Baseline Fire Safety Assessment: Marketplaces in Hargeisa

Final Report

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Kindling
FIRE SAFETY FOR ALL

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Contents

Executive Summary

This report shares the findings and recommendations from a baseline fire safety assessment of marketplaces in Hargeisa, Somaliland carried out by Kindling, and commissioned by the British Office, Hargeisa. The assessment was carried out in response to the fire that devastated Waheen marketplace on 1 April 2022.

Following a review of available literature, the Kindling team visited Hargeisa in May 2022 and conducted a series of interviews with government bodies, fire services, non-governmental organisations, and civil society organisations. The team also visited Waheen Market, Gobanimo Market, and the State House Internally Displaced Persons (IDP) Camp.

Aims:

The assessment looks at fire risks in marketplaces across Hargeisa, taking into account existing fire safety systems and cultures, and opportunities and barriers to reducing fire risk. It recommends a number of strategic risk reduction measures to improve fire safety and reduce the likelihood of another fire of the scale experienced at Waheen.

Context of Hargeisa:

A range of social, economic, and political factors have led to an absence of building and safety regulations, significant fire risks and a lack of fire response infrastructure.

Fire risk in Hargeisa marketplaces is underpinned by the social, economic, and political context of the city. Hargeisa's rapid urbanisation has largely been unregulated, taking place within a context of weak institutional capacity and limited government financial resources. The absence of building and safety regulations means buildings are often constructed without state oversight and do not prioritize structural and human safety, creating significant fire risks in terms of ignition and spread hazards. Inadequate infrastructure and services including water supply and road development also contribute to fire risk in terms of hindering effective and timely fire responses.

Fire risk findings and recommendations

Ignition, spread and early fire growth risks

Ignition risks within marketplaces are high due to cooking and lighting practices which use open flames and poorly regulated, low quality, informal electricity connections which can overload and short circuit. Higher temperatures and drought can also increase the probability of ignition and fire spread. The increasing use of LPG, often in an unregulated manner also poses ignition, spread, and explosion risks. Activities that use oil and petrol,

such as maintenance and repair of heavy goods vehicles, also take place in or near marketplaces, posing heightened risks from flammable liquids.

Promoting safe energy use and storage is vital, as is education around using open flames and other risky energy sources. Alternative energy sources could be researched and promoted. Vulnerable groups must be supported to access safer energy alternatives. Electricity installations should be regulated, and in the meantime, guidelines for owners, installers and occupants provided on how to safely install connections.

Fire spread risks include the wide range of combustible commodities densely stored inside marketplaces, including imported consumer goods (comprised of materials with high heat release rates such as synthetic materials, hydrocarbons, plastics, paper, cardboard). Combustible materials used in construction of buildings and stalls, such as timber, foams, plastics, and textiles, also support fire growth and spread.

Non-combustible building materials such as masonry and concrete prevent fire spread to some extent, but in the event of fire, observed gaps between walls and roofs can allow gases to escape and ignite, contributing to fire spread.

Fire spread risks are also intensified by the physical layout and spatial use of marketplaces like Waheen. Growth has occurred incrementally over time and in an unregulated manner as shops and stalls have extended into the streets, leading to congestion of egress and access routes. Buildings are often subdivided into multiple rooms and then again into stalls within rooms, and aisles within them are difficult to maintain. This spatial density along with high numbers of people using small access routes to trade creates fire spread risks as well as evacuation and firefighting access issues in the event of a fire.

Establishing roads and maintaining open space between buildings is vital to mitigate fire spread. The use of non-combustible building materials should be encouraged where possible and the use of combustible materials, including combustible cladding, regulated. Awareness raising and support to shop and stall traders to reduce fire spread (e.g., by minimising, or reconfiguring storage of goods on site) is recommended.

In enclosed spaces, the risk of flashover is high due to ventilation conditions and high fuel loads.

Wind effects on smoke/flame generation and dispersion can also contribute to fire growth, especially in outdoor environments, with seasonal variations influencing wind speed and patterns.

Socio-economic vulnerabilities

A wide range of people work within marketplaces, including women and men of different ages, people with disabilities, people of different ethnicities, with IDP/refugee status and with a range of trading statuses, whether unregistered, self-employed, business owners, employees and building owners. People who depend on marketplaces therefore experience varying degrees of socio-economic vulnerability. Women make up the large number of small-scale traders using open flames to cook and sell food and may therefore be intimate with a cooking fire in its early stages. Their socio-economic status also puts them at greater risk in recovery stages if a fire does occur. Intersecting social identities can further compound these vulnerabilities.

It is important to recognise the range of vulnerabilities that exist and potential exclusions from fire safety planning and interventions as well as relief and recovery systems. A full gender analysis should be conducted, and results used to mainstream gender in fire safety planning to ensure gender based injustices are not replicated in solutions.

Fire safety findings and recommendations

The fire safety ecosystem in Hargeisa is weak, characterized by the absence of regulations, unclear roles and responsibilities, unreliable water and road infrastructure, limited fire response equipment, limited community engagement, and a general lack of oversight, governance, communication, and coordination between relevant actors. Efforts to improve fire safety are largely limited to ad hoc responses during actual fire incidents, rather than proactive strategies to prevent or prepare for fires, or to mitigate risks. The establishment of the Somaliland Fire Service eight years ago is an exception to this finding, however, and it is an acknowledgement of the importance fire safety plays in development. Furthermore, all informants agreed the Waheen Market fire was a wake-up call that represents how significantly fire can undermine progress in Somaliland.

Prevention

Minimal prevention activities were observed, with levels of fire safety awareness in the population at large reported to be low, which increases risks due to likely weak fire preparation, detection and communication awareness, community responses and occupant protection. There may be potential gender differentials in awareness due to limited education opportunities for women and girls. No automatic fire detection devices were observed in marketplaces, and so detection relies on people. This highlights the importance of increased fire safety awareness education and building community capacity as a key recommendation.

Efforts to develop a building code suitable for Somaliland began prior to the Waheen Market fire. A committee facilitated by the Ministry of Public Works is composed of technical experts with broad experience in design and construction. This is a positive

development, and has great potential for further fire risk reduction, if it is rolled out in an incremental and supportive manner, and with strong coordination across public and private actors.

Response

In the event of fire, **egress** from the marketplace is complex due to congested pathways, posing high risks to traders and market users trying to escape. Coordinated egress systems are needed including occupant protection and evacuation strategies, particularly for those requiring assistance. Clear evacuation management strategies with assigned roles and responsibilities are required.

Community based firefighting can be effective in reducing fire risk by creating fire breaks and minimising fire spread whilst waiting for emergency services to arrive – if done in a safe manner. Awareness raising and training of market traders on appropriate responses to small fires could be carried out, supported by collaboration between local NGOs and community-based organisations and the National Fire Service.

The **Somaliland Fire Service** plays an important role in reducing fire risk and has a well-educated personnel. An in-depth study of their capacities and resources was not carried out however investment is needed to expand capability and capacity to manage all-hazards incident responses through purchase of additional vehicles and equipment, recruitment, and by training personnel. Regular maintenance and refilling of equipment is vital. Data management systems that record and review fire incidences could also be reviewed. There is a potential role for the Fire Service to support wider fire safety development through regulatory development and enforcement, and fire safety education delivery.

Communications between the public and the Fire Service may also be improved; confusion over fire service and police numbers and their interchangeability was reported, causing delays in assigning call out responsibilities. Additionally, the absence of an incident command centre with communications equipment and mechanisms to bring key actors across relevant agencies together is noted. Such a facility would allow for a coordinated disaster management response.

The lack of an **address system** can lead to way-finding issues, and it is recommended that simple navigation services such as What3Words could be integrated into fire service response systems.

Fire Services face access challenges due to **poor road infrastructure**, and it is recommended that ongoing road improvements take into account this need. It is also important to maintain access around the perimeter of marketplaces for fire response vehicles.

Access to water is a key risk factor in the response stage. Current drought conditions combined with poor water delivery infrastructure and a limited number of tenders inhibits firefighting response; fire service appliances can only provide a few minutes of active firefighting. In the Waheen fire, private water haulers contributed necessary but insufficient water supplies. Ongoing development of a water distribution system in the city is noted, and more information is needed on the inclusion of permanent fire hydrants and interoperability with fire service equipment.

A lack of an ambulance service increases risks associated with injuries and health vulnerabilities due to a lack of onsite health responders and delays in transporting people to hospital. Advanced first aid/medical training could be provided to firefighters whilst an ambulatory care and transport system is established. Burns care facilities should be reviewed and specialised units established, which also provide long term health and psycho social support for burns survivors.

Recovery and reconstruction

The National Disaster Preparedness and Food Reserve Authority (NADFOR) is responsible for disaster related crises and coordination, however implementation of policies is lagging due to resourcing issues. Fire risk and disaster is not covered by NADFOR, risking delayed, inadequate and siloed responses to fire disasters. A lack of representation and collaboration was noted between the National Response and Relief Committee established in response to the Waheen fire, risking incomplete recovery response due to the exclusion of existing DRM expertise and experience within Somaliland. It is recommended that such inter-agency coordination is reviewed, and responsibilities and authority clarified to avoid replication of response and to streamline resources. Fire as a risk should be integrated into multi-hazard disaster management, to institutionalise and share knowledge from fire disasters as well as apply learning from other risks to fire disasters.

Attention should be paid by health recovery efforts to the potential of **psycho-social trauma** from fire disaster in the post-civil war context as well as longer term cascading health and economic impacts beyond loss of life and injury.

The lack of formal property insurance systems means that there is heavy reliance post fire on the clan system and fundraising by the diaspora to provide economic safety nets. There is the risk that these mechanisms may not reach all those affected by fire disasters, particularly smaller scale informal traders. It is recommended that economic recovery planning is integrated into holistic fire risk reduction, taking into account the full range of people working within markets.

The **construction of new and temporary markets** post Waheen is an opportunity to integrate fire safety principles, mechanisms and infrastructure. It is recommended that reconstruction follow participatory urban planning principles and processes to address

the needs of all types of market workers and specific fire risk vulnerabilities. A fire safety strategy for the construction of new marketplaces needs to be developed, implemented, and maintained, taking into account the realities of future expansion and informal evolution of marketplaces. International standards may be consulted for guidance but need to be contextualized to account for local conditions.

Overarching recommendations

It should be acknowledged that difficult choices between competing needs and risks contribute to a lack of fire safety prioritization, however it is possible to build a strong safety culture grounded to Somaliland's specific context. There is no one solution or intervention that can be implemented to achieve fire safety. It is a shared and complex risk requiring multiple responses at different levels, requiring collaboration and coordination between a range of actors across diverse sectors not limited to disaster management but including urban development planning, water and energy provision, environmental hazards, economic and social development planning, and more. Table 1 details specific risks, recommendations and suggested key actors. It can be seen that policy, organisational and community-based interventions, infrastructure and building investments, and institutional capacity building all play a part in a holistic approach.

An overarching recommendation from this report is for a participatory process to be carried out to facilitate dialogue and debate among key actors (e.g., building owners or their representatives, regulatory authorities, insurance providers, fire officials, traders, customers) to build a collaborative and institutionalized approach to fire safety, supporting the roles that all actors play. Fire safety goals and objectives for marketplaces and the built environment in Somaliland need to be identified, leading to strategy development and implementation. Fire safety goals and objectives need to be aligned with society's safety expectations, which are dynamic in general, and as a result of the Waheen market fire. This process should be designed to be sustainable so it can serve as a foundation of fire safety development, especially for regulatory development.

In the current absence of government regulations and whilst building codes are being developed, the rebuilding of Waheen Market could become a prototype for such interventions. By establishing an ongoing stakeholder forum responsible for managing fire safety strategy within the rebuilding program, the market traders, city council, private building owners, government officials, fire services, and other key actors can develop and implement arrangements that facilitate safety outcomes in the absence of regulation. This approach has the advantage of focused application and capacity building. Such a process could lead discussion and generate broader understanding within the community about what constitutes both a tolerable and manageable risk.

Adopting a hybrid approach to fire safety is recommended to take into account the urban context of Hargeisa, where informal construction and infrastructure co-exist with

processes of formalisation and development of regulations. A hybrid approach comprises both engineered fire safety systems (e.g., building regulations, fire service responses) as well as ad hoc fire safety subsystems which emerge and adapt (e.g., community-based fire response teams, fire safety education in schools). [1]

A supporting and enabling approach is needed that recognizes that communities and residents must be worked with to inform holistic fire safety solutions which navigate local barriers and leverage resources. Helping communities to strengthen their capacities to protect themselves from fire and fostering an enabling environment that supports and encourages the emergence of local fire safety practices may be the most achievable and scalable way to improve fire safety and fire resilience and should therefore complement more traditional institutional fire safety responses.

Table 1: Summary of Fire Risks and Recommendations

Observations	Fire risks	Recommendations	Suggested key actors
Open flames are used in marketplace for commercial activities - gas stoves, three stone fires, candles.	Ignition hazard from heat sources that can interact with combustible materials	• Promote safe energy usage and storage for cooking and lighting, education to vulnerable groups using open flames and other risky energy sources (i.e., sources using open flames or that have with a high probability of generating sparks). • Promote and stimulate market for alternative energy sources and devices which reduce risk of ignition, e.g., self-extinguishing stoves, electrical stoves; stoves with emergency shut-off valves. • Programs that support vulnerable groups to access safer alternatives would help to reduce fire risk and socio-economic vulnerabilities. • Develop and implement regulations governing/promoting identification, elimination, or control of fire hazards, e.g., ignition sources, stored fuels, and hazardous processes. Provide advisory support to traders to educate them on hazards and to promote compliance.	National Fire Service (I)NGOs and CSOs Ministries NADFOR National Response Committee (NRRC)
Informal, low quality electrical connections	Ignition hazards from short circuits and overheating can generate heat and sparks in close proximity to combustible building materials and goods.	• Diversify electricity generation and enhance electricity transmission, and distribution capacity to reduce overloading. Ensure reliability and reduce interruptions that lead people to employ more hazardous alternatives. • Regulate electrical installations, assigning clear roles and responsibilities to utility providers, contractors, customers, and other relevant key actors. • While regulations are under development, provide guidelines for owners, installers, and building occupants on how to safely install electrical connections and troubleshoot. • Utility companies to upgrade safety of existing electrical infrastructure and installations. • Establish a program to upgrade electrical connections reported as unsafe (promoting compliance rather than punishing non-compliance). Promote public education messaging on how to identify and report unsafe electrical connections. • Promote the installation of arc fault protection. • Promote the use of high-quality electrical wiring and equipment. • Promote and stimulate market for alternative energy sources and devices which reduce risk of ignition.	Government Utility providers Contractors Energy regulatory authority Utility customers Building owners
Predominance of small scale, lower income female traders using open flames to cook and sell foods.	• Women traders are more likely to be intimate (i.e., in proximity) with a fire caused by cooking • Lack of childcare facilities contributes to fire risk via lack of supervision of children within market and ignition risks they may create.	• Gender analysis in the context of fire risk should be conducted. Gender mainstreaming should be applied to fire safety planning and interventions to ensure fire does not exacerbate gender-based injustices, e.g., women's poor access to banking makes them more economically vulnerable in the face of a fire incident. • Provide childcare facilities in marketplaces with evacuation plans, drills, and staff training.	Local gender expert (I)NGOs and CSOs National Fire Service Ministries; Employment, Social Affairs and Family
• Combustible materials are used in buildings and market stalls, e.g., timber, plastic, textiles, foams • Non-combustible materials include concrete, steel (corrugated sheeting and structural steel), mud/clay, and brick. • Gaps between roofs and walls, and window and door openings	• Combustible materials contribute to ignition risks, fire growth, and fire spread rate. • Non-combustible materials do not contribute to fuel loads and if installed as a fire resisting system, may help to reduce fire growth and fire spread • During early fire growth, gaps allow gases to escape and ignite, contributing to fire spread to neighbouring shops. • Fire spread risk. Flames can impinge on combustibles through gaps of adjacent shops/structures	• Encourage the use of non-combustible building materials, and materials with some fire resisting capabilities (e.g., concrete, brick) • Adopt regulations to control use of combustible cladding and internal lining materials • Fire safety conscious upgrades of shops e.g., use of non-combustible internal lining materials. • Separate combustible building materials from potential ignition sources • Separate rooms and buildings with combustible construction materials and contents from each other via separation distances or passive fire protection (e.g., fire resisting construction) • Ensure high quality construction with limited gaps. Do not pack gaps in construction with combustible materials.	Ministries; Planning and National Development; Public Works, Land and Housing National Fire Service Building regulatory authority Market traders and building owners
Market buildings and stalls are vulnerable to collapse during a fire Long slender sections (light weight timber and steel) being used. Light weight structures have no structural integrity during a fire without passive fire protection.	• Structural collapse is a risk to occupants if people do not have enough time to escape, and to firefighters who may be carrying out firefighting and rescue operations when collapse occurs. • Structural collapse may contribute to fire spread.	• Structures need to be designed in such a way that they can maintain their structural integrity for a period long enough for all occupants to escape and for fire-fighters to attend scene carry out firefighting and search and rescue operations. The time depends on the size of the building, occupancy type and number of occupants. • Critical loadbearing structural members should a) be designed to resist the expected fire hazard for the required time, b) have passive protection (e.g., fire rated boards) that provides the fire resistance required, or c) have sufficient redundancy that failure of one zone or region does not result in total collapse. • Municipality should ensure that all buildings/structures are signed off by professional engineer	Ministries; Planning and National Development; Public Works, Land and Housing Building regulatory authority Structural Engineers Market traders and building owners
Dense storage of diverse combustible goods - mattresses, synthetics, hydrocarbons, plastics, paper, cardboard	• Internal fire growth. • Many goods are made of materials with high heat release rates, contributing to fire intensity. • High diversity of fuel load in close proximity (due to limited aisle widths and	• Separate fuel loads via aisles and advocate for maintaining separation between fuel loads. • Import controls to restrict entry of products and materials that present fire hazards. • Minimise storage of goods on site e.g., by providing access to off-site storage facilities. • Maintenance of aisles (e.g., through education of traders and allocation of alternative spaces for less congested trading).	Ministry of Public Works, Land and Housing Ministry of Planning and National Development National Fire Service

