation maps (RII = 0.90) was the dominant cause, leading to delayed identification of emergency exits (RII = 0.90) and difficulty evacuating during power failure or poor visibility (RII = 0.83).

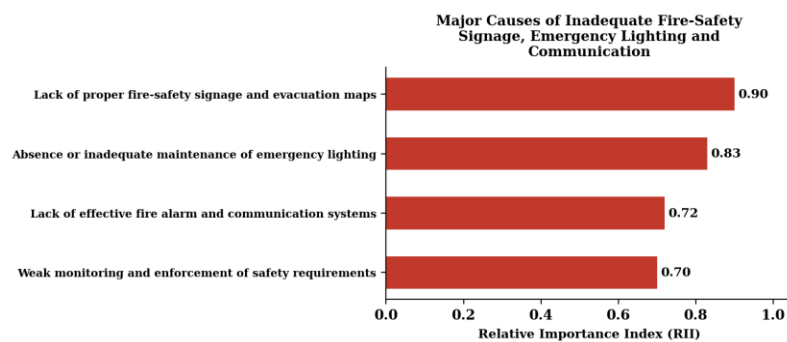


Figure 4.10. Major Causes of Inadequate Fire-Safety Signage, Emergency Lighting and Communication

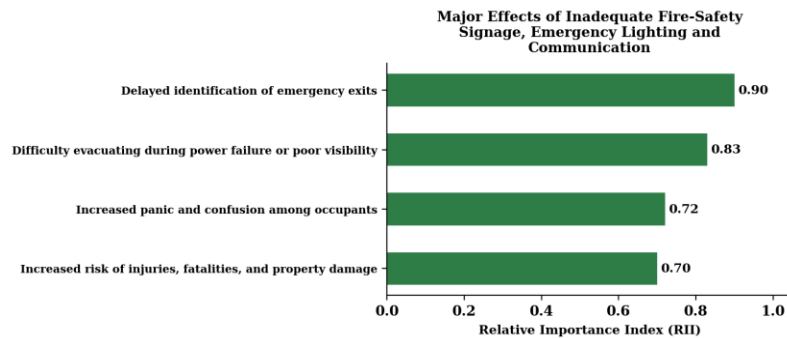


Figure 4.11. Major Effects of Inadequate Fire-Safety Signage, Emergency Lighting and Communication

4.9 Unsafe storage and commercial practices

Improper storage of combustible materials (RII = 0.90) was the leading cause of unsafe storage and commercial practices, increasing the likelihood of fire ignition (RII = 0.90) and rapid spread and intensification of fire (RII = 0.83).

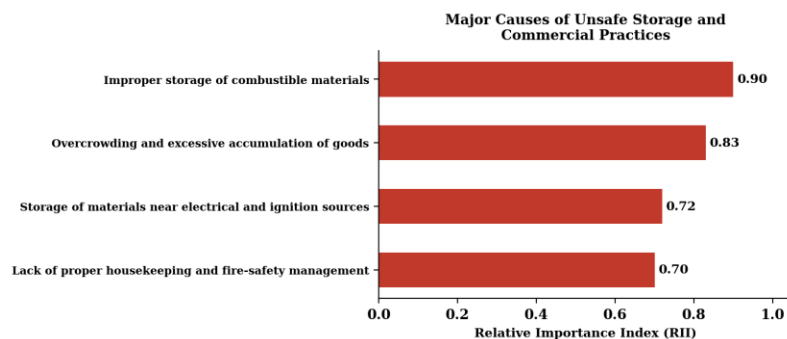


Figure 4.12. Major Causes of Unsafe Storage and Commercial Practices

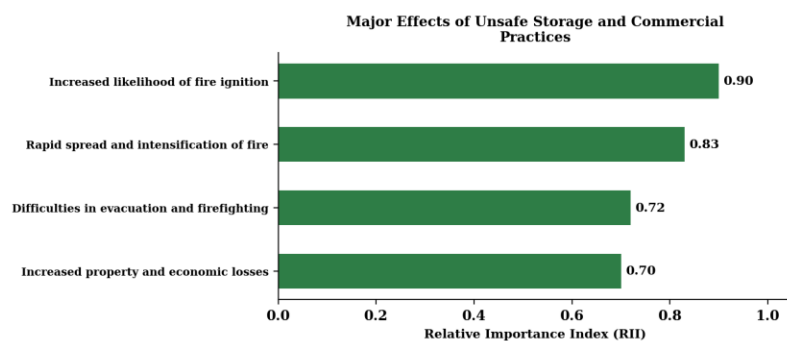


Figure 4.13. Major Effects of Unsafe Storage and Commercial Practices

4.10 LPG, kitchen, and other specific fire hazards

Improper handling and storage of LPG cylinders (RII = 0.90) was ranked as the leading cause of LPG, kitchen, and other specific fire hazards, tied for the highest overall problem ranking (RII = 0.92), resulting in an increased risk of LPG leakage, fire, and explosions (RII = 0.90).