	internal subdivision of shops) increases the likelihood of ignition, the rate of early fire growth and ultimately the fire spread hazard between shops.		Market traders and building owners Hargeisa Municipality Chamber of Commerce
• Congestion between shops due to trading in roads, shops extending onto streets interconnecting stalls, etc. • Wide streets around the market helped to control fire spread during the April 2022 Waheen market fire.	• External fire spread. • No separation between stored goods contributes to fire load and risk of fire spread between shops. • Wide streets in the city that create fire breaks in and around markets.	• Separate fuel loads via fire resisting construction systems and separation distances, and advocate for maintaining separation between fuel loads. • Organize/separate market areas based on types of activities and anticipated fuel loads to minimize mixing of fuel types. Separate high hazard areas (e.g., electrical rooms, storage of flammable or combustible liquids) via passive fire protection. • Prioritise establishing roads and maintaining open space between buildings as a means of mitigating fire spread and maintaining escape routes and firefighting access routes. • Design, install, and maintain systems to contain fire (e.g., active suppression, passive protection). • If sufficient separation distances or compartmentation between individual shops is not possible, fire breaks should be provided. • Maintenance of roads (e.g., through education of traders and allocation of alternative spaces for less congested trading).	Ministry of Transport and Road Development Ministry of Public Works, Land and Housing Ministry of Planning and National Development National Fire Service Building regulatory authority Market traders and building owners Hargeisa Municipality Chamber of Commerce
Wind can contribute to fire spread	Can contribute to early fire growth and rapid spread rates between shops	Awareness of seasonal fire risks to be integrated into fire safety planning and education.	National Fire Service Fire education providers?
Shops built within enclosed spaces	Shops located within another structure (e.g., large warehouse) could be more vulnerable to fire spread due to heat build-up in secondary structure radiating heat to other shops. This could also be an evacuation risk, since smoke and heat are captured by secondary structure, as opposed to releases into the environment like shops outdoors.	Utilize smoke ventilation to vent hot gases from enclosures	Ministries; Planning and National Development; Public Works, Land and Housing Building regulatory authority Building owners
Gaps between roofs and walls, and window and door openings	• During early fire growth, gaps allow gases to escape and ignite, contributing to fire spread to neighbouring shops. • Cumulative risk grows as fire spreads.		Building contractors, owners.
Wide range of traders - including women and men, girls and boys, people with disabilities, wide age range, different ethnicities, IDP/refugee status	Intersecting social identities potentially increase vulnerabilities to fire risk, particularly in terms of economic recovery and inclusion in fire safety planning.	• Integration of intersectionality approach into gender analysis. • Socio-economic data gathering on diversity of market traders. • Attention to accessibility requirements for evacuation planning and design. • Inclusion of different identities in fire safety awareness and education. • Advocate for gender inclusive banking access and business support	NGOs, CSOs Urban planners and designers Financial institutions
Range of marketplace trader statuses - unregistered self-employed traders, business owners, employees and building owners	• Varying degrees of economic vulnerability depending on size of business, savings, access to alternative income generating opportunities. • Unregistered, self-employed traders perhaps the most vulnerable as they rely on market access to cover living costs on a daily basis.	• Inclusive economic recovery planning integrated into holistic fire risk reduction strategies. Take into account the full range of traders including majority on low incomes. • Collaboration with local CSOs working on building economic options and mutual aid. • Formalize relief fundraising mechanisms to engage diaspora, private sector, clan systems quickly after the next fire. • Encourage development of financial risk management and risk transfer mechanisms, i.e., insurance, due diligence, and lending conditions.	NADFOR NRRC CSOs, NGOs Diaspora Private sector Clan systems Financial institutions Ministry of Employment, Social Affairs and Family
Low levels of fire safety awareness in general population.	Increases fire risk in terms of lack of prevention, detection and communications, responses, occupant protection.	Scoping study on fire safety awareness, attitudes and burns knowledge, integrate results and gaps into development of a culturally appropriate fire safety education programming.	National Fire Service (I)NGOs, CSOs Health workers NADFOR

• No automatic fire detection and alarm devices observed in the marketplaces. • Fire detection and alarm appears to be manual, based on people noticing a fire and then communicating with others by word of mouth	Delayed fire detection allows fire to continue growing without intervention and delays notification to occupants to escape	• Design, install, maintain systems to detect fire and alert occupants, the fire services, and other key actors. • Install manual pull boxes in existing and new marketplaces. • Install hard-wired, interconnected automatic detection and alarm systems in new marketplaces. • Install battery-powered automatic detection and alarm devices throughout existing marketplaces. • Refer to international standards for guidance on design and installation of detection and alarm systems and make local adaptations to account for environmental conditions (e.g., ambient temperatures), language, and culture. • In coordination with wider fire strategy development, establish a strategy and procedures for what to do in the event of a fire emergency and provide communications support (e.g., signage, radio communication systems, voice guidance, posters with evacuation routes), documentation, training, and awareness raising for all relevant stakeholders based on their roles and responsibilities (e.g., traders, security guards). • Develop culturally appropriate evacuation messaging and communication mechanisms for use during emergencies that considers range of traders and the public that use market.	National Fire Service NADFOR NRRC Traders Building owners
• Hargeisa marketplaces tend to include multiple buildings and outdoor areas in close proximity. • • Pathways are often congested in marketplaces. • • Crowds gathered to watch the April 2022 Waheen market fire.	• The risk of fire is shared amongst the multiple buildings and outdoor areas making up marketplaces, which makes detection, alarm, and evacuation highly complex and interdependent between different areas. • • Risks to occupant protection and firefighting.	• Research human behaviour during fires in Somaliland to support fire safety improvements in marketplaces and contribute to fire safety development more generally. • Design, install, and maintain a coordinated, protected (i.e., fire and/or smoke separated), and reasonably efficient egress system with multiple ways out to assembly points remote from the marketplace and sufficient capacity for large occupant loads expected in marketplaces. • Establish a coordinated market-wide occupant protection/evacuation strategy, including for persons who require assistance to escape (e.g., persons with disabilities, children, elderly). • Refer to international standards, such as NFPA 101 or IBC, for guidance on design of egress systems, but contextualize guidance to account for local conditions. • Utilize smoke ventilation to vent hot gases from enclosures and away from egress pathways. • Develop, coordinate, and implement marketplace fire management strategies in collaboration with market traders, representatives/associations. • Establish clear roles and responsibilities for evacuation management using fire wardens, evacuation planning exercises, fire drills, etc. • Consider the use of a security company for fire evacuation management and coordination. • Require certain occupancies to hire and train staff to manage incipient fires and direct evacuations in the event of fire. • Support development and practice of personal emergency evacuation plans for persons requiring assistance to escape, e.g., persons with disabilities, children, older adults. • Maintain good housekeeping. • Police to provide crowd management services during large scale fire emergencies.	National Fire Service Market traders Building owners Ministry of Public Works, Land and Housing Ministry of Planning and National Development Ministry of Information, National Guidance and Culture Building Regulatory Authority Somaliland Police
• Stories of ad hoc firefighting by the community in the State House IDP demonstrated some capacity to form alert others, demolish structures and form bucket brigades for firefighting. • Hose reels observed in newer buildings	• Communities are nearly always the first responders to fire. This can put their lives at risk if they don't have appropriate PPE, equipment, training, etc. • Supported and trained community members can play a significant role to manage a fire incident before the fire services arrive, however. • Consider the risk of untrained and unequipped occupants using firefighting equipment provided.	• Engage with communities to understand their experiences and strategies to respond to fires. • Awareness raising and training on appropriate responses to small fires (e.g., small waste basket fire, cooking pan fire). Considering women's role with cooking, programs need to include and target women. • Encourage development of partnerships between Somaliland National Fire Service and community-based organizations to increase fire safety awareness. • Provide resources and appropriate training for responding to small fires – e.g., fire extinguishers, buckets of sand, pot covers, fire blankets. • Establish community-based firefighting teams, with training, PPE, equipment, and support to enable safe responses to fire in early stages, before fire services arrives. • Provide coordination training to enable community-based firefighting teams to play a supportive role, if needed, to the fire services upon their arrival. • Design, install, and maintain equipment for incipient firefighting by trained occupants, e.g., hose reels, fire extinguishers.	National Fire Service Market traders CSOs, NGOs NADFOR, NRRC Communities
• Fire services has grown considerable in its 8 years. • Most firefighters have a high level of education (college degree) • Review of PPE, firefighting equipment, personnel, training, etc. not carried out.	• Firefighters are exposed to high risks during fire response if not equipped with sufficient and appropriate PPE, equipment, vehicles, training, etc. • Note PPR and firefighting equipment only provide protection if maintained and used properly and in acceptable exposure conditions.	• Fire service requires sufficient resources and procedures to procure, operate and maintain PPE and firefighting equipment. • Annual assessment and reporting on quality and quantity of existing stock, personnel and training to detail deficits and costs in order to advocate for resource allocation. • Carry out detailed review of fire brigade's resource deficits, as noted in Section **Error! Reference source not found.**. • Invest in expanding capability and capacity of Somaliland National Fire Service to manage all-hazards incident responses through purchase of additional vehicles and equipment, recruitment, and by training personnel. • Review fire incidence data management system. • Design, install, and maintain equipment in buildings and marketplaces to support the fire services response, e.g., building access, fire department connections, fire control room, fire hose valves • Leverage the education of fire-fighters to support wider fire safety development, e.g., building regulatory system development and enforcement, fire safety education delivery. • Recognize and authorize expanded role of Somaliland National Fire Service in managing all-hazards emergencies.	Fire Service NADFOR NRRC International donors Fire service exchanges

Separate telephone numbers to contact fire service and police, which are used interchangeably.	Delays in identifying response responsibility leading to delays in fire services arrival to fire scenes.	• Develop and coordinate procedure for police to hand over fire calls more quickly. • Promote use of 990 number to reach fire services directly. • Establish a common call-answering point for all emergencies, which has responsibility for engaging all response agencies to affect the necessary mobilization and coordination.	National Fire Service Somaliland Police Ministry of Planning and National Development Ministry of Information, National Guidance and Culture NADFOR
No local address system	Leads to way-finding issues which can delay fire services arrival to fire scenes.	• Integrate location and navigation service What3Words into fire services response system • Promote use of What3Words to public.	National Fire Service NADFOR Somaliland Police
Road infrastructure is often unpaved or not suitable for heavy vehicles	Impediment to firefighting response. Contributes to delaying fire services arrival to fire scenes.	• Improve road conditions to increase capacity, improve safety, and to decrease fire services response times. • Maintain access around the perimeter of marketplaces for fire response vehicles.	Ministry of Transport and Road Development Ministry of Public Works, Land and Housing National Fire Service
• Conditions of water scarcity, current drought conditions. • Firefighting reliance on voluntary services of private water haulers	• Firefighting capacity is limited by water that can be carried on appliances; only a few minutes of active firefighting water is available. • Timely, voluntary donation of water by private haulers can be valuable but not guaranteed.	• Regulate water rights to maintain adequate supply and reserves for human health, sanitation, and firefighting. • Continue installing water mains and fire hydrants to ensure equitable access and consistent supply; ensure interoperability with Somaliland Fire Brigade vehicles and equipment. • Water distribution system currently in process of development; need more information on inclusion of permanent fire hydrants, interoperability with fire service equipment.	Ministry of Water Resource Development Ministry of Health Development Ministry of Environment and Climate Change National Fire Service International donors
Absence of incident command centre with communications equipment and mechanisms to bring key actors together during fire incidents. Ad hoc communication by telephone instead.	Delays response times, effective communication and adequate turn out/response of actors with necessary expertise and decision-making power.	• Establish an inter-agency coordination centre (incident command) to manage disaster response by providing leaders with a place to gather and collaborate on decision making. Equip with communications equipment. • Establish legislative and procedural mechanisms to bring key actors together (ideally at an incident command centre) during a fire incident.	President National Fire Service NADFOR Ministries (e.g., Interior, Health, and Finance), Mayor Governor Police Commander Military Commander Water supply companies Electric utility companies
Lack of ambulance service run by health workers; those injured by fire are taken privately or by fire service to hospital	Increased risks of injury, death and other health vulnerabilities increased due to lack of paramedic responders and potential delays in transporting fire victims to hospital.	• Continue providing first aid training to fire-fighters on regular basis. • Provide advanced medical training to fire-fighters. • Establish ambulatory care and transport system. • Establish burn care units in existing health facilities. • Further research on burns injuries treatment facilities to understand if they can respond to severe burns. Build capacity for advanced burn care. • Long term health and psycho-social support for burns survivors.	Somaliland Red Cross Society National Fire Service Hargeisa Group Hospital NADFOR
• NADFOR has responsibility for disaster related crises and coordination, implementation of policies lagging due to financial and resource issues. Focus on fire is minimal. • National Response and Relief Committee created in response to Waheen fire but minimal coordination with existing national DRM bodies	• Risk of delayed, inadequate, and siloed responses due to gaps in institutional capacity to create strong DRM mechanisms and coordination. • A lack of representation/ collaboration between NRRC and NADFOR increases risk of incomplete response due to exclusion of existing DRM expertise and experience within Somaliland	• Establish a Memorandum of Understanding (MOU) between the Somaliland Fire Brigade and NADFOR governing inter-agency coordination of response to major disasters. • Carry out an evaluation of the NRRC performance and share lessons learned with NADFOR and other key actors to inform future fire recovery efforts. • Review and refine policies governing emergency and disaster declarations to clarify thresholds and authorities. • Integrate fire into existing mechanisms for multi-hazard disaster management to coordinate relief and recovery across ongoing disasters, and to institutionalize knowledge from each incident. • Fire safety representation on disaster management committee to contribute to the above and create a direct link between fire and international assistance. • Form inter-agency group within government and public-private partnerships to develop and implement an integrated Somaliland risk reduction strategy beginning with a fire focus then expanding to other natural and technological hazards.	National Fire Service NADFOR NRRC

Fire can cause or trigger emotional trauma, especially in this post-civil war context, as well as longer term cascading health and economic impacts beyond loss of life and injury.	Risks to psycho-social, health, economic recovery.	• Health and well-being responses should address emotional trauma alongside physical trauma. • Longer term health impacts of fire on livelihoods and well-being need to be understood and considered in recovery planning.	Health worker professionals NGOs Ministry of Health Development
Lack of formal property insurance systems and reliance on clan systems and fundraising for economic safety net	Risks to economic recovery.	• Inclusive economic recovery planning integrated into holistic fire risk reduction strategies, taking into account full range of traders. • Formalise relief fundraising mechanisms to engage diaspora, private sector and clan systems quickly and fairly post-fire. • Encourage development of financial risk management and risk transfer mechanisms.	CSOs and NGOs already working on building economic options and mutual aid Ministries; NADFOR, Committee Diaspora groups Private sector associations Banking institutions
Construction of new markets and temporary markets is an opportunity to integrate fire safety principles, mechanisms, and infrastructure.	Overall risk reduction	• Reconstruction should follow participatory urban planning principles and processes to address needs of all types of traders and specific fire risk vulnerabilities. • Develop, implement, and maintain a fire safety strategy for the construction of new marketplaces. Anticipate future expansion and informal evolution of marketplaces. • Refer to international standards for guidance but make sure to contextualize guidance to account for local conditions. • Fire risk assessments and fire safety planning for temporary markets established by Hargeisa municipality and private sector	International assistance (fire engineering expertise) NADFOR NRRC Ministry of Water Resource Development Ministry of Transport and Road Development Ministry of Public Works National Fire Service (I)NGOs, CSOs,
Need to develop fire safety strategies for all existing, new and temporary markets in Hargeisa	Overall risk reduction	• Fire Safety Strategy Development for Marketplaces • Establishment of market trader associations with diverse trader representation for ongoing consultation to support fire safety development. • Establish responsibilities and accountability mechanisms requiring building owners, contractors, and other stakeholders to review or develop fire strategies based on international good practice, until building regulations are launched • Forge clear understanding of roles and responsibilities amongst traders, landlords, customers with regards to fire safety in marketplaces, through regular coordination and communications between key actors. • Recognize and respect informal mechanisms that promote and ensure compliance with fire safety norms in the absence of regulation. • Develop public-private partnerships between Somaliland National Fire Service and key actors to implement and evaluate fire safety strategies in key sectors such as marketplaces. • Mainstream fire safety across other sectoral programs and interventions (e.g., health, WASH). • Promote a local culture of fire safety and community risk reduction through coordinated strategies that raise awareness and disseminate accurate and timely information through social media and trusted messengers, using gender responsive and socially inclusive methods to reach everyone. • Promote a culture of fire safety in wider society e.g., through schools, social media, social development interventions. • Promote a culture of learning and acting together rather than relying on expert led top-down information giving through public fire safety messaging and education programs within marketplaces. • Community risk reduction through coordinated strategies that raise awareness and disseminate accurate and timely information through social media and trusted messengers	All - but needs locus of responsibility to coordinate and oversee process
There is no building regulatory system in Somaliland. First draft of building regulations under development	Construction, operation, and maintenance of the built environment is informal and largely relies on the private sector, which is not bound by any codes or standards to prioritize health, safety, or welfare of people, property, or the environment	• Develop and implement building regulations which promote and support (even incentivize) compliance. • Develop, resource, and implement a building regulations advisory and enforcement strategy with clear roles and responsibilities for central government and municipal government. • Develop and share guidance for building owners, contractors, and other stakeholders on new building regulatory environment and how they are expected to interact with it. • Identify and pilot innovative ways to fund fire mitigation efforts, e.g., micro-lending, grants, tax on market goods and services sold.	Ministry of Public Works National Fire Service (I)NGOs, CSOs, NADFOR

1 Introduction

Around 8pm on 1 April 2022, the eve of Ramadan, a fire started at Waheen Market in Hargeisa, Somaliland, one of the largest marketplaces in the Horn of Africa. The cause of the fire is not known, but it is believed to have started in a clothing shop. The fire quickly spread across the dense marketplace. Community members joined fire services in responding to the incident, utilizing private water tankers and any other resources they could access. Ultimately poor access, unreliable water supplies, lack of equipment, and the severity of the fire itself, left responders with no option but to take a defensive approach around the perimeter of the market. Crowds gathered to watch, hindering fire brigade response. The fire destroyed Waheen market including some of the buildings along the perimeter but did not jump across the main streets to other areas of the city. The timing of the fire on a Friday and in the evening meant that few people were at the market. There were no deaths but 28 injuries were reported. [2]

The Waheen Market represented perhaps the most important public amenity available to the people of Somaliland. As noted by the Minister of Religion, “Waheen is Hargeisa, Hargeisa is Waheen. It is the touchstone of our identity”. Before the fire, Waheen was the largest market and an economic centre of Somaliland. More than 3000 business owners were estimated to be directly affected, with many more unregistered traders impacted. Large financial losses were directly incurred, with concerns about the longer-term impacts on Hargeisa’s ability to cope with yet another shock in a context of drought, water shortages and high food prices.

An early report titled *‘Preliminary Report on the fire devastated Waaheen Market in Hargeysa’* from the National Relief and Support Committee to the Victims of Waaheen Market (dated 5 April 2022) identified an immediate *“need for technical support in all phases of the recovery plan, including…redesign and reconstruction of infrastructure, setting a security structure for existing markets, and building marketplaces, etc.*

Figure 1: Damaged area of Waheen Market, including both the public and private areas, is approximately 6 hectares; Source: FCDO

In response to the government's request for technical support, the British Office Hargeisa contacted Kindling, a US based nonprofit specializing in fire safety in complex, resource-deprived settings. This report shares findings and recommendations resulting from a baseline fire safety assessment of marketplaces in Hargeisa which ran from 18th May - 18th August 2022. This project aims to improve collective understandings of fire risks in marketplaces across Hargeisa, as well as the wider infrastructure and safety systems, safety culture, and opportunities and barriers to improve fire safety. Specific objectives of the assessment were to:

- Identify key fire risk factors in marketplaces, including fire hazards and vulnerabilities
- Understand construction, maintenance, and operation of marketplaces in relation to fire safety
- To develop a baseline understanding of current fire safety practices and safety culture in Hargeisa
- To understand the current and potential future roles of marketplace traders, the fire services and other key actors in fire risk reduction and fire response
- To map out available capital to support fire safety improvements, i.e., natural capital, cultural capital, human capital, social capital, political capital, financial capital, built capital
- To identify potential opportunities for improving fire safety in marketplaces

2 Methodology

2.1 Conceptual Framing

We conceptualize urban fire risk as a socially constructed complex problem, and more than just a physical hazard. To understand fire risk, we use a complex systems approach to identify key actors and their perspectives as well as relationships between them, how these contribute to the development and manifestation of fire risk, and to identify routes towards the progression of fire safety.

Urban fire risk is understood to result from the interaction between hazards and vulnerabilities. Fire hazards are the materials, substances or actions that increase the size or severity of a fire, or the likelihood of a fire occurring, whilst vulnerabilities are the broader contextual conditions that lead to loss in the presence of a hazard. Both fire hazard and vulnerabilities are the result of systemic political, social, and economic relations based in societal structures.

The assessment draws on two key frameworks: the Pressure and Release (PAR) framework [3], and the Web of Institutionalization. [4]

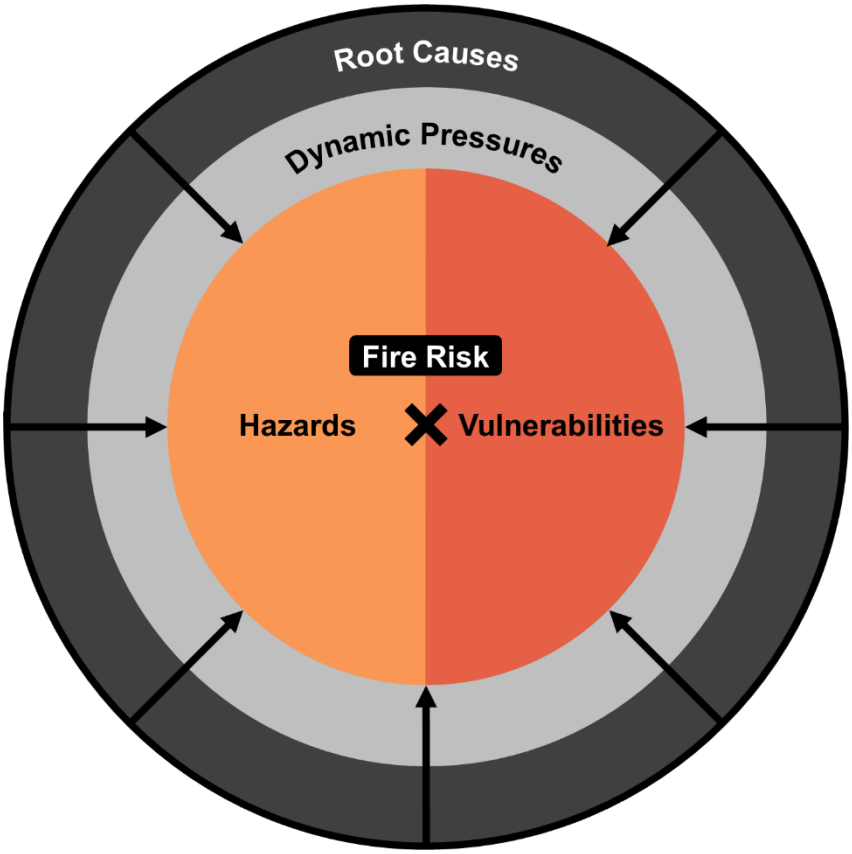


Figure 2: Adapted PAR framework [1]

In the PAR:

- root causes are interrelated political, social, and economic structures within societies and economies, which affect the allocation and distribution of resources, wealth, and power among different groups of people.
- dynamic pressures are more immediate processes and activities that translate the impacts of root causes, temporally and spatially, into unsafe conditions (such as the status of local institutions, scientific knowledge, rapid urbanization, co-existing environmental hazards).

An urban fire adapted PAR framework (see [5]), allows for a contextual analysis of fire risk in Hargeisa beyond a technical focus on fire hazard as a spontaneously occurring phenomenon. Urban fire hazards are understood to arise as a result of human decisions and activities and as such need to be considered in conjunction with socio-economic context, such as the underlying historical, economic and social development of the city. These contextual conditions feed into socio-economic vulnerabilities, that susceptibility of individuals or communities to the impacts of hazards. Whilst the original PAR separates natural hazards and vulnerability, in the case of urban fire risk, the hazard is man-made and so they reinforce each other; poverty, inequality and resource deprivation can lead to a number of ignition risks, and in the event of a fire, the vulnerabilities experienced by people can lead to further ignition risks.

The Web of Institutionalisation is also used as a diagnostic tool to understand the current status of fire risk and safety, as well as to map potential strategies to improve fire safety. This framework allowed the assessment team to recognise residents' experiences of fire risk, as well as allow for an assessment of policy, organisational and delivery aspects of the current fire safety system, and potential opportunities for improvement.

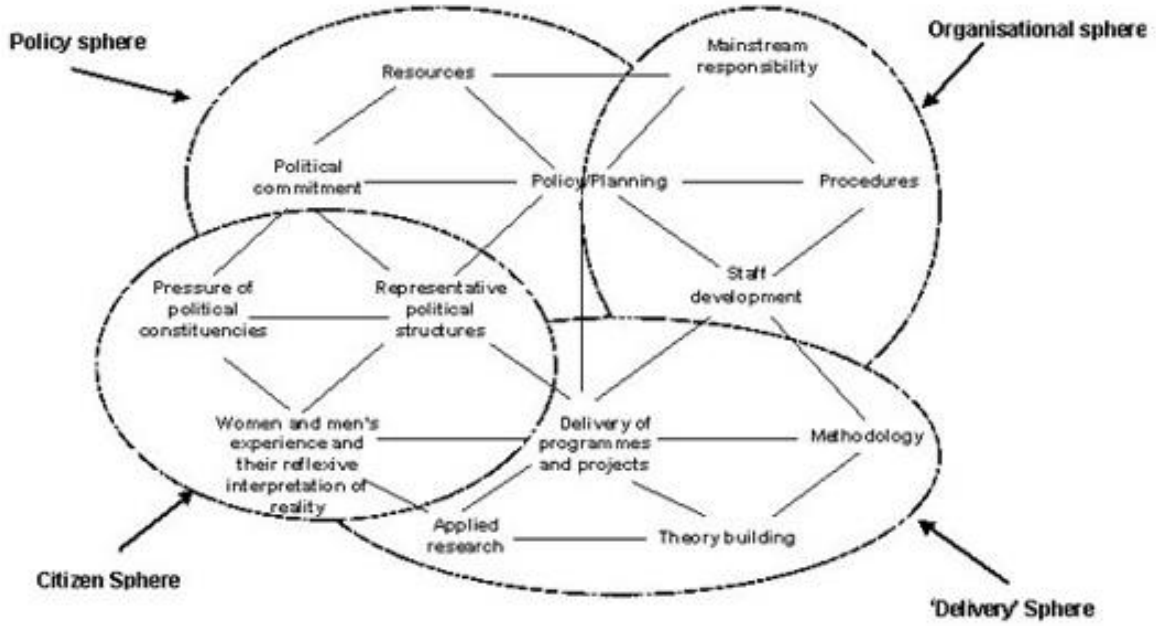


Figure 3: Web of Institutionalization [4]

2.2 Overview of Research Activities

Mixed methods were used to conduct the rapid assessment, with data triangulated across each research activity to build an understanding of the Waheen fire, its impacts, and recovery efforts, and fire risks and fire safety in marketplaces more generally.

Prior to the field visit, a rapid literature review of available data, reports, and media sources was conducted in addition to informal discussions with people with relevant experience of the Somaliland context, including residents and fire safety professionals. The British Office Hargeisa provided key background information on the Hargeisa context, Waheen market fire, and relevant key actors. This allowed for an initial key actor mapping and prioritisation of key interviews prior to the visit.

Kindling Consultants, Danielle Antonellis and Mark Chubb visited Hargeisa from 22nd - 28th May 2022. The schedule allowed for 15 semi structured interviews with the following individuals and groups:

- Chamber of Commerce – private sector committee responsible for fire relief
- Civil Society Organization (CSO)
- Humanity & Inclusion
- Ministry of Energy
- Ministry of Environment and Climate Change
- Ministry of Finance

- Ministry of Public Works – Building Code Committee
- Mayor & two City Councillors
- Nagaad Network
- National Disaster Preparedness and Food Reserve Authority (NADFOR)
- Save the Children
- Somaliland National Fire
- Somaliland Red Cross Society
- Sompower
- Transparency Solutions

A remote interview with the Minister of Endowment and Religious Affairs & Chairman of the National Response and Relief Committee (NRRC), and his consultant was conducted on 7th July 2022.

Site visits were carried out to Waheen Market site, Gobanimo Market and the State House Internally Displaced Persons (IDP) Camp. Direct observations were taken during guided walks facilitated by a City Councillor (for Waheen Market site), Nagaad Network (for State House IDP Camp), and our local translator and guide for Gobanimo Market. During our visit to the Gobanimo market, we engaged in a few informal discussions with traders regarding their business and relationship to Waheen market (if any), with translator support.

2.3 Limitations

Time limits on data collection narrowed the selection of interviewees to only those with availability during the week's field trip to Somaliland. While the research team interviewed a wide range of individuals across key actor groups, the data is by no means exhaustive, and findings reflect the rapid nature of the assessment.

Some official documentation was not available for our review. Consequently, we could not independently verify some of the information provided by interviewees, nor reconcile conflicts that were noted between the observations of various interviewees.

Interviews were conducted primarily with government representatives, NGOs, and utility service providers. There were limited opportunities in the time available to engage directly with a full range of traders, especially women and other under-represented groups, hindering a full understanding of their role in and experiences of fire safety. Their perspectives were conveyed via NGO and civil society organisations with experience of working directly with these groups. This has had an impact on the level of detail and range of data available to conduct a full gendered analysis of fire risk. However, an initial overview of key issues has been compiled.

During the engagement, the importance of the clan system and the diaspora was emphasized, especially with regards to mutual aid, which has been very active post-fire to support Waheen relief and recovery. However, time constraints meant that we were not able to map or explore these relationships in detail.

2.4 Ethics

The following ethical research conduct principles were applied:

- Obtaining informed consent from research participants, after sharing information on who we are, why we were carrying out this work and how the information they share will be used
- Safeguarding the confidentiality and anonymity of participants and their opinions regarding aspects that could put people at risk of any harm
- Protecting collected data by keeping written notes in the personal possession of researchers and only using password protected, secure collaborative workspaces for documentation and analysis
- Collecting limited personal identification data of traders and residents engaged with, such as gender, age, and people's relationship to the place
- Being mindful of the potential experiences in fire and their relationship to PTSD, therefore avoiding questions about their feelings during or after a fire, and instead only asking high level questions about past fire incidences

3 Context Analysis

This section is organized through the lens of the fire adapted PAR, identifying root causes and dynamic pressures that contribute to the emergence of fire risk in marketplaces, as well as observations of socio-economic and economic vulnerabilities.

3.1 Root Causes and Dynamic Pressures

Urban migration and processes of urbanization in Hargeisa have intensified in recent decades as deforestation and desertification has accelerated, and regional displacement across the Horn of Africa has increased. The end of the civil war has also led to rapid expansion and reconstruction of the city. The city's population has grown from 300,000 in 2005 to 780,000 in 2015, generally growing at a rate of 3.1% annually. [6] This growth has contributed to pressures on urban services and infrastructure, as well as contributing to the growth, size, nature, and significance of Waheen market and similar marketplaces.

The civil war that led to the declaration of Somaliland's independence in 1991 decimated the region and its infrastructure. Consequently, nearly all buildings and infrastructure are the result or rebuilding and investments made since 1991. This reconstruction has been

rapid but in a context with weak institutional capacity, particularly with reference to urban planning and administration. There is no building regulatory system in Somaliland. Construction, operation, and maintenance of the built environment is informal and largely relies on the private sector, which is not bound by any codes or standards to prioritize health, safety, or welfare of people, property, or the environment. A lack of adequate urban services and infrastructure contributes to a risky environment with regards to fire, i.e., a high likelihood of fire occurrence, high risk of fire growth and spread, and limited systems to support fire responses (communications, evacuation, firefighting).

Commercial activities in marketplaces in Hargeisa are key economic activities for the sustainability and development of Somaliland. Many traders, especially smaller traders participating in the informal economy[1], rely on the marketplaces for survival, on a daily basis.

While it was outside the scope of this study to evaluate distribution of power, wealth, and resources in Hargeisa, it is important to highlight such inequalities are often root causes of fire risk emergence in other contexts – e.g., there are strong relationships between poverty and incidences of fire.

In terms of dynamic environmental pressures, the context of water scarcity as a result of arid climate and lack of rainfall in the city is a critical concern in terms of its contribution to fire risk emergence. Across the region this contributes to the prevalence of severe wildfires. In an urban context these conditions can contribute to fire spread. In addition, when fires occur their effects exacerbate water and food insecurity related to drought conditions.

The historical and socio-economic context of Hargeisa therefore contributes to the emergence of fire risk in urban marketplaces via rapid urbanisation, unregulated building and urban development, and conditions of economic precarity which have manifested in a reliance on marketplaces and the informal economy as means of economic survival.

3.2 Overview of Hargeisa Marketplaces

Before the April 2022 fire, Waheen market was a key trading hub within Somaliland but also one of the largest and busiest within the Horn of Africa, with linkages to the Middle East, China, Asia, and Europe. It has been described as ‘more than a market…an entire financial district’. [7]

The market had developed incrementally over the years, with significant growth since the end of the civil war. Market ownership was mixed, with some buildings owned by central and local government, and the majority by private interests. Traders at the market included Somalilanders and migrant workers from Somalia, Ethiopia, and other parts of

[1] The informal economy provides about 77% of the total employment in the Hargeisa. (World Bank 2012, in [6])

East Africa, with women running small businesses reportedly making up the majority of traders. [2] [8]

Trade carried out by the estimated 2,000 market stalls (estimated to employ up to 12,000) was highly diverse. [7] Fresh fruit, vegetables, meat, spices, and other foodstuffs were sold by smaller traders (80% of vegetable and meat sellers were estimated to be women). Retail and wholesale goods available included but were by no means limited to clothing, shoes, electrical goods, cosmetic goods, household items, and furniture. The market also provided a range of services including butchery, tailoring, beauty salons, tech support stores. [2] Business to business services were also a key part of the market ecosystem; cooked meals and drinks were prepared on site for consumption by traders and employees, wheelbarrow services were provided by men to move goods around for traders and market users. Unregistered self-employed people affected are perhaps most vulnerable, including street vendors, brokers, handcart people, sanitation workers, security guards, and porters who rely on market access to make daily wages. Building owners, (small and large) business owners and employees have varying degrees of vulnerability based on their size, savings, and access to alternative income generating opportunities.

The market comprised a mixture of permanent structures and makeshift stalls, crossed by roads and narrow pathways, where street traders would site themselves as well as move by foot with their goods around the market. Permanent structures would house large, more formal businesses as well as being subdivided by fabric or plastic sheeting into numerous rented market stalls of a more informal nature.