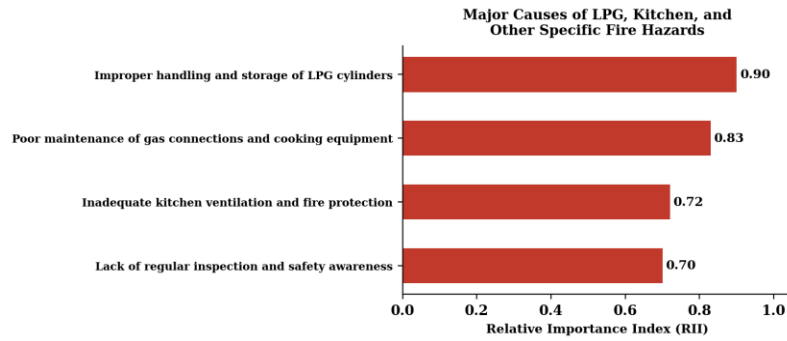


Figure 4.14. Major Causes of LPG, Kitchen, and Other Specific Fire Hazards**

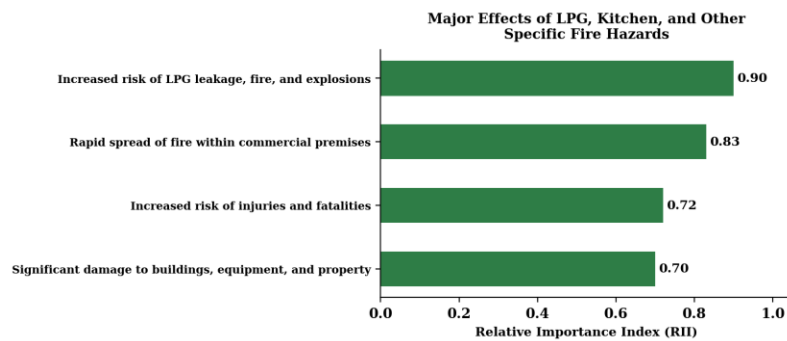


Figure 4.15. Major Effects of LPG, Kitchen, and Other Specific Fire Hazards

4.11 Poor fire-engine accessibility and urban access constraints

Narrow and congested roads around commercial areas (RII = 0.90) were identified as the primary cause of poor fire-engine accessibility (overall RII = 0.82), resulting in delayed arrival of fire engines at the incident site (RII = 0.90) and difficulty in firefighting and rescue operations (RII = 0.83).

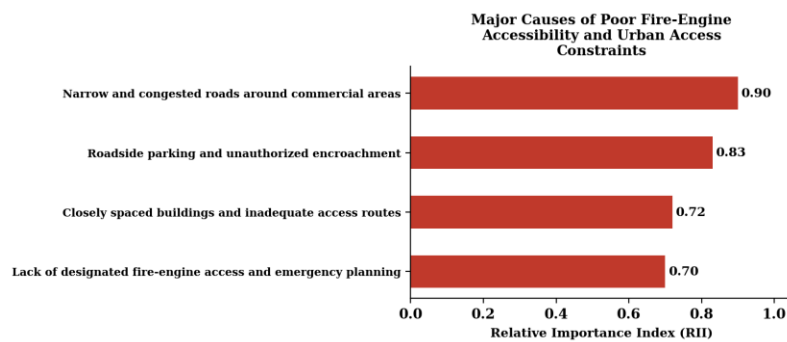


Figure 4.16. Major Causes of Poor Fire-Engine Accessibility and Urban Access Constraints