Nearly every interviewee agreed that crowding conditions within Waheen Market were rampant. As the market grew, its horizontal expansion was constrained, and it became more congested. These spaces were filled with shopping stalls, pedestrian movement, and transient traders. Aisles between traders were difficult to maintain. What had once been actual roadways or city streets like those outside the market had become little more than walking paths between rows of stalls. These conditions made it easy for a fire once ignited to spread rapidly. The crowded conditions would also have made evacuating people difficult if the market had been open during the Waheen fire, and it clearly impeded firefighting access.

We observed many different types of construction within the Gobanimo Market (refer to Figure 4 to Figure 17), such as:

- Large market structures with many shops inside – roofs tend to be lightweight timber structures with corrugated metal sheeting; external walls and internal partitions may be combustible (e.g., plywood) or non-combustible (e.g., stone, brick); large openings are common

- Concrete masonry or brick structures with no walls (open to outside) and roofing made from corrugated sheeting
- Concrete masonry or brick structures with large openings
- Outside market stalls created from various combustible and non-combustible materials, including steel cans weaved together, sheet metal, lightweight timber elements, plastic sheeting, and various textile coverings
- Market stalls spaced so close together they create a quasi-indoor environment; constructed of lightweight timber elements, walls of corrugated metal sheets, plastic or the exterior of other buildings, and coverings made of draped plastic sheeting and corrugated metal sheeting

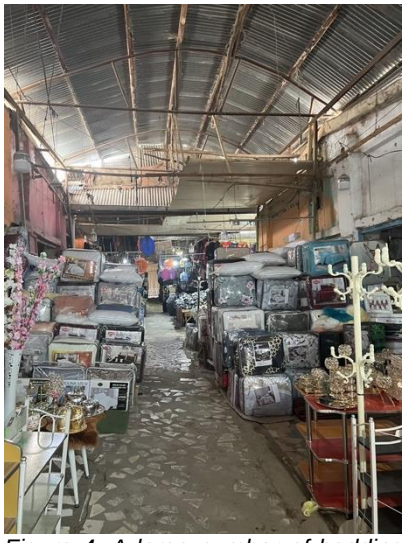


Figure 4: A large number of bedding products stored within an enclosure; Gobanimo Market

Figure 5: Combustible materials stacked high at a shop that survived the fire in a building on the perimeter of Waheen Market

Figure 6: Boxes stacked to ceiling level and plastic toddler products stored inside a small enclosure; Gobanimo Market

Figure 7: Outside marketplace with no separation between shops; Gobanimo Market

Figure 8: Indoor marketplace with shops on both sides and temporary stalls in aisle; red wagon in middle is a pop-up clothing shop about to open; Gobanimo Market

Figure 9: Enclosure for shop in Waheen market

Figure 10: Large building with shops inside; Gobanimo Market

Figure 11: Combustible mattresses underneath electrical wires, including informal connections; Gobanimo Market

Figure 12: Outdoor stalls at Gobanimo Market

Figure 13: Shops inside covered structures

Figure 14: Outside market stalls created from various combustible and non-combustible materials, including steel cans weaved together, sheet metal, lightweight timber elements, plastic sheeting, and various textile coverings

Figure 15: Market stalls with overlapping roof materials, creating a quasi-indoor-outdoor environment

Figure 16: Plastic sheeting and textiles hung across pedestrian pathways and covering market stalls and transient workers; forming a bridge of combustible materials between buildings

Figure 17: Installation of Aluminium Composite Panels on a building along the perimeter of Waheen market (post-fire image)

3.3 Socio-economic Vulnerabilities

Gendered vulnerabilities

Gendered vulnerabilities refer to how the (lack of) capacity of an individual or group to 'anticipate, cope with, resist and recover from' the impact of a hazard [9] [3] may be mediated by gender dynamics, such as access to resources, assets and power as well as the influence of the different roles that women and men play in society. The assessment team had limited opportunities to speak directly to traders, and there is limited secondary data available on the gendered aspect of marketplaces in Somaliland. However, the following gendered vulnerabilities were noted during conversations with civil society organisations and local residents.

Figure 18: Wheelbarrow for selling pasteurized milk. Trader interviewed lost 80% of her business from the Waheen market fire, and was selling her milk at Gobanimo Market when we met her on May 26, 2022

In the ignition phase, there are some specific gendered practices which increase fire risks. An informant noted that children are sometimes brought to the market in the absence of childcare provision and accommodated in open improvised boxes for children to play whilst women trade. This makes for a highly vulnerable situation in terms of both ignition risks created by

unattended children, the spread potential of materials used to contain children, as well as in terms of evacuation if a fire started during the daytime and mothers were at a distance from their children. It was also reported that young girls may be responsible for making informal electrical connections, putting them at increased risk of electrocution and injury.

In terms of preparedness, it is not known what level of fire safety awareness is held by traders specifically, however it was reported that more generally within society there is little knowledge of fire risk. Research from other contexts shows that access to fire safety knowledge is often gendered in that social norms may deem it unnecessary for women to participate in fire safety training, or they may only be allowed access to partial information. Fire safety knowledge is often disseminated in schools, and if women do not have access to the same level of formal schooling, they may have a lower level of awareness in terms of risk perception, early warning, and evacuation behaviour. Future fire safety education efforts should take into account gender dynamics and gender sensitive methods for learning, taking into account literacy levels, to ensure fire safety knowledge is accessible to all traders.

Men may be particularly physically vulnerable during fire response due to their roles in fire suppression. All firefighters in Hargeisa are men, whereas women have administrative and support roles within the fire service, which may reflect gender norms in how people may respond in the community in the event of a fire. Fire response in informal settlement contexts tends to follow similar patterns where women guard possessions, raise the alarm and bring water whilst men attempt to fight fire. [10] [11]

Overall, a large portion of Waheen market is comprised of businesses run by women[2]. Women are therefore disproportionately at physical risk of fire during daytime hours simply in terms of exposure. The types of businesses that women work in also contribute to their vulnerability. Their businesses tend to be smaller, often individually run, informal and of a more transient nature, located on the roads[3]. This is potentially linked to inequalities experienced by women in Somaliland in terms of formal education, lack of access to assets, resources, and financial systems to improve businesses, and the time burdens of combining caring and productive work.

Women tend to be lower income earners and have limited voice and representation in the public realm, making them some of the most socio-economically vulnerable traders. This

[2] The number of women working in the informal economy in Hargeisa is thought to be greater than that of men (UNDP, 2014 in [6], p.7)

[3] Those working in the informal economy on the roads in Hargeisa report facing more challenges than those working in roofed buildings, including business levels, lack of inclusion in government policy, economic variables and lack of access to finance, lack of literacy, numeracy and business skills, difficulties with infrastructure and operating space. [6]

puts women at greater risk from fire in terms of coping, recovery and reconstruction, as they have fewer resources to fall back on.

There is a noted lack of female representation on the two key committees for relief and recovery that have been set up in response to the Waheen fire. Women's potential exclusion from recovery and reconstruction planning could contribute to their vulnerabilities being carried forward into future market developments if their voices, experiences, and needs are excluded.

Intersecting social identities

In addition to gendered vulnerabilities, other key social identities that experience exclusion and marginalisation (and intersect with gender) include disability, age, refugee/IDP status and minority clan membership. The ways in which these aspects of social identity intersect with each other have implications for fire risk and safety. Certain people may be excluded from safety and reconstruction planning and relief support, and experience compounded economic vulnerabilities before and after a fire. Relief efforts in the aftermath of any fire should take into account how intersectionality deepens vulnerability and thus targeted support to particular groups may be required rather than a blanket approach (e.g., women with disabilities, or women belonging to minority clans).

Whilst it was reported that before the fire there were few traders or market users with disabilities at Waheen, reconstruction planning should support the participation of people with disabilities in order to make sure new markets are accessible for trading, but also have evacuation routes and plans that address the physical vulnerabilities of all users in the event of a fire. It has also been noted that women traders tend to be of older age, and thus their accessibility requirements must also be taken into account.

Psycho-social and health vulnerabilities

Historically, fire has been used as a weapon of civil war and thus experiencing additional fires potentially re-traumatises people, creating further vulnerabilities in terms of livelihoods, wellbeing, and social development. In a context where there are no formal systems of psycho-social support in place, alongside social stigma of such mental health issues, such emotional trauma should be considered as part of health and wellbeing responses. Nagaad Network provides psychosocial support for women, and this expertise could be shared amongst other key actors regarding specific psycho-social vulnerabilities in relation to fire.

The Waheen fire resulted in no deaths and few injuries[4]. However, several interviewees emphasized longer term risks to health and life as a result of poverty as the economic

[4] No data on fire deaths and injuries in Hargeisa more widely was available for this assessment.

impact of the fire unfolds over time. Health impacts should therefore be considered holistically and take a long-term view beyond immediate injury and loss of life.

Fire risk awareness

Interviewees noted that culturally, taking precautions against fire risk was perceived in a negative light by Somalilanders. Contributing factors identified include the perception that taking precautions tempts fate, and a fatalistic attitude or acceptance of fire risk in a context of multiple risks, precarious living conditions, and historical civil war experiences. This needs further investigation and to be taken into account with regard to public fire safety education and messaging so that fire safety becomes valued and acted upon within society.

Alongside this reported attitude to fire risk, it was also reported that people generally had little knowledge of how to deal with fires. This again needs further investigation with results integrated into public fire safety education programming.

Participatory spaces

Concerns were raised among civil society actors about the lack of influence and voice that market traders, particularly those from minority clans and non-elite groups, had to participate in reconstruction decision making, despite assurances by Ministries that 'everyone' was able to do so. No formal associational organisations of market traders were noted[5], and it was unclear what processes or mechanisms for equitable participation and recognition of the diverse needs of market traders might be available in relief and reconstruction efforts.

[5] It is noted however that 'trust, mutual association and community sharing seems to be a feature of the informal economy in Hargeisa which creates an enabling environment for its workers. [6] , p.14. This feature could be taken into account when considering reconstruction planning, relief dissemination, as well as when designing fire safety awareness campaigns.

Recommendations to Address Social Vulnerabilities

1. The relationships between men and women and their relative access to and control of resources and decision making in terms of fire safety should be interrogated. Gender analysis with regards to fire risk should be integrated into all future interventions to ensure gender-based injustices and inequalities are not exacerbated by interventions. On the basis of current available data, such an analysis cannot yet be carried out. It is recommended that a comprehensive gender analysis should be conducted with regards to fire risk to take into account how differences in gender roles, activities, needs, opportunities and rights affect women, men, girls and boys in the context of fire. Ideally, this type of analysis would be carried out by a local gender expert and a gender action plan for gender mainstreaming with regards to fire safety would be developed. This should be cross cutting across each stage of the disaster risk reduction cycle.
2. To address vulnerabilities that arise from intersecting social identities, an intersectionality approach should be integrated into gender analysis. Socio-economic data on the diversity of traders and market users is required, either from secondary sources (if available), or through primary research. Particular attention should be given to the needs of people who require assistance to escape in a fire such as persons with disabilities, children, and older people with regard to accessibility requirements related to evacuation planning and design, as well as their inclusion in fire safety awareness education.
3. To support recovery processes and reduce psycho-social vulnerabilities to fire, health and wellbeing responses should address emotional trauma alongside physical trauma.
4. The longer-term health impacts of fire and how it impacts livelihoods and wellbeing needs to be understood and considered in recovery planning.
5. Provide psycho-social support to affected populations and promote its benefits in a culturally appropriate way.
6. A scoping study on fire safety awareness and attitudes is required in order to understand the current situation, with results and gaps to be integrated into culturally appropriate fire safety education programming which spans prevention, preparedness, mitigation, response and recovery.
7. To avoid replicating fire risks in new markets, reconstruction should follow participatory urban planning principles and processes to address the needs of all types of traders and specific fire risk vulnerabilities. Organisations such as Practical Action and Architecture Sans Frontieres have resources and toolkits available to help design and implement planning using these approaches.
8. Establish an association of market traders with diverse trader representation for ongoing consultation to support fire safety development.
9. Establish child-care facilities in marketplaces with evacuation plans, drills, and staff training.

3.4 Economic Vulnerabilities

Whilst informal economic practices can bring benefits to many, they can also be a source of vulnerability when a disaster happens, for traders who lack of a financial safety net. Many market traders are only able to make income for that day's costs and some survive meal to meal. Some smaller scale traders, often women, may even take out daily loans to produce cooked goods to sell.

No formal property insurance systems exist in Somaliland. This lack of an economic safety net is felt during times of disaster such as the Waheen fire, particularly for anyone who may not have been able to access financial relief from government or NGOs. As noted by a local CSO: "All you have is flames. You have no cushion". Support may come from the clan system, but this was reported to be stretched by the scale of the Waheen fire, with some turning to social media to raise financial support.

Whilst economic relief has been provided via government, the private sector and diaspora, with the aim of providing support to the most vulnerable and on a needs basis, it was not possible to ascertain the extent to which this has been successful, and whether the claims of a return to pre-fire levels of trading were accurate.

However, it was reported by some that those who had suffered direct asset losses and who had their own business premises were prioritized. The lack of support for smaller scale traders therefore serves to exacerbate their vulnerability. Those reportedly most affected included street vendors, brokers, hand cart drivers, sanitation workers and security guards.

Disruptions to trading will have had deep impacts on household incomes, which can push households into further poverty. Whilst estimates of potential financial losses to formal businesses have been talked of, direct losses to households reliant on the informal sector must also be taken into account; these include material losses, physical harm, income loss through inability to work and time taken to re-establish trading, and the knock on effects on household members; some respondents reported not being able to eat as well as disruptions to children's schooling due to financial losses as a result of the Waheen fire.

In response, CSOs are trying to build economic options and promote self-help groups, which should be taken into account when planning holistic fire risk reduction strategies.

3.4.1 Insurance

Traditionally and historically, Somalilanders have relied on one another for assistance in times trouble or unexpected need, especially through clans. This system remains the primary means of meeting many needs.

One of the most effective means of guarding against economic losses is the institution of insurance. The Islamic culture of Somaliland places strict limits on how an insurance scheme may operate but it does not prevent the development of such institutions altogether. Mutual insurance schemes in which those contributing funds receive prescribed benefits in times of need and revenues accrued in excess of payments for losses and operating expenses are reinvested or distributed for the benefit of all members, comply with Sharia Law. Similarly, Sharia Law imposes limits on lending practices to prevent economic exploitation. As such, it seems consistent with these principles to exercise due diligence in certain situations to provide lenders with assurances that the resources expended can and will be recovered over the period of the transaction. Insurance and lending conditions that require compliance with certain building safety practices can play important roles in facilitating commerce by providing a mechanism for ensuring confidence. In other countries, lenders routinely condition construction and mortgage financing on third-party verification that funds are employed in a fashion consistent with the intent of the loan and in a manner that ensures return on the investment.

Recommendations to Address Economic Vulnerabilities

1. Inclusive economic recovery planning should be integrated into holistic fire risk reduction strategies. This should take into account the full range of traders including the majority who are on low incomes. It is suggested that this is done in collaboration with local CSOs already working on building economic options and mutual aid.
2. Formalize relief fundraising mechanisms to engage the diaspora, private sector, and clan systems quickly after the next fire.
3. Advocate for gender inclusive banking access and business support.
4. Encourage development of financial risk management and risk transfer mechanisms, i.e., insurance, due diligence, and lending conditions.

4 Fire Risks in Hargeisa Marketplaces

This section provides a technical overview of fire risks and how they manifest in marketplaces. It supports the reader in understanding the rationale for technical recommendations made in Section 5, many of which target specific aspects of fire risk.

The ‘fire life cycle’ is presented through the following subsections as: Ignition, Early Fire Growth, Fully Developed Fires, Fire Spread, and Containment and Extinguishment.

4.1 Ignition

Combustion is a chemical reaction that takes place when a substance rapidly reacts with oxygen, releasing light and heat in the process. For the combustion process to occur, fuel, oxygen and heat need to be present. Without any one of these components, combustion cannot occur. These three components are known as the combustion or fire triangle; see Figure 19.

Figure 19: Combustion triangle [2]

Ignition is the first sign of combustion, and it can either be spontaneous or piloted (presence of flame or spark).[6] As shown in Section 3.2, marketplaces in Hargeisa are built of combustible materials and contain many consumer goods which are combustible, such as timber, plastics, textiles, and foams. These materials can easily be ignited if heated in the presence of a piloted ignition source. Various piloted sources are currently present in Hargeisa are discussed below. The presence of a piloted source increases the ignition risk significantly because it (a) lowers the surface temperature required for ignition of the combustible material to take place, and in some cases (b) it is also provides the heat source, e.g., candle flame.

If a solid (e.g., timber, foam, plastics, etc.) is heated to a specific temperature, it converts into a gas. This flammable gas is what actually burns – not the solid material. Similar to LPG gas, if there is a spark present, the gases from the timber will ignite. Marketplaces in Hargeisa have numerous open flames and opportunities for sparks, and so the likelihood of ignition is high.

An ignition hazard is the initial heat source that causes a fire to start. Increasing the fuel load, or changing the type of fuel, can increase or decrease the likelihood of ignition from a heat source. For example, if a candle is pushed over in an open space with no combustible materials surrounding it, further fire growth is highly unlikely to occur. However, if a candle is pushed over in an enclosure full of combustible materials, the

[6] Spontaneous ignition is a phenomenon that take place once a material's surface reaches a certain temperature, causing the material to ignite spontaneously, without the presence of a flame or spark. For spontaneously ignition, the surface temperature of a solid material should typically exceed 500°C. However, once a flame or spark (i.e., a piloted source, such as a candle or open flames) is present, some solid materials can ignite at a surface temperature of 250°C (i.e., half the temperature required for spontaneous ignition). Hence, A combustible material ignites when it is heated to its ignition temperature. For some materials, such as plastics, foams and synthetics, this ignition temperature is lower compared to other denser materials such as wood. However, there are other material properties that also influences the time to ignition.

likelihood that the candle will ignite combustible materials is significantly greater, and further fire growth is likely to occur.