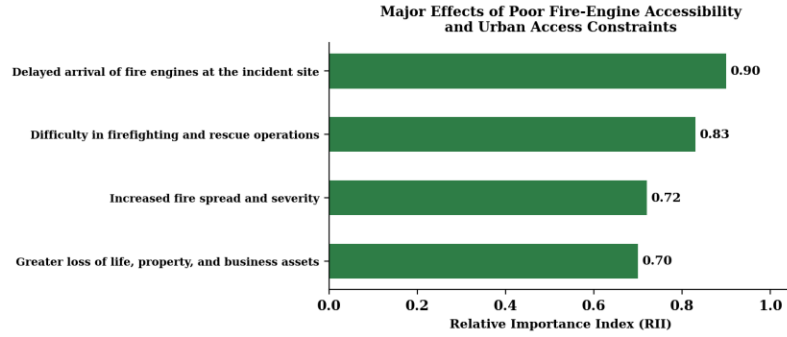


Figure 4.17. Major Effects of Poor Fire-Engine Accessibility and Urban Access Constraints

4.12 Inadequate building design and fire-safety compliance

Non-compliance with building and fire-safety standards (RII = 0.90) was the leading cause of inadequate building design and fire-safety compliance (overall RII = 0.80), producing increased vulnerability to fire incidents (RII = 0.90) and difficulties in evacuation and firefighting operations (RII = 0.83).

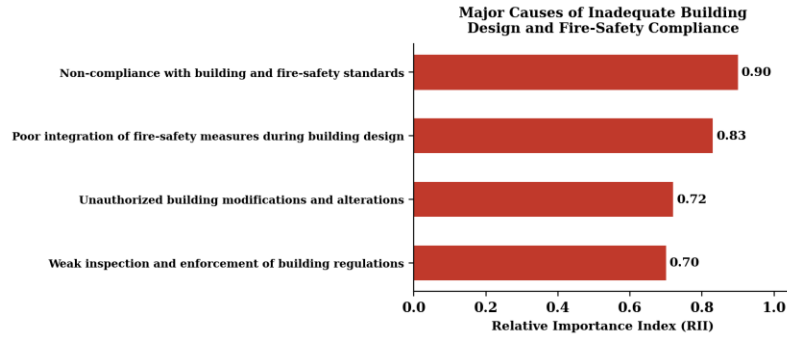


Figure 4.18: Major Causes of Inadequate Building Design and Fire-Safety Compliance

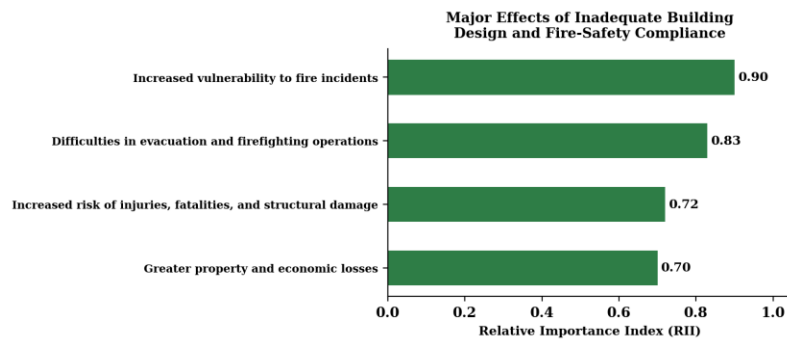


Figure 4.19. Major Effects of Inadequate Building Design and Fire-Safety Compliance

4.13 Weak institutional inspection, monitoring, and enforcement

Inadequate frequency of fire-safety inspections (RII = 0.90) was the leading cause of weak institutional inspection, monitoring, and enforcement (overall RII = 0.78), resulting in continued non-compliance with fire-safety requirements (RII = 0.90) and unidentified and unaddressed fire hazards (RII = 0.83).

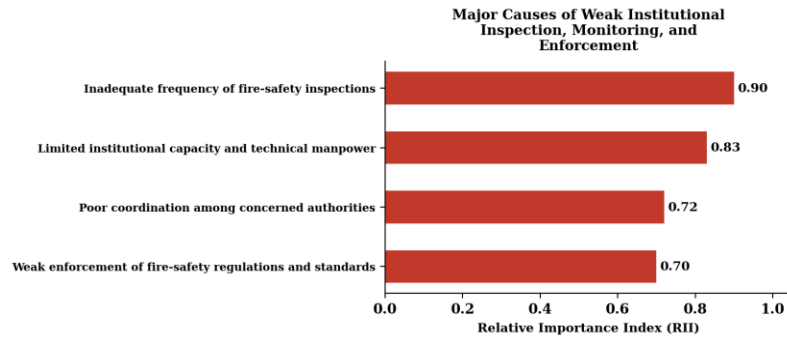


Figure 4.20. Major Causes of Weak Institutional Inspection, Monitoring, and Enforcement