Ignition risks tend to be correlated with energy access and the ways energy is used. Energy poverty, inadequate access to energy infrastructure and reliance on unsafe and potentially hazardous forms of energy for daily activities such as cooking and lighting, significantly increases fire risks.

Additionally, higher temperature and drought can also increase the probability of ignition since during dry hot days materials retain less moisture and are ‘preheated’ to some extent.

Cooking and Lighting

Open flames are common in marketplaces in Hargeisa and are often used for cooking (e.g., gas stove, three stone fires, etc.) or lighting (e.g., candles). The presence of open flames is a significant ignition hazard since open flames present a heat source that can easily interact with combustible materials, bringing all three elements of the combustion triangle together, leading to unwanted ignition.

The use of charcoal braziers to pasteurize milk was observed during the site visit to Gobanimo Market. The Minister of Environment and Climate Change reported that charcoal remains the primary heat source used by households for cooking. Liquefied Petroleum Gas (LPG) is available and is becoming a more common fuel source, gradually displacing charcoal for household use.

Currently, all LPG supplies are imported and dependent upon private sector investment. The Director General of the Somaliland National Fire Service reported that LPG fires are not a significant cause of household fires compared to other unintentional causes at this time. No observations were made about LPG usage in the market, but it is likely that LPG is being used in markets for cooking if it is becoming more common in households. The Director General of the Somaliland National Fire Service noted that users often close the valve on their gas cooker to turn off the flame, but don’t close the valve on the LPG tank, which allows gas leaks to occur. Storage of LPG containers in confined or enclosed spaces increases ignition, fire spread, and explosion risks. Leaking containers or pipes will lead to the dispersion of gas, that can rapidly fill an enclosure and instantly ignite if in contact with a flame or a spark. Additionally, LPG containers can explode if heated, putting first responders at risk, and contributing to rapid spread between shops. Internationally, building codes tend to have specific requirements on maximum sizes of LPG containers allowed inside an enclosure, minimum distances from openings (such that leaking gas cannot enter buildings), drains, electrical points (which could cause sparks), and more, because LPG containers can present a significant fire risk.

Energy infrastructure and usage

Electrical fires are one of the most common causes of fires globally. Many of those interviewed in Somaliland indicated that electrical hazards were common. Interviewees noted that four electrical utilities supply electrical power in Somaliland which represent the consolidated assets of some 40 companies that at one time or another had operations in the country. Each of the four electrical utilities operates its own generation, transmission, and distribution infrastructure, which are all supported by private investment and revenue from rates regulated by the government. Most of the power produced in the country comes from diesel generators. The rising cost of petroleum due to supply chain disruptions, especially since the Ukraine War, represent a significant burden on electricity producers.

Several interviewees, including the National Fire Service, indicated that electrical short circuits and overheating were common causes of fires. Interviewees indicated that the electrical services in buildings are poorly regulated. It appears that utilities are connected to buildings by the owner of the building and then connections are provided (and charged by owners/landlords) to individual shops, likely through informal connections. It is posited utility providers do not pay close attention to these informal connections because they are downstream of the meter and there is a clearly identified customer paying for the electricity.

These connections are often of questionable quality. In Gobanimo market informal electrical connections were observed, comprising exposed wiring (reportedly imported and low quality). These connections can increase the probability of overloading a circuit and short-circuiting, generating heat and thus increasing the probability of ignition if in the presence of combustible materials. Figure 11 is an image from Gobanimo market showing some informal electrical connections, which could easily generate significant heat and sparks. Highly combustible materials (mattresses) are located directly below the electrical connections that if ignited, would be a significant fuel load to support fire spread.

Arson

interviewees indicated that intentional fires do occur in Somaliland but did not indicate that this was a significant or frequent cause of destructive fires. No suspicions of arson were cited by interviewees as a cause of the Waheen marketplace fire .

Batteries

While there were no direct observations of battery powered devices for sale at Gobanimo market, it is likely that marketplaces in Hargeisa do sell battery powered devices. Batteries have stored energy inside, and if they are damaged, that energy can be released in the form of heat, potentially causing a fire. Therefore, the potential risk of batteries

causing a fire should be considered, especially lithium-ion batteries which can release even more energy than other types of batteries in consumer goods.

Other ignition sources

The areas outside the Gobanimo market and adjacent to trading areas was occupied by maintenance and repair shops for heavy goods vehicles, which involve the use of cutting or welding equipment. It is likely that these types of activities involve flammable liquids, such as oil and petrol, which ignite at much lower temperatures compared to other combustibles and are thus a larger ignition risk. They can also significantly contribute to fire spread. Safe storage and use of flammable liquids is an important aspect of fire safety.

4.2 Early Fire Growth

Once a combustible material has been ignited (hence, prevention failed) and combustion is sustained, the fire can grow if there are sufficient combustible materials and oxygen available. This is known as the growth stage. There are three modes of fire spread or heat transfer between combustibles during this early stage, namely radiation, convection, and conduction, as depicted in Figure 20.

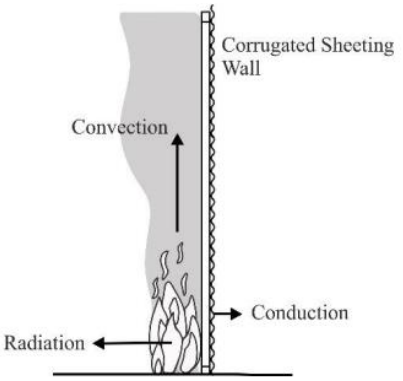


Figure 20: Modes of heat transfer [2]

- **Radiation** refers to the transfer of heat through electromagnetic waves, which can pass through transparent liquids, solids or through a vacuum. Radiation is typically the main heat transfer mechanism from a flame to the surface of a combustible.
- **Convection** refers to heat transfer with the flow of fluids (gas or liquid) and has a significant effect on the transport of hot gases to ceiling level in an enclosure.
- **Conduction** refers to heat transfer through a solid material. Heat transfer through a solid will always be from the surface with the higher temperature, to the surface with a lower temperature.

Typically, during the early stages of fire growth, the fire is fuel controlled [7], implying that there is sufficient oxygen supply for complete combustion to occur. During the growth stage, hot combustion gases are released. Since these gases are hotter than the surrounding environment, and thus less dense, they rise due to buoyancy. In other words, smoke rises.

[7] Fuel-controlled fires have sufficient oxygen to sustain or grow, therefore the fuel and its arrangement dictates fire behavior. This contrasts with ventilation-controlled fires, which do not have sufficient oxygen to sustain or grow, meaning combustion is incomplete.

Fires in enclosed spaces (e.g., in a room) behave differently from fires in large open spaces, or outdoors. This section and subsequent sections discuss fire growth and spread through the lens of these generalized scenarios for marketplaces in Hargeisa.

4.2.1 Outdoor Environments

For a scenario where ignition is taking place outdoors, hot gases (i.e., smoke) will rise and disperse through the environment, influenced by environmental conditions. Wind can have a significant effect on smoke generation and dispersion, as well as fire growth and spread (see Section 4.4.1).

Early fire growth is mainly a result of heat radiating from flames to adjacent combustibles nearby and fire spread along combustible materials. Outdoor fires tend to be fuel controlled throughout their life cycle. Refer to Section 4.5 for information on fire spread between market stalls.

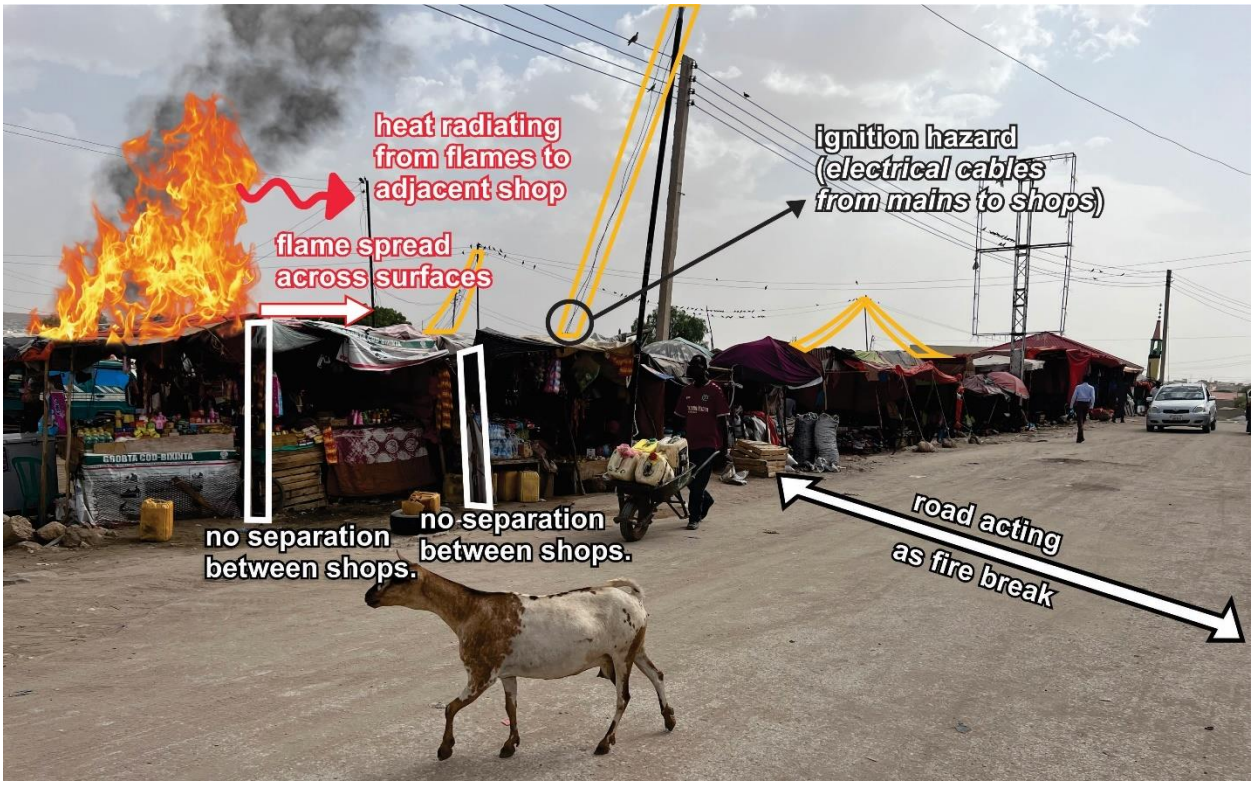


Figure 21: Mock-up of fire scenario for outdoor market stalls

4.2.2 Enclosed Spaces

In contrast to outdoor fires, hot gases that are produced from fires inside enclosures (large or small) rise to the ceiling/roof and accumulate, creating a smoke layer, or hot layer. As

the combustion of fuel continues to take place, more hot gases will be produced and rise. Flames will also radiate heat towards nearby combustible materials and the hot layer becomes a source of radiative heat transfer to combustibles below, as depicted in Figure 22. This allows combustible materials to 'preheat' and ignite easily from the burning materials. In enclosures, the hot gas layer can expose occupants trying to escape from the fire to smoke and high temperatures, which can lead to incapacitation, especially where fires may spread quickly, and detection, alarm, and egress systems are insufficient.

The radiation from the hot layer can become significant enough to ignite combustibles at floor level, but flashover[8] will not occur in a large compartment like the larger structures containing multiple shops observed in Gobanimo market.

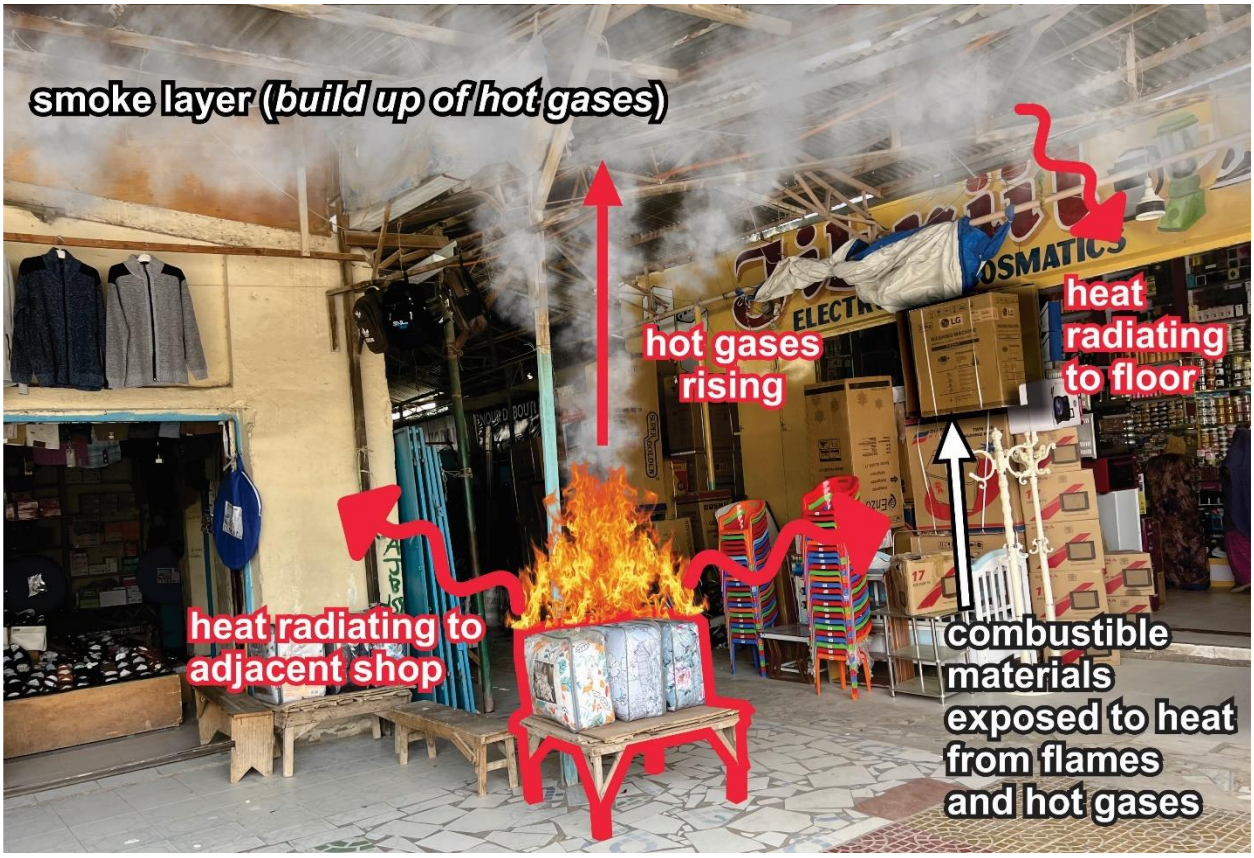


Figure 22: Mock-up of fire scenario in larger structure covering multiple shops

Fires in smaller enclosures can progress to flashover if there is sufficient fuel and ventilation (e.g., via openings). Once an enclosure experiences flashover, firefighters cannot enter the shop and victims inside the enclosure cannot survive, as the heat is beyond living conditions.

[8] Flashover is when all combustible materials in the enclosure ignite nearly simultaneously. Flashover typically occurs when the hot gas layer temperature of between 500-600°C.

The fuel load in marketplaces include combustible commodities stored in marketplaces as well as construction materials. The use of combustible construction materials such as timber framing, external insulation materials, roofing materials, and interior wall coverings was observed in Hargeisa. The use of plastic and textile lining materials was commonly observed in Gobanimo market which can contribute to fire growth and fire spread. Additionally, it is important to highlight that the use of combustible cladding materials (metal composite materials denoted as MCMs and aluminum composite panels denoted as ACPs[9]) was observed on the exterior of buildings along the perimeter of Waheen Market (Figure 17).

It was also observed that many marketplace buildings consist of masonry or concrete construction. While these non-combustible materials will not contribute fuel to a fire and may have some fire resisting qualities, they won't prevent fire spread from one room to another or vertically between floors. Sufficient containment[10] can only be achieved with fire resisting construction that acts as a system. For example, Figure 9 shows a shop in Waheen market with masonry walls which on their own have some fire resisting qualities. But there are significant gaps in the construction where the walls meet the roof which would allow hot gases and fire to spread to the next shop. The timber roof structure also creates a bridge of combustible materials between shops. So, while the wall construction may not contribute to the fuel load on its own, it also will not prevent fire spread.

Limiting the combustibility of building materials prevents them from contributing fuel to a fire involving building contents. Non-combustible building materials also resist ignition from heat sources such as electrical wiring and connections often attached to structural element of concealed in wall or ceiling cavities.

4.3 Fully Developed Enclosure Fires

After flashover, a small enclosure, such as a marketplace shop, typically enters a fully developed fire stage. During this stage the heat release rate (i.e., the amount of energy, in the form of heat, released during combustion of an object) and temperatures are at its highest for the single enclosure. Once an enclosure enters the fully developed stage, the fire typically becomes ventilation controlled, meaning there is insufficient oxygen entering the shop (through openings) for complete combustion to occur. Hence, some unburnt gases start to accumulate within the shop and may start to escape through openings such

[9] ACPs have grabbed the world's attention in recent years for their contributions to catastrophic fires such as the Grenfell Tower Fire in London, UK that caused 72 deaths and numerous high-rise building fires in the Middle East and Asia, and weaknesses in building regulatory systems around the world in regulating the use of these materials.

[10] Containment refers to systems to limit fire and all its consequences to as small an area as possible

as windows and doors. They ignite once in contact with oxygen, resulting in flames emerging from openings.