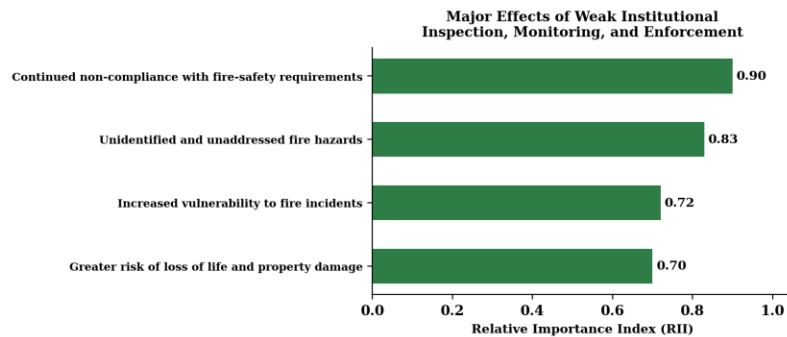


Figure 4.21. Major Effects of Weak Institutional Inspection, Monitoring, and Enforcement

4.14 Mitigation measures of problems regarding fire safety

Respondents ranked ten mitigation measures using RII. Improving fire detection and firefighting facilities was ranked highest (RII = 0.90), followed by ensuring electrical safety and reducing fire loads (RII = 0.85), providing adequate emergency exits and clear evacuation routes (RII = 0.83), and strengthening evacuation preparedness and occupant awareness (RII = 0.82). Strengthening institutional inspection, monitoring, and enforcement, while identified as necessary, was ranked comparatively lower in immediate priority (RII = 0.20).

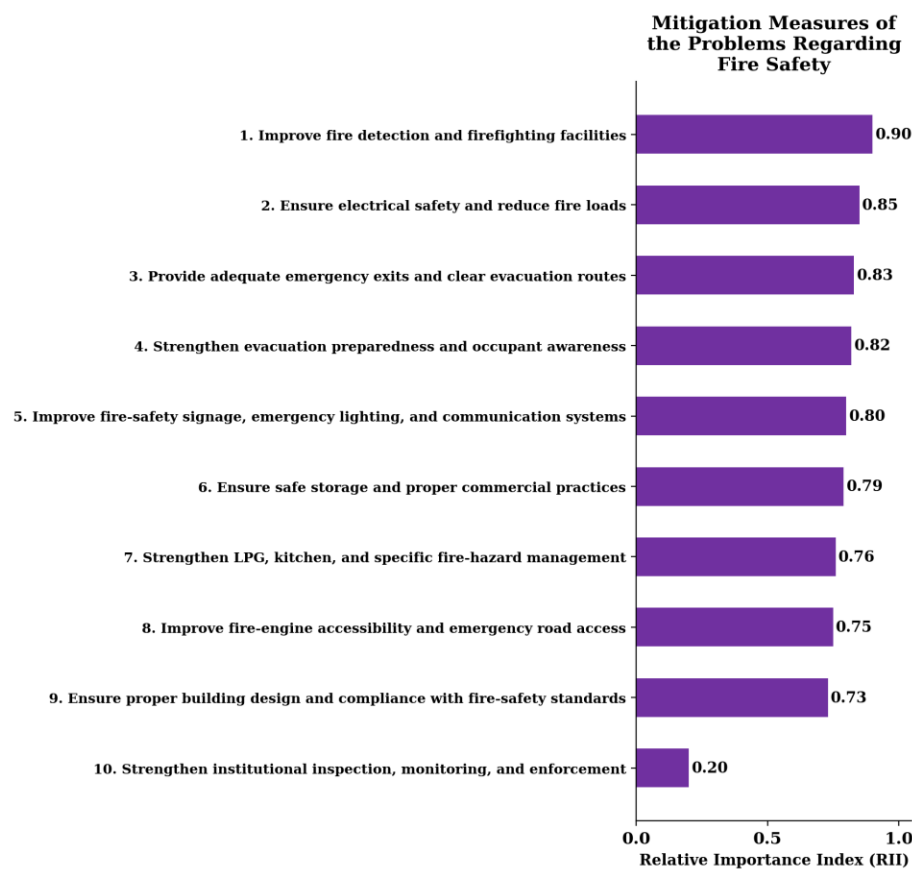


Figure 4.22. Mitigation Measures of the Problems Regarding Fire Safety (RII ranking)

4.15. Findings from field observation

Field observation confirmed that Hotel Gorkha Garden and NPI Hospital had comparatively better fire safety provisions, with a wide range of firefighting and emergency-response facilities, though both had exit-door deficiencies including prohibited locks not being enforced, non-outward-opening doors, and sliding/overhead doors on some exits. Hotel Gorkha Palace demonstrated the weakest fire safety provisions overall, with only a single identified exit, no proper signage, and the near-total absence of firefighting and emergency-response facilities.