Figure 23: Mock Up of Fully Developed Enclosure Fire Scenario

Full-scale fire experiments have shown that internal lining materials such as cardboard or timber can significantly decrease the time to flashover in enclosures. For example, in the experiment shown in Figure 24, flashover occurred 12 seconds after the ignition of the cardboard. Flame spread occurred rapidly over the vertically lined cardboard and released substantial heat, allowing the hot layer to reach the temperature required for flashover within seconds. Such a rapid onset to flashover is extremely dangerous, since even for small shops, 12 seconds are not enough time to evacuate.

Figure 24: Timber plank wall and corrugated steel sheet roof shelter experiment conducted by the University of Stellenbosch [12]

Not all small enclosures will reach flashover, however. This can be best explained through an example comparing fire experiments of an enclosure built with non-combustible (corrugated steel) walls and roof (Figure 25) to an enclosure with combustible (plastic sheeting) walls and roof (Figure 26). The enclosure with non-combustible walls experienced very similar fire behavior as discussed above, i.e., ignition, rapid growth, and flashover, which was instantly followed by flames ejecting from the openings. In contrast, the plastic sheeting roof in the other experiment melted soon after ignition, allowing hot gases to escape and a relatively symmetric fire plume to develop. This plastic sheeting enclosure did not experience flashover and thus no flames ejected from the openings, decreasing the risk of lateral fire spread between structures.

Figure 25: Non-combustible enclosure tested by Stellenbosch University [26]

Figure 26: Combustible enclosure tested in Bangladesh [27]

Recommendations: Limit fuel load

1. Use non-combustible building materials, or limit their combustibility
2. Adopt import controls to restrict entry of products and materials that may present fire hazards, e.g., electrical goods, combustible building materials
3. Minimize storage of goods on site, e.g., by providing access to off-site storage facilities
4. Adopt regulations to control the use of combustible cladding, e.g., ACP and MCM
5. Fire safety conscientious upgrades of shops, e.g., use of non-combustible internal lining materials

4.4 Fire Spread to Adjacent Shops and Combustibles

Thermal radiation (transfer of heat through electromagnetic waves) and direct flame impingement are the most important factors contributing to fire spread.

4.4.1 Outdoor Environments

A fire in an outdoor market stalls made with combustible materials, such as plastic sheeting, like those shown in Figure 21, will behave similarly to the combustible enclosure discussed in Section 4.3. The plastic exterior will melt quickly after fire ignition, allowing hot gases to escape and a relatively symmetric fire plume to develop. This means the fire will not behave like an enclosure fire and will not eject flames from the openings. Instead, this fire would behave like an outdoor fire. Flames would spread across combustible materials and heat would transfer between materials and shops via radiation.

The amount and type of fuel (combustible materials) inside the shops therefore becomes extremely important, as they will significantly affect the heat release rate (HRR) of the fire. The heat release rate refers to the amount of energy, in the form of heat, released during the combustion of an object. In other words, the characteristic that describes how ‘big is the fire?’ is the heat release rate. According to Babrauskas and Peacock [1] the HRR is “the single most important variable in fire hazard”. Since the HRR directly influences the intensity of the fire, it controls the radiative heat transferred to adjacent materials or shops. Referring to photos taken during the site visits to the Gobinimo market

(see Section 3.2), it is possible to highlight materials[11] with high heat release rates which will promote rapid fire spread, such as mattresses (foam materials), synthetic materials, hydrocarbons, plastic materials, paper, and cardboard.

The shorter the distances between combustible materials, the more likely it is that fire will spread between them via radiation. Many shops observed had no separation between stored materials and limited aisle widths implying that all stored materials could become involved in a potential fire, and therefore contribute to the total fire load.

Wind forces can result in flames tilting in the direction of combustible materials, increasing radiation due to the shortened separation distance between the hazard (the flame) and the target (the combustibles) and thus exponentially decreasing the time to ignition (and the fire spread risk). Wind can increase the probability of flame impingement between the source and target shelter or shop.

Furthermore, it is important to note here that flame spread vertically (known as concurrent flame spread) is significantly faster than flame spread horizontally (known as opposed flame spread) [2]. Thus, stacking combustible materials vertically significantly increases the fire growth rate, which was observed throughout Gobanimo market and the shops still operating around the perimeter of Waheen market.

4.4.2 Enclosures

In this scenario depicted in figure 23 the shop on the left experienced flashover and is in a ventilated-controlled fully developed fire stage, with flames ejecting from the shop front. The time to ignition of an adjacent shop exposed to the burning shop is a function of a) the heat it receives and b) the material that is receiving the heat.

Radiative heat transfer from the fire inside the shop and the flames ejecting outside the shop radiate to the surrounding environment. In addition to the heat radiating from the shop, the hot gases will accumulate at ceiling level in the market building, and heat will radiate downwards pre-heating combustible materials. For closely spaced shops, flames ejecting from openings may impinge directly on neighboring shops causing rapid fire spread.

The heat received is a function of the heat emitted by the burning shop, and the separation between the burning and the adjacent shop. The closer the burning shop is to the adjacent shop, the greater the radiant heat transfer from the heat source to the target. Decreasing the separation distance by a factor of two, would increase the radiant heat transfer by a factor of four. Ultimately, heating up the target material four times faster. Thus, the time to ignition of the adjacent shop (target material) exposed to the burning shop (the fire

[11] In general, commodities for sale in marketplaces are diverse and include imported consumer goods, which do not appear to comply with any international or local quality control standards.

hazard) is approximately exponentially proportional to the separation distance between the target and burning shop.

The materials that are receiving heat via radiation – e.g., the combustible items (e.g., carpets) in front of the shop on the right and the materials inside that shop in Figure 23 – ignite when heated to their ignition temperatures. For materials, such as plastics, foams and synthetics, the ignition temperatures are lower compared to other denser materials such as wood. The larger the area of the combustible material that is exposed to/receiving heat, the greater the likelihood of ignition.

Once a fire spreads beyond the shop of origin (containment to a single shop has thus failed), fire spread to the next shop or objects will start to occur more rapidly as more combustibles become involve in the fire. The more shops/objects on fire the more heat is transferred to other structures and objects. In other words, as more shops become involved in the fire (i.e., increased fuel load involved), the fire hazard exposure to neighboring unburned shops increases significantly, increasing the risk of fire spread.

Throughout the market, incremental construction is evident, where a structure of lightweight timber is built with corrugated metal sheet roofing to extend the shop onto the street. This is one example of how public areas may be encroached on by evolving marketplaces, connecting markets adjacent to each other, and reducing the distances between markets across aisles or roads, thus contributing to the risk of fire spread. Interviewees also indicated an area meant for one shop may be subdivided into many mini shops, which could significantly increase the diversity of the fuel loads and their proximity to each other, thus promoting fire spread.

In combination with firefighting efforts and the wide streets between Waheen market and other areas, the non-combustible construction of some of the commercial buildings bordering Waheen Market appeared to help prevent the spread of fire beyond the market area.

4.5 Structural Performance

It should be noted that structural failure occurs when the stress in a structural member[12] exceeds the material strength. Some considerations for structures exposed to elevated temperatures include:

- Internal forces and deformations may be induced by differential thermal expansion, i.e., structural elements heat up faster on one face compared to the others (e.g., a structural beam heated from the bottom)

[12] Load-bearing components of a structure

- Interactions with the surrounding structure occur as members try to expand, e.g., a beam trying to expand might be restrained by columns, hence forces will then be induced in the columns.
- The strength of materials may be reduced by elevated temperatures, e.g., materials such as steel and concrete lose their strengths at elevated temperatures. For simplified fire design, concrete is typically assumed to have zero strength at 500 degrees C. and hot-rolled steel typically loses half of its yield capacity at 500 degrees C
- Cross-sectional areas may be reduced by charring (timber) or spalling (concrete).
- During a fire, large deflections are expected. However, deflections are not important unless they affect strength.

The above factors may be different for different materials. For example, failure of a simply supported steel beam will occur when the reduction in yield strength of the material drops so low that it is less than the actual stress in the member at the time of the fire. However, in contrast, failure of a simply supported timber beam will occur when, when the increase in stresses increase due to loss of cross section by charring exceeds the material strength. Different to steel, the material strength only decreases slightly due to elevated temperatures within the beam.

Structural stability is important for life safety. Depending on the size of a building, the occupancy type and number of occupants, a structure needs to resist the expected fire hazard of 30 minutes, 1 hour, 2 hours or even up to 4 hours (e.g., hospitals). This is to allow all occupants to escape, allow time for firefighters to get to the scene and then have time for firefighters to enter the building to rescue possible victims. Hence, critical members should a) be designed to resist the expected fire hazard for the required time, b) have passive protection (e.g., fire rated boards) that provides the resistance required, or c) have sufficient redundancy that failure of one zone or region does not result in total collapse.

Recommendation: Structural Performance in Fire

Structural stability is important for life safety. Depending on the size of a building, the occupancy type and number of occupants, a structure needs to resist the expected fire hazard of 30 minutes, 1 hour, 2 hours or even up to 4 hours (e.g., hospitals). This is to allow all occupants to escape, allow time for firefighters to get to the scene and then have time for firefighters to enter the building to rescue possible victims. Hence, critical members should a) be designed to resist the expected fire hazard for the required time, b) have passive protection (e.g., fire rated boards) that provides the resistance required, or c) have sufficient redundancy that failure of one zone or region does not result in total collapse.

5 Fire Safety in Hargeisa Marketplaces

Fire safety can be considered as *"the set of practices to prevent or avert occurrence of fire and manage growth and effects of accidental or intentional fires while keeping resulting losses to an acceptable level."* (p.2) [13]

In this section, observations relating to existing fire safety systems in Hargeisa are discussed and recommendations are provided to further reduce fire risks in marketplaces. These recommendations include measures related to the following fire safety principles [14]:

- **Prevention** – Safeguarding against the outbreak of fire
- **Detection and Communication** – Investigating and discovering of fire followed by informing occupants and the fire service
- **Occupant Protection** – Facilitating occupant avoidance of and escape from the effects of fire
- **Containment** – Limiting of fire and all of its consequences to as small an area as possible
- **Extinguishment** – Suppressing of fire and protecting of the surrounding environment

This section begins with an overview of why fire safety is a cross-cutting issue demanding institutionalization and the need for clear fire safety goals and objectives to determine what is safe enough.

5.1 A Cross-Cutting Issue Demanding Institutionalization

The complex nature of fire risk makes it difficult to address. There is no one solution or intervention that can be implemented to achieve fire safety. It is a shared risk requiring multiple responses at different levels. There is a role for policy interventions, organizational interventions, infrastructure investments, investments in buildings, financial interventions, community-based interventions, and more.

The fire safety ecosystem in Hargeisa is weak, characterized by the absence of regulations, unclear roles and responsibilities, unreliable water and road infrastructure, limited fire response equipment, limited community engagement, and a general lack of oversight, governance, communication, and coordination between relevant actors. Efforts to improve fire safety are largely limited to ad hoc responses during actual fire incidents,

rather than proactive strategies to prevent or prepare for fires[13], or to mitigate risks. The establishment of the Somaliland Fire Service eight years ago is an exception to this finding, however, and it is an acknowledgement of the importance fire safety plays in development. Furthermore, all interviewees agreed the Waheen Market fire was a wake-up call that represents how significantly fire can undermine progress in Somaliland.

From Kindling's previous work [1], we have learned the importance of institutionalizing collaborative fire safety that takes into account and supports the important role that all actors play and helps the whole system bear accountability and responsibility. This approach considers the reality of contexts with high levels of informality where formal command-and-control fire safety systems[14] alone can be inappropriate and unachievable. The command-and-control approach minimizes the role of the public in protecting themselves from fire (before, during, and after an incident), which is not reflective of the reality, especially in areas where the public may be the only ones able to respond quickly.

Somaliland is currently developing building regulations and beginning the process of formalization of the built environment. In Hargeisa, this will take a significant amount of time and resources, and there will likely always be informal areas or aspects of the built environment. Therefore, adopting a hybrid approach to fire safety is recommended, which comprises engineered fire safety systems (e.g., building regulations, fire service responses) as well as ad hoc fire safety subsystems which emerge and adapt (e.g., community-based fire response teams, fire safety education in schools). [1]

Kindling advocates for a supporting and enabling approach that recognizes that communities and residents must be worked with to inform holistic fire safety solutions which navigate local barriers and leverage resources. Helping communities to strengthen their capacities to protect themselves from fire and fostering an enabling environment that supports and encourages the emergence of local fire safety practices may be the most achievable and scalable way to improve fire safety and fire resilience and should therefore complement more traditional institutional fire safety responses.

At a government level, the cross-cutting nature of fire demands diverse sectoral responsibilities. Fire risk cross cuts departments holding responsibility for urban development planning, water provision, energy, environmental resources, and hazards.

[13] An exception is the Somaliland Fire Service's efforts to provide fire safety training in schools and universities. They reportedly trained 381 people in 5 months prior to our visit to Hargeisa.

[14] *"Urban fire safety typically includes regulatory system development, implementation and enforcement, fire services response infrastructure and capacities, and public education (i.e., prescriptive education to the public). This top-down command and control approach to fire safety has contributed to safer outcomes in the US, UK, Australia, and many other high-income countries."* [4]

The Somaliland Fire Service is a key actor and relevant ministries in Somaliland could include:

- Ministry of Water Resource Development
- Ministry of Transport and Road Development
- Ministry of Public Works, Land and Housing
- Ministry of Planning and National Development
- Ministry of Health Development
- Ministry of Environment and Climate Change
- Ministry of Energy and Minerals
- Ministry of Employment, Social Affairs and Family
- Ministry of Information, National Guidance and Culture

Any future coordinated attempts to improve fire safety should include representatives from the relevant government departments in order to improve mainstreaming of fire safety.

5.2 What is safe enough?

Efforts to develop a building code suitable for Somaliland began prior to the Waheen Market fire. A committee facilitated by the Ministry of Public Works is composed of technical experts with broad experience in design and construction.

Although building codes provide technical guidance governing design and construction, they are fundamentally legal instruments grounded in social expectations and legitimized through political action and governmental oversight. As such, the process of developing building regulations must not only answer the questions “what” and “how,” but also “why,” “when,” “where,” and “how much.” At the most basic level, building regulations require tacit if not explicit agreement upon the level of tolerable risk to individuals and society. Individual risk can be expressed as the likelihood of experiencing a particular adverse outcome such as death or serious injury over a given period. Societal risk may be expressed as the aggregate number of people affected, loss experienced, or collateral effects experienced as the result of an incident. In many countries, the implicit individual risk tolerance is equated with common but unfortunate events such as being struck by a car crossing the street.

When considering where to focus attention on building safety, regulators and stakeholders should remain mindful of the power of existing institutions and arrangements, even informal ones, to satisfy societal expectations and manage individual risks. As such, they should focus their attention on problems where many if not most stakeholders agree existing arrangements are inadequate to ensure tolerable risk expectations. This suggests the new Waheen Market and other similar facilities designed to accommodate large numbers of visitors must be an early focus of building regulations.

The fire service director general also indicated he had drafted and was preparing to submit legislation to regulate fire safety in new and existing buildings. The Kindling team has not secured a copy of the draft regulations but was informed these regulations will include provisions governing the installation and maintenance of fire safety features such as portable fire extinguishers, fire hose reels, fire detection and alarm systems, emergency lighting, exit signs including pathway identification, means of egress and exits, and fire service access. It was not clear if the building regulations and fire safety regulations will be merged, linked, or independent, and the level of coordination and collaboration is unknown.

In the absence of a building code defining requirements for new construction, the scoping and application of the proposed fire safety regulations should consider the extent to which these requirements should apply to existing conditions.

Fire safety interventions should not only focus on disincentives but incentives as well. Disincentives usually take the form of penalties or punishments for failure to satisfy expectations. Incentives reward decisions and actions that promote intended or expected outcomes. Because building regulations are intended to represent only a floor and not a ceiling, care must be taken to craft regulations in a way that encourages those responsible for compliance to do more than the minimum when it comes to safety, health, and general welfare. This can be accomplished by linking lending, insurance, and tax compliance with the provision of safety measures in buildings.

Furthermore, the World Bank's 2015 report, *Building Regulation for Resilience,* emphasizes the importance of advisory services to promote compliance rather than relying solely on police enforcement, citing positive experiences from post-disaster reconstruction programs. This report advocates for institutionalization of a supportive, advisory approach coupled with a rigorous inspection regime. The advisory element focuses on increasing compliance with minimum safety standards in relation to specific building practices and local hazards, through strong communications aimed at building trust and confidence amongst stakeholders. [15]

In the absence of government regulation, the rebuilding of Waheen Market can become a prototype for such interventions. By establishing an ongoing stakeholder forum responsible for managing fire safety strategy within the rebuilding program, the market traders, city council, private building owners, government officials, fire services, and other key actors can develop and implement arrangements that facilitate safety outcomes in the absence of regulation. This approach has the advantage of focused application and capacity building. This could provide a forum for building a broader understanding within the community about what constitutes both a tolerable and manageable risk.

For this baseline fire safety assessment, not enough data exists on fire incidences in Hargeisa marketplaces to quantify or rank risks, but it is possible to consider potential fire

scenarios and fire safety interventions that could address identified fire risks. This approach has largely been adopted through Sections 4 and 5 and is aligned with the principles of performance-based fire engineering design, which is defined as *"an engineering approach to fire protection design based on (1) agreed upon fire safety goals and objectives, (2) deterministic and/or probabilistic analysis of fire scenarios, and (3) quantitative assessment of design alternatives against the fire safety goals and objectives using accepted engineering tools, methodologies, and performance criteria."*

Performance-based design is especially useful when there are no locally appropriate building codes and standards that address the unique risks of a setting, which is the case for marketplaces in Somaliland. Performance-based design is an approach which enables holistic assessment of fire risks and potential consequences through the development and analysis of fire scenarios. It enables development of a coordinated fire safety strategy which reduces risk to a tolerable level, aligned with agreed fire safety goals and objectives, which should be informed by society's safety expectations[15] among other stakeholders' expectations.