Beyond the three case-study buildings, the broader field survey found those systemic fire safety concerns are widespread: approximately 64.5% of the surveyed commercial buildings lacked an adequate number of fire extinguishers, while only 35.5% had sufficient extinguishers, which were often concentrated on particular floors rather than distributed throughout the building. Other commonly observed problems included obstruction of entrances and circulation spaces by vehicles and stored materials, inadequate protection of electrical panels and wiring, limited fire safety inspections, insufficient consideration of neighboring buildings in fire safety planning, inadequate fire-rated doors and partitions, and restricted access for fire engines.

4.16. Findings from focus group discussion

The focus group discussion revealed that fire safety deficiencies in commercial buildings of Gorkha Municipality are linked not only to limited awareness but also to financial, technical, institutional, and enforcement constraints. Building owners cited the high cost of installing and upgrading fire safety systems as a major barrier, while technical representatives highlighted the difficulty of retrofitting older buildings constructed before effective enforcement of the National Building Code. Preventive maintenance and infrared electrical inspections were

reported to be rarely conducted due to inadequate trained personnel and specialized equipment, and the absence of designated fire safety coordinators contributed to weak evacuation preparedness. Municipal and fire service representatives reported low inspection frequency and the absence of a systematic building registry, while restricted fire-engine access in the congested areas of Gorkha Bazaar – due to narrow roads, roadside parking, and closely spaced buildings – was identified as a further major concern. Participants recommended a phased approach to NBC compliance supported by low-interest financing or municipal subsidies, public awareness programme, mandatory fire drills, and periodic joint inspections.

5. Discussion

The findings reveal critical gaps between existing fire safety practices in Gorkha Municipality's commercial buildings and the requirements of NBC 107:1994. More than half of the surveyed buildings lacked an adequate number of fire extinguishers, with existing units often restricted to specific floors rather than distributed comprehensively, compounded by a general shortage of essential active and passive safety technologies such as fire alarms, smoke detectors, automatic sprinkler systems, fire hydrants, and emergency communication systems.

These findings are consistent with existing literature on commercial fire safety in Nepal. An operational assessment of commercial buildings in Birtamode, Jhapa similarly found only partial compliance with NBC 107:1994, identifying comparable deficiencies including inadequate exit access, non-functional hose reels, lack of proper signage, and a shortage of trained manpower [13]. Earlier research in Kathmandu likewise found widespread failure of commercial buildings to meet basic fire exit requirements [14], suggesting that the vulnerabilities observed in Gorkha reflect a broader nationwide gap in urban fire safety planning.

The RII analysis further underscores the severity of these conditions, identifying inadequate fire detection and firefighting facilities as the highest-ranking safety problem (RII = 0.92), closely followed by LPG and kitchen-related hazards (RII = 0.92) and unsafe electrical installations with high fire loads (RII = 0.90). Evacuation routes and building entrances were frequently compromised by haphazard vehicle parking and commercial storage of materials, while overloaded electrical circuits (RII = 0.90) significantly heightened the risk of electrical failure-induced fires, consistent with municipal police records identifying electrical short circuits and poor handling of high fire-load kitchen areas as leading causes of fire incidents in Nepalese urban centers.

The absence of regular fire safety audits, building designs that overlook external factors such as neighboring structures, and the lack of essential compartmentation features (fire-rated doors, walls, and partitions) point to a widespread oversight in structural fire safety planning, compounded by inadequate staff training, limited occupant familiarity with safety protocols, and weak coordination with external emergency services. Poor fire-engine accessibility (RII = 0.82), driven by narrow, congested urban roads and unauthorized roadside parking, further restricts emergency response capability. Addressing these multi-faceted challenges – as reflected in the top-ranked mitigation measures of improving fire detection facilities (RII = 0.90) and ensuring electrical safety (RII = 0.85) – requires a synchronized approach involving stricter municipal enforcement of safety audits, mandatory infrastructure upgrades, and comprehensive capacity-building for all building stakeholders.

6. Conclusions

This study assessed the fire safety management system of commercial buildings in Gorkha Municipality city area and their compliance with NBC 107:1994. The assessment reveals that existing fire safety measures are present but largely incomplete. The most pressing hazards identified are inadequate fire detection and firefighting facilities, with nearly 65% of surveyed buildings lacking sufficient fire extinguishers; unsafe electrical installations; specific LPG and kitchen hazards; and operational constraints such as evacuation routes and building access being obstructed by parked vehicles and commercial storage.

Compliance with NBC 107:1994 is highly inconsistent and fragmented across the municipality. Case-study assessments of Hotel Gorkha Garden, NPI Hospital, and Hotel Gorkha Palace showed that even buildings with

reasonable firefighting equipment failed critical structural requirements, such as exit doors that are inward-opening, fitted with locks, or operating on sliding mechanisms, while Hotel Gorkha Palace lacked fundamental firefighting equipment, compliant exits, and proper emergency signage almost entirely.

Immediate action is required at the building level to upgrade firefighting equipment, correct non-compliant exit arrangements, and install proper illuminated signage. Because persistent non-compliance is driven heavily by institutional and financial constraints rather than mere unawareness, municipal authorities must establish a formal building registry and strengthen regular inspection capacity, while local governments should introduce financing mechanisms to make retrofitting of older buildings feasible and address structural urban constraints, such as congested, narrow lanes that restrict fire-engine access, through coordinated municipal planning.

Based on these findings, the study recommends: (i) upgrading fire detection and emergency equipment – installing distributed fire extinguishers, smoke/heat detectors, fire alarms, illuminated exit signage, emergency lighting, and communication systems with mandatory annual testing and certification, alongside periodic infrared electrical inspections and strict prohibition of combustible-material storage near ignition sources; (ii) improving egress and structural fire resistance – replacing non-compliant exit hardware with outward-opening, key-free doors, requiring a second independent exit, mandating fire-rated doors and walls, appointing designated fire safety coordinators, and conducting regular fire drills and staff training; (iii) strengthening municipal enforcement and code updates – establishing a municipal registry for commercial buildings, conducting joint fire service inspections, enforcing NBC 107:1994 compliance during building approvals, and updating the code to reflect international benchmarks; and (iv) improving urban access and financial support – enforcing minimum fire-engine access widths, restricting unauthorized parking, installing hydrants along commercial corridors, and introducing low-interest financing or municipal subsidies to support phased safety retrofits.

References

- [1] Team. (2007). Understanding fire: Chemistry, causes, and classification of fire hazards.
- [2] Maharjan, S. (2022). Fire risk and firefighting challenges in Nepalese buildings. Kathmandu.
- [3] United Nations Department of Economic and Social Affairs. (2021). World economic situation and prospects: Least developed countries report. United Nations, New York.
- [4] Baruwal, A. (2014). Urbanization and building vulnerability in the hills and mountains of Nepal.
- [5] Khanal, B. N. (2020). Nepal: A brief country profile on disaster risk. ADRC Visiting Researcher Program 2019B, Disaster Management Division, Ministry of Home Affairs, Kathmandu.
- [6] Dangal, R. (2011). Disaster risk management institutional and legislative systems in Nepal. Ministry of Home Affairs, Government of Nepal.
- [7] Ministry of Home Affairs, Government of Nepal. (2025, January 1). Nepal Disaster Risk Reduction Portal. <http://drrportal.gov.np/>
- [8] National Fire Protection Association (NFPA). (2022). Fire safety management guidelines. NFPA, Quincy, MA.
- [9] Department of Urban Development and Building Construction. (1994). Nepal National Building Code NBC 107: Provisional recommendation on fire safety. Government of Nepal, Ministry of Physical Planning and Works.

- [10] Israel, G. D. (1992). Determining sample size. University of Florida, Institute of Food and Agricultural Sciences.
- [11] Government of Nepal. (2017). Local Government Operation Act, 2074. Nepal Law Commission.
- [12] Sakhare, V. V., & Patil, S. S. (2019). Application of relative importance index (RII) in construction research – A review. *International Journal of Engineering Research & Technology*.
- [13] Lama, S., & Mishra, A. (2022). Operational assessment of fire safety status of existing commercial buildings at Birtamode, Jhapa, Nepal. 7(3–4), 1–7. <https://doi.org/10.24321/2456.9925.202202>
- [14] Mishra, A. K., & Shrestha, A. (2017). Assessment of exit requirements for fire safety of commercial buildings, Kathmandu, Nepal. *Journal of Emerging Technologies and Innovative Research*, 4(10). <https://doi.org/10.3126/gjn.v10i0.17396>