From Kindling's interviews with key actors in Hargeisa, it was clear that no fire safety goals, or objectives have been explicitly defined for marketplaces or the built environment more generally. Perhaps the most important recommendation from this report, therefore, is for a participatory process to be carried out to facilitate dialogue and debate among key actors (e.g., building owners or their representatives, regulatory authorities, insurance providers, fire officials, traders, customers) to define fire safety goals and objectives for marketplaces and the built environment in Somaliland. This should be designed to be an ongoing process so it can serve as a sustainable mechanism for fire safety development, especially for regulatory development. Fire safety goals and objectives for marketplaces should be aligned with society's safety expectations, which are dynamic in general, and certainly changing in Hargeisa as a result of the Waheen market fire.

Examples of fire safety goals include life safety[16], property protection, livelihood protection, business continuity, and environmental protection. Internationally, life safety is prioritized in building regulatory systems, although they often provide some benefit for property protection as well.

[15] It is important to note that society's safety expectations are rarely explicit. Building codes, for example, are influenced by past fire incidents, local resources, local practices, and more. Decision makers (e.g., designers, regulatory authorities) often interpret prescriptive requirements deemed to be acceptable (e.g., from codes and standards) against proposed alternative design options to determine if they provide an equivalent level of safety implied by the prescriptive requirements. Alternatively, performance-based design offers opportunities to develop a 'safety case' which demonstrates how explicit goals can be achieved.

[16] Life safety goals could include protection of occupants not intimate with the initial fire development and improvement of the survivability of occupants intimate with the initial fire development, for example.

Fire safety objectives should identify the items that are intended to be protected from fire and provide greater detail of tolerable levels of damage than the goals do (e.g., maximum allowable levels of injury, damage to property, damage to critical equipment, or length of loss of operations). Examples of fire safety objectives include occupant protection (e.g., a structure shall be designed, constructed, and maintained to protect occupants who are not intimate with the initial fire development for the time needed to evacuate, relocate, or defend in place), structural integrity, and systems effectiveness.

It is also recommended that performance-based design be used for the Waheen market reconstruction project, noting this approach takes more expertise to apply and review than prescriptive-based design, and therefore international assistance will likely be required (considering there is little or no fire engineering expertise in country). Note, the design should anticipate future changes to the market, based on likely incremental and possibly informal ad hoc development. It should establish clear boundary conditions to indicate if/when the fire strategy needs to be revised to reflect significant changes.

Recommendations: Fire Safety Strategy Development for Marketplaces

1. Forge clear understanding of roles and responsibilities amongst traders, landlords, customers with regards to fire safety in marketplaces, through regular coordination and communications between key actors.
2. Develop, implement, and maintain a fire safety strategy for the construction of new marketplaces. Consider future expansion and informal evolution of marketplaces.
3. Fire risk assessments and fire safety planning for temporary markets established by Hargeisa municipality and private sector.
4. Map existing marketplaces and document existing fire risks and fire safety systems. Develop, implement, and maintain a fire safety strategy. Consider future expansion and informal evolution of marketplaces.
5. Refer to international standards for guidance but make sure to contextualize guidance to account for local conditions.
6. Establish responsibilities and accountability mechanisms requiring building owners, contractors, and other stakeholders to review or develop fire strategies based on international good practice, until building regulations are launched.
7. Recognize and respect informal mechanisms that promote and ensure compliance with fire safety norms in the absence of regulation.
8. Develop public-private partnerships between Somaliland National Fire Service and key actors to implement and evaluate fire safety strategies in key sectors such as marketplaces.
9. Mainstream fire safety across other sectoral programs and interventions (e.g., health, WASH).
10. Promote a local culture of fire safety and community risk reduction through coordinated strategies that raise awareness and disseminate accurate and timely information through social media and trusted messengers, using gender responsive and socially inclusive methods to reach everyone.
11. Promote a culture of fire safety in wider society e.g., through schools, social media, social development interventions.
12. Promote a culture of learning and acting together rather than relying on expert led top-down information giving through public fire safety messaging and education programs within marketplaces.
13. Community risk reduction through coordinated strategies that raise awareness and disseminate accurate and timely information through social media and trusted messengers.

Recommendations: Building Regulations

1. Develop and implement building regulations which promote and support (even incentivize) compliance.
2. Develop, resource, and implement a building regulations advisory and enforcement strategy with clear roles and responsibilities for central government and municipal government.
3. Develop and share guidance for building owners, contractors, and other stakeholders on the new building regulatory environment and how they are expected to interact with it.
4. Identify and pilot innovative ways to fund fire mitigation efforts, e.g., micro-lending, grants, tax on market goods and services sold.

5.3 Fire Prevention

Fire prevention is a set of practices to safeguard against the outbreak of fire; it is an opportunity to stop a fire from ever occurring.

Fire prevention is accomplished by removing or reducing ignition sources and/or by separating ignition sources from combustible materials, thereby preventing the three elements of the combustion triangle (heat, fuel, oxygen) from coming together, and leading to unwanted ignition. This section should therefore be considered in conjunction with Section 4.1 which provides an overview of the types of ignition sources in Hargeisa marketplaces – e.g., open flames for cooking and lighting, energy infrastructure and usage (especially electricity).

Recommendations: Fire Prevention

1. Promote safe energy usage and storage, e.g., safe practices using cooking and lighting equipment. E.g., provide education to vulnerable groups using open flames and other risky energy sources to help them reduce risks in their environment.
2. Promote and stimulate a market for alternative energy sources and devices which reduce risk of ignition, e.g., local solar power generation for lighting as an alternative to informal electrical connections; stoves that self-extinguish if knocked over; electrical stoves to replace open flames; stoves with emergency shutoff valves. Programs that support groups vulnerable in accessing safer alternative would help to reduce the likelihood of fires affecting entire marketplaces while also reducing socio-economic vulnerabilities.
3. Develop and implement regulations governing/promoting identification, elimination, or control of fire hazards, e.g., ignition sources, fuels, and hazardous processes. Provide advisory support to traders to educate them on hazards and to promote compliance.
4. Store batteries away from combustible materials.

Electricity related fire prevention recommendations

5. Diversify electricity generation, transmission, and distribution capacity to reduce overloading, and ensure reliability and reduce interruptions that can lead people to employ more hazardous alternatives, e.g., open flames, solid fuel appliances.
6. Regulate electrical installations, assigning clear roles and responsibilities to utility providers, contractors, customers, and other relevant key actors.
7. While regulations are under development, provide guidelines for owners, installers, and building occupants on how to safely install electrical connections and how to identify issues.
8. Utility companies to upgrade safety of existing electrical infrastructure and installations.
9. Establish a program to upgrade electrical connections reported as unsafe (promoting compliance rather than punishing noncompliance). Promote public education messaging on how to identify and report unsafe electrical connections.
10. Promote the installation of arc fault protection.
11. Promote the use of high-quality electrical wiring and equipment.

5.4 Detection and Communication

If prevention has failed and a combustible material ignites, detection is the next barrier of defense. At this stage, it is critical the fire is discovered as early as possible. Since the main determinant of survival in fire is a victim's time to incapacitation, the faster occupants become aware of a fire, the faster they can react and take protective actions. Early detection can also enable the activation of active fire protection systems[17] and notification of third parties (e.g., security company, fire department) who can then support fire response through communications, evacuation support and/or firefighting.

Fire is generally detected in one of two ways: (1) occupants, passersby, or others notice (often ambiguous) environmental cues that a fire is occurring, which may be visual, audible, or odor-based, or (2) a device is activated which detects smoke, heat, or energy (visible or invisible light) emitted by the flames.

No automatic fire detection devices were observed in Hargeisa marketplaces, and therefore it is assumed that occupants and passersby are relied upon for fire detection. This is consistent with stories of the April 1st Waheen Market fire. There are several problems with relying on people to detect fires through environmental cues including:

- Fires that start out of sight or out of hours (e.g., when shop or market is closed) may go undetected for long periods of time, allowing the fire to grow, increasing danger to occupants and making it more difficult to control the fire, which is particularly relevant in marketplaces where the risk of fire spread between shops and across large areas is high, as illustrated by the Waheen Market fire.

- People may not be trained or equipped to notify other occupants and third parties as soon as they detect a fire to enable response actions to take place.

- Delays between detection and alarm – i.e., even if people are trained on how to respond to a fire, there will be time delays between a person noticing an environmental cue to investigating that cue, determining the appropriate response, and then notifying others.

Manual fire alarm boxes can help to mitigate the risks associated with delayed notification to occupants and third parties. With some training and awareness raising for traders and the public on the need to pull the alarm in the event of a fire, manual alarm boxes can quickly notify others of a fire and trigger the fire response procedure for a facility.

Providing automatic means of fire detection and alarm is the most reliable way to reduce the risk of a fire going unnoticed and enabling quick responses, if appropriately designed,

[17] Active fire protection systems rely on an action (manual or automatic) to take place in order to activate. Examples include smoke detectors, fire extinguishers, sprinkler systems, and smoke ventilation systems.

installed, and maintained. What is appropriate is a function of the local hazards (expected types of fires), safety culture, environment[18], and other factors.

According to NFPA[19] 72, National Fire Alarm and Signaling Code, the purpose of fire alarm and signaling systems is primarily to provide notification of alarm, supervisory, and trouble conditions; to alert the occupants; to summon aid; and to control emergency control functions.

These systems often employ a network of low-voltage wiring monitored for integrity and fault conditions and equipped with batteries or other emergency power supplies, which ensures reliable operation in the event of a power failure. Upon detection of a fire condition, these systems activate audible or visible warning signals installed throughout a building. These systems can also be connected to the fire service or other off-site monitoring locations to alert and mobilize firefighting resources. In some cases, fire detection and alarm systems are interconnected with other building features, to release doors separating compartments to limit fire spread or to activate fans to control smoke migration and protect evacuation routes, for example.

Communications include but are not limited to alarms. Signage for evacuation routes, radio communication systems, and voice guidance are just a few examples of other kinds of communication that may be utilized to achieve desired goals of alerting occupants and responders about a fire incident and providing additional information to inform responses.

[18] Frequent nuisance false alarms from dust, bugs, or smoke from cooking, for example, increases the likelihood that people ignore alarms during a real fire incident, or alter the devices (e.g., by removing batteries) to prevent false alarms, thereby undermining the detection and alarm strategy of the facility.
[19] NFPA is the National Fire Protection Association, a US-based standards development organization

Recommendations: Detection and Communication System

1. Design, install, and maintain systems to detect fire and alarm occupants, the fire services, and other key actors.
2. Install manual pull boxes throughout existing and new marketplaces.
3. Install hardwired, interconnected automatic detection and alarm systems throughout new marketplaces.
4. Install battery-powered automatic detection and alarm devices throughout existing marketplaces.
5. Refer to international standards, such as NFPA 72, for guidance on design and installation of detection and alarm systems, and make local adaptations as needed to account for environmental conditions (e.g., ambient temperatures).
6. In coordination with wider fire strategy development, establish a strategy and related procedures for what to do in the event of a fire emergency and provide communications support (e.g., signage, radio communication systems, voice guidance, posters with evacuation routes), documentation, training, and awareness raising for all relevant stakeholders based on their roles and responsibilities (e.g., traders, security guards).
7. Develop culturally appropriate evacuation messaging and communication mechanisms for use during emergencies that considers the full range of traders that use the market.

5.5 Occupant Protection

Occupant protection refers to facilitating occupants' avoidance of and safe escape from the effects of fire. Since, fire and smoke can be deadly and can affect the capabilities of occupants to escape, planning, implementing, and maintaining sufficient escape routes is critical.

Fire and smoke can be deadly and can affect the capabilities of occupants to safely escape and limit the ability of firefighters to respond offensively to fires (e.g., search and rescue, firefighting to achieve extinguishment). The main determinant of survival in fire is time to incapacitation. Once a person becomes incapacitated in a fire (due to exposure to heat exposure, carbon monoxide exposure, low levels of oxygen etc.), conditions can become fatal within seconds.

Fire hazards affecting escape capabilities typically occur in the following sequence:

1. Smoke obscuration reduces visibility.
2. Smoke starts to irritate respiratory tract and eyes causing a further reduction in vision, pain and the victim has trouble breathing.
3. Toxic combustion gases cause asphyxiation leading to loss of consciousness.
4. Severe skin and respiratory tract pain and burns due to exposure to heat.

With this in mind, the main determinant of occupant survival in fire is the evacuation time required by occupants for incapacitation not to occur. Occupant protection therefore includes measures that aim to either (1) reduce the time required for occupants to escape or (2) increase the time available for escape (by delaying when the effects of fire, heat, smoke, etc., impact evacuation).

In buildings, egress is typically considered complete when occupants exit the building to the outside. However, in an indoor/outdoor environment like Gobanimo Market, egress is not this simple. People may evacuate from one building and still be in the middle of the marketplace exposed to hazards. Egress systems therefore need to be considered at the market scale, not only in individual buildings within the market. This can complicate the design and management of marketplaces and needs to be considered, not only in terms of how spaces and physical fire safety systems connect, but also in terms of detection, communication, and fire response procedures, with emphasis on coordination.

Perhaps one of the most overlooked but most impactful ways to improve occupant protection is to maintain good housekeeping. Obstacles in egress paths can delay evacuation and if combustible, compromise the egress route by allowing fire to spread into it.

5.5.1 Reduce the time required for occupants to escape

To understand and ultimately reduce the time required for occupants to escape, human behavior in fire needs to be understood in the context of marketplaces in Hargeisa. A widely accepted timeline for human responses to building fire emergencies is shown in Figure 27, which broadly categorizes evacuation time as pre-evacuation period and movement period.

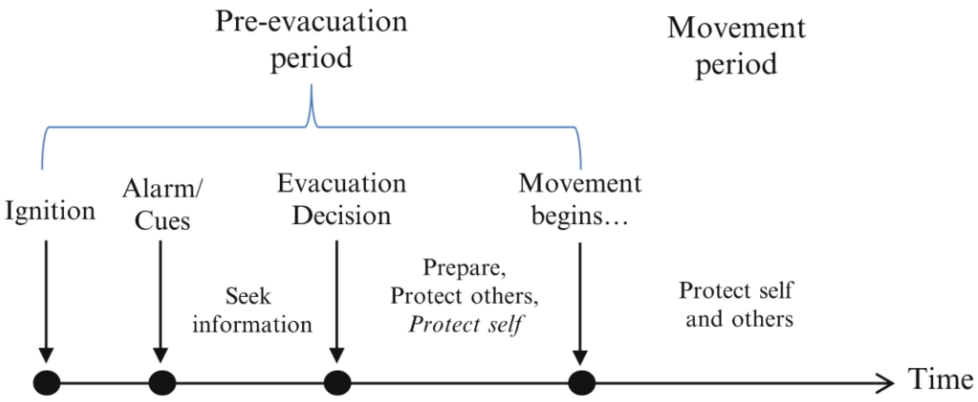


Figure 27: Timeline for human responses to building fire emergencies [14]

The pre-evacuation period is largely a function of detection and communication systems in place (or lack thereof) and the level of awareness and preparedness of occupants and other stakeholders (e.g., security guards) to make timely and appropriate decisions upon fire detection; refer to Section 5.4. The timeline in Figure 27 is simplified in that it separates the pre-evacuation period and movement period and does not account for situations where people may re-enter areas of danger to help others evacuate, retrieve belongings, fight the fire, or carry out other activities. It also does not account for people making the decision to not evacuate away from the danger area, noting that crowding was a problem during the Waheen Market fire as people stayed to watch and record the incident.

There is insufficient evidence on the actions people take during fire emergencies in Hargeisa marketplaces, which are dynamic indoor/outdoor places with complex interactions between people, the built environment, and fire. Therefore, it is not yet possible to apply definitive contemporary behavioral frameworks and theories to better understand decision making. Research that explores human behavior during fires in a Somaliland context, considering local culture and social norms in relation to fire could support fire safety improvements in marketplaces and contribute to fire safety development in Somaliland more generally.

Once occupants decide to evacuate, the movement period commences. Several approaches exist to assess egress performance, including the application of prescriptive codes, performance of an egress trial, the application of a (computer-based) simulation model, and the application of an engineering calculation. There are benefits and limitations to each approach, and *"…people's responses [to fire] are sensitive to the incident scenario, the information available, and the local conditions (among other things)…it relies on a number of factors that can interact and can influence the outcome in different ways"*; see Figure 28. [16] Therefore, *"…in reality, none of these approaches consider all factors that influence the outcome of an evacuation. It is vital to understand*

the limitations of these models in order to more reliably interpret and assess the results produced." [16]

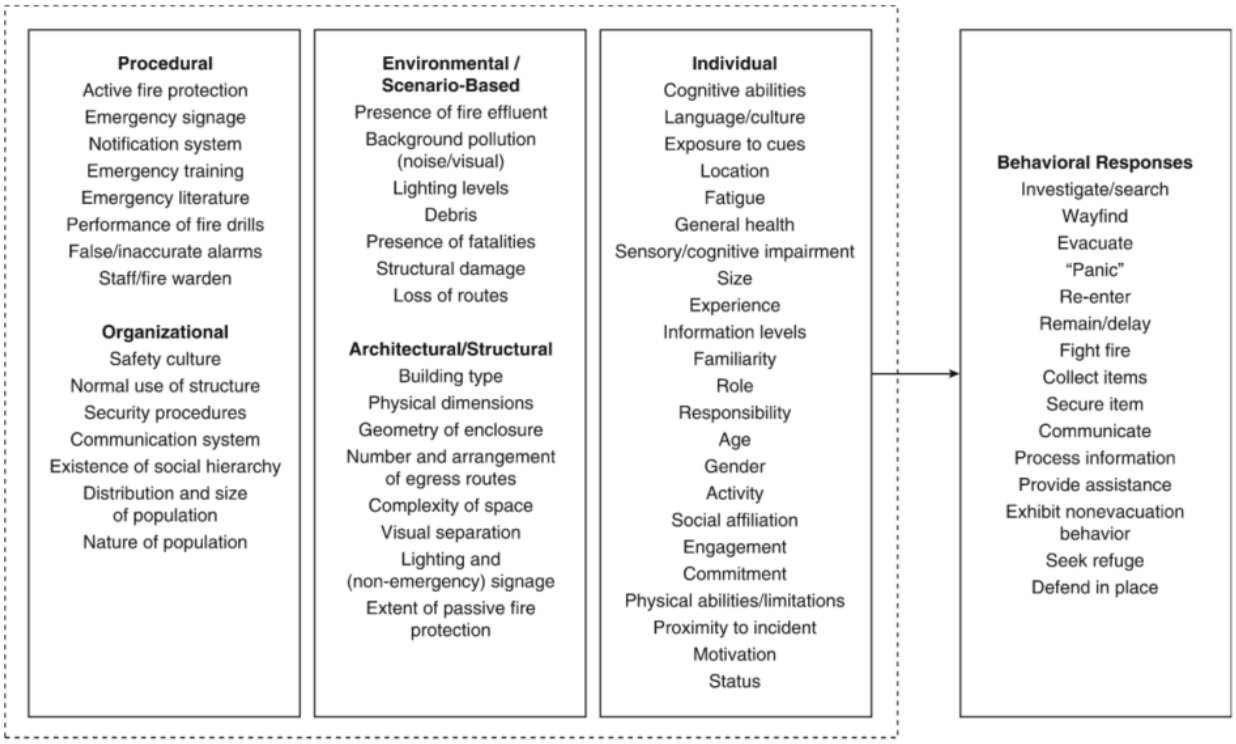


Figure 28: Factors that can influence egress performance [16]

Prescriptive code-based approaches to egress system design typically include the following types of requirements, among others:

- Minimum number of exits
- Minimum width and headroom along exit paths, providing sufficient capacity for anticipated occupant loads
- Specific dimensional limits and accessory requirements (e.g., handrails) for elements that traverse vertical elevations, such as stairways and ramps
- Exit and exit access configurations – e.g., maximum travel distances[20], dead ends[21], common paths of travel[22]
- Means of egress illumination

[20] NFPA defines 'travel distance' as *"maximum permitted distance that occupants are permitted to travel from their location in a building to the nearest exit"* [23]

[21] NFPA notes a *"**dead end** can exist in a path of travel where there is no direct access from an occupied space but can also exist where an occupant enters a corridor thinking there is an exit at the end and, finding none, is forced to retrace their path to reach a choice of exits"* [23]

[22] NFPA notes a *"common path of travel exists in the initial portion of the exit access where a space is arranged so that occupants within that space can travel in only one direction to reach any of the exits or to reach the point at which they have the choice of two paths of travel to two different remote exits."* [23]

- Accessible means of egress

Note, it is uncommon for accessibility requirements to provide equitable access to means of escape for persons requiring assistance to escape, such as persons with disabilities, children, or elderly persons. Additional considerations to protect and support egress of these vulnerable populations is needed to ensure fire safety for all.

Additionally, building fire safety codes and standards do not account for the potential complexities associated with indoor/outdoor spaces, such as marketplaces, and the need to coordinate the design, construction, and maintenance of egress systems beyond the building scale to protect occupants until they reach safety. Consistency and coordination through marketplaces in the egress system design and evacuation procedures are critically important.

5.5.2 Increase the time available for occupants to escape

There are several strategies used to delay or prevent the effects of fire, heat, smoke, etc., impacting evacuation, increasing the time available for escape, e.g.,

- Physical separation of egress routes from other areas via passive fire protection[23], e.g., stairway enclosure constructed of 2-hour fire barriers, smoke barriers along corridors, and active fire protection, e.g., automatic door closers, fire and smoke dampers
- Ventilation of egress pathways
- Ventilation or smoke control systems (e.g., in atriums) to keep smoke and heat away from occupants

[23] Stationary materials designed to help prevent the spread of fire or smoke; examples include fire barriers, fire and smoke doors, opening protection, and firestopping.

Recommendations: Occupant Protection

1. Research human behaviour during fires in the Somaliland context to support fire safety improvements in marketplaces and contribute to fire safety development in Somaliland more generally.

2. Design, install, and maintain a well-coordinated, protected (i.e., fire and/or smoke separated), and reasonably efficient (e.g., within agreed limits on dead ends, travel distances, and common paths of travel) egress system with multiple ways out to assembly points remote from the marketplace and sufficient capacity for large occupant loads expected in marketplaces.

3. Establish an occupant protection/evacuation strategy, including for persons who require assistance to escape (e.g., persons with disabilities, children, elderly).

4. Refer to international standards, such as NFPA 101 or IBC, for guidance on design of egress systems, but make sure to contextualize guidance to account for local conditions.

5. Utilize smoke ventilation to vent hot gases from enclosures and away from egress pathways.

6. Develop, coordinate, and implement marketplace fire management strategies in collaboration with market trader representatives/associations. Establish clear roles and responsibilities for evacuation management using fire wardens, evacuation planning exercises, fire drills, etc. Consider the use of a security company for fire evacuation management and coordination.

7. Require certain occupancies to hire and train staff to manage incipient fires and direct evacuations in the event of fire.

8. Support development and practice of personal emergency evacuation plans for persons requiring assistance to escape, e.g., persons with disabilities, children, older adults.

9. Maintain good housekeeping.

5.5.3 Medical Responses

Emergency medical response and treatment facilities were not fully interrogated; however, it was reported that those injured are taken privately or by the fire service to Hargeisa Group Hospital, which treats fire related injuries. Firefighters from the Somaliland Fire Service are receiving first aid training from the Somaliland Red Cross Society, but no advanced medical training is provided to firefighters. The lack of an ambulance service serviced by health workers, potentially increases health vulnerabilities

in the aftermath of a fire. The specific expertise and resources available at the Hargeisa Group Hospital to treat burn injuries is not known, but this is an important area of inquiry to address health vulnerabilities in relation to fire.

Recommendation: Treating Injuries

1. Continue providing first aid training to firefighters on a regular basis
2. Provide more advanced medical training to firefighters, such as Emergency Medical Technician training or Paramedic training
3. Establish ambulatory care and transport system for persons injured in a fire and other emergencies; provide training specific to initial response to burn injuries
4. Establish burn care units in existing healthcare facilities
5. Further research on burns injuries treatment facilities is needed to understand whether these can respond to severe burns. More research is required on knowledge levels amongst the general population on how to treat burns in the first instance. Results should be addressed in any fire safety education programming
6. Provide long-term health and psycho-social support for burn survivors

5.6 Containment

Containment refers to limiting fire and its consequences to as small an area as possible. Containment may be achieved through active fire protection systems, passive fire protection systems, or simply by separating combustible materials.

When developing a fire strategy, the tolerable loss (what is expected; refer to Section 5.2) and what is achievable should inform the approach to containment. For example, automatic fire sprinklers may enable a fire to be contained to its room of origin, passive fire protection may enable a fire to be contained to its compartment of origin, separation between buildings may enable a fire to be contained to its building of origin.

5.6.1 Active Fire Protection Systems

Automatic sprinklers are the most effective method of active fire control. These devices operate only when the temperature at the ceiling exceeds the threshold to activate the operating element. This releases water from a network of piping connected to a suitable water supply. Water applied to the fire and exposed materials from sprinklers will limit fire growth or spread and can cool hot gases. Only sprinklers exposed to high enough temperatures will operate, which also limits water damage. In most cases, fires in

sprinkler protected buildings are controlled by less than four operating sprinklers, which produces much less water damage than firefighting hoses. The area protected by four sprinklers is usually small enough to limit damage to such an extent that the building often sustains insufficient damage to prevent reoccupation or continued operation.

Automatic fire suppression systems that employ firefighting agents besides water are available. But they have limited utility and are often suitable for protecting discrete, high-hazard or high-value hazards, such as electronic or specialized industrial equipment.

But despite the superior performance of automatic sprinkler systems in protecting life and property from fire, the resources required to design, install, and maintain these systems are not readily available in Somaliland. Fire sprinkler system equipment (e.g., sprinklers, fire pumps) is not available in Somaliland and would need to be sourced internationally which can be expensive and require long lead times. One informant did discuss tax breaks for importation of fire safety equipment as a potential incentive to promote development of the fire safety industry in Somaliland, which is currently in its infancy. Additionally, there are limited (if any) local companies and professionals with the appropriate qualifications and experience to install and maintain automatic fire sprinkler systems.

However, the installation of automatic sprinklers or water mist fire extinguishing systems may be worth considering as the city continues to develop, especially as a means of limiting demands on scarce water supplies and limited firefighting capabilities due to traffic and road conditions. These systems may be more achievable as the water distribution infrastructure in Hargeisa develops, because without a reliable water supply, dedicated fire water tanks would be needed.

An effective water rights regime could be used to incentivize the installation of automatic sprinklers and water mist fire extinguishing systems. Such a regime would also help ensure the sustainability of this vital natural resource.

While it is not recommended to retrofit existing markets like Gobanimo market with automatic fire suppression systems because of practical limitations, these systems are an option to consider for new construction projects such as the new Waheen Marketplace.

5.6.2 Passive Fire Protection Systems

As noted in Section 5.5, passive fire protection systems contain stationary materials designed to help prevent the spread of fire or smoke; examples include fire barriers, fire and smoke doors, opening protection, and firestopping.

Compartmentation is an approach using passive fire protection to limit the size of a fire to a specific area, defined as a compartment. This approach is often relied upon in places where active fire protection systems are not achievable or sustainable and where there are clear expectations on the tolerable size of a fire or area of fire exposure, and/or where

evacuation strategies are used that include some people evacuating while others remain in the building (e.g., used to limit evacuations of hospitals).

In marketplaces in Hargeisa, passive fire protection systems should be considered to provide separation between shops indoors and outdoors.

5.6.3 Separation Distances

There is a direct relationship between separation distances (between combustible materials) and radiant heat transfer. Therefore, there is a relationship between separation distances and the likelihood of ignition via radiation, as well as the time to ignition; refer to Section 4.4. Separation distances via aisles, pedestrian pathways, roads, and open spaces all contribute to reducing the risk of fire spread and should be maximized.

In marketplaces in Hargeisa, however, space is a highly valuable and is rarely left unused. As discussed in Section 3.2, the Waheen Market was congested. Aisles within and between traders, roadways, and city streets were difficult to maintain, often filled with goods, shops, and stalls. This significantly contributed to the rapid fire spread in the April fire. One positive outcome of the fire, however, is that it did not spread beyond the city blocks containing Waheen Market. Wide streets around these blocks, combined with firefighting efforts, prevented the fire from continuing to spread. The non-combustible construction of some buildings around the perimeter of Waheen Market also appear to have contributed to its containment.

Hargeisa does not currently adopt or enforce land use or development regulations to control or restrict how boundaries between adjoining buildings are managed, lot coverage, site access, and other conditions. As such buildings on adjoining lots or land parcels may abut one another without effective fire separation. In the absence of building regulations requiring fire resistant construction, limiting openings, or requiring fire resistant opening protectives, fires in adjoining buildings may spread easily from one to another.

Recommendations: Containment

1. Recognize the importance of establishing roads and maintaining open space between buildings as a means of mitigating fire spread.
2. Design, install, and maintain systems to contain fire (e.g., active suppression, passive protection).
3. Separate fuel loads via construction systems and advocate for maintaining separation between fuel loads and maintenance of aisles and roads (e.g., through education of traders and allocation of alternative spaces for less congested trading).
4. Organize/separate market areas based on types of activities and anticipated fuel loads to minimize mixing of fuel types. Separate high hazard areas (e.g., electrical rooms, storage of flammable or combustible liquids) via passive fire protection.
5. If sufficient separation distances or compartmentation between individual shops is not possible, fire breaks or compartmentation should be provided over larger areas, acknowledging that the size of the clusters are a reflection of the expected loss

5.7 Extinguishment

Extinguishment refers to suppressing of fire and protecting the surrounding environment. It represents an opportunity to stop a fire and therefore limit its consequences. Extinguishment at an early stage of a fire may be simple and require very few resources, however as a fire grows, so do the complexities and resources required to extinguish it. For example, a cooking oil fire that starts inside a pan may be extinguished by placing a cover on top of the pot, cutting it fire off from its oxygen supply, thereby breaking the combustion triangle. The only resources needed to extinguish a fire at this stage are a cover and knowledge[24]. Alternatively, a fire that goes unnoticed in a locked shop for several minutes may be too large when discovered to be safely extinguished by those who discover it based on the resources, knowledge, and experience available to them.

5.7.1 Community-Based Firefighting

In the UK, people deal with 70 to 80 percent of fires in the home without ever calling the fire service. Yet their contribution to firefighting is rarely acknowledged or supported, and

[24] If the person cooking knows how to appropriately extinguish the fire, it is a simple reaction preventing a potentially large fire incident with catastrophic consequences. However, if the person cooking does not know how to appropriately deal with this kind of fire, then they may put water on the oil fire, causing a severe reaction that will spread oil and therefore fire, and potentially injure themselves.

the formal advice is ‘leave it to the professionals’. [17] On the other side of the spectrum, there are refugee camps with no fire service response to fires, where refugees are expected to fight (often quite large multi-dwelling) fires with just a fire extinguisher and no PPE.

In Hargeisa at the State House IDP camp, residents told us about fires that occurred just a few days before our visit. They told us how they organized ad hoc firefighting teams in response to fires in the camp. The first respondents to a fire usually demolish or remove exposed structures to prevent the fire from spreading. Once adjacent dwellings are knocked down, and more people arrive the groups organize themselves into bucket brigades consisting of two lines, one bringing filled buckets to the fire from a water source and the other returning empty buckets. This arrangement continues until the arrival of the fire service. Interviewees in the camp indicated these efforts often control if not extinguish fires before firefighters arrive.

Communities therefore have a role to play in firefighting, whether it is formally acknowledged and supported, or not. Engaging with communities to understand their past experiences with fire and strategies they have developed to respond to fire incidents is a critical step in understanding how fires are often dealt with, successfully and unsuccessfully. Community members are almost always first responders, especially in contexts like Hargeisa where fire services response may be delayed by late notification, traffic, poor road infrastructure and limited access to fire scenes.

Grappling with the reality that people often engage with fire during an incident, the focus shifts to how community members can be empowered with training, equipment, and other resources to safely fight fire.

Equipment could include PPE (e.g., fire resistant clothing, gloves), portable fire extinguishers, and hose reels. If community-based firefighting teams are established, more advanced equipment may be provided (e.g., small fire response vehicles), based on their capabilities and capacities to safely respond to fire.

Portable fire extinguishers are one of the most efficient and effective means of controlling small fires. But training is needed for occupants to use fire extinguishers to safely respond to small fires. In other contexts, it has been reported that fire extinguishers have been vandalized, stolen, and discharged but not immediately recharged or replaced. Fire extinguishers typically contain a firefighting agent, which may consist of water, foam/water solution, dry chemical powder, or a gaseous agent, such as carbon dioxide or a mixture of inert gases and hydroflourocarbons (HFCs) or hydrochlorofluorcarbons (HCFCs). Different firefighting agents are more or less effective in fighting specific types of fires involving different fuel sources.

Water-based portable fire extinguishers are effective in combatting fires involving most common combustibles but inappropriate for use on energized electrical equipment. Dry

chemical powder fire extinguishers may be safely and effectively used on all types of fires but the units themselves and the firefighting agent must be imported. Other types of fire extinguishers may be effective on flammable liquid or energized electrical equipment but perform poorly against fires involving ordinary fuels and have a higher price point than the other options. At present, the supply of this equipment in Somaliland is limited by the very small fire equipment service industry. The Kindling team observed portable fire extinguishers in a few public buildings. This equipment was not common in most locations we visited.

Some newer buildings Kindling visited were equipped with firefighting hose reels for occupant use. These hose reels are connected to a water supply and can be operated by people with limited training. However, their installation is often more costly than portable fire extinguishers and occupants with limited training may attempt to fight fires too large for them to control or withdraw too late when attempting to use these appliances, putting their lives in danger.

Most interviewees identified a need to ensure workplaces of a certain size and public gathering places had sufficient equipment available to fight incipient fires. However, these measures should be seen as a supplement to and not a replacement for training staff to initiate and guide the evacuation of building occupants in the event of fire and call the fire brigade. Similarly, the provision of incipient firefighting equipment does not reduce the need for a well-equipped and well-trained firefighting force. Once buildings are equipped with means of detecting fire, alerting occupants, facilitating evacuation, and providing incipient firefighting capabilities, building owners must take care to ensure they remain readily available, usable, and fit for purpose.

Some occupancies, like Waheen Market, are sufficiently large and complex that they may require additional arrangement beyond those available to or within the control of individual traders. The market and other large public venues may need to hire, and train dedicated staff to manage occupant safety. These personnel may have collateral duties but their main function must be ensuring the safety, health, and welfare of visitors.

The Somaliland Fire Service is primarily a fire response agency. But it recognizes the opportunity to lead fire safety development in Somaliland more generally.

By working with traders as a center of social networks, the fire service can reach many more people than possible through its efforts alone. Engaging and empowering traders in efforts to prepare and respond to hazards in the marketplace, they can create a web of influence that can extend well beyond the market itself. Such partnerships have proven effective in other countries where fire services work closely with employers and community-based organizations to develop targeted strategies and build capacity. This devolves ownership of the solutions to those closest to the problems while creating an empowered partnership for change.

Recommendations: Community-Based Firefighting

1. Design, install, and maintain equipment for incipient firefighting by trained occupants, e.g., hose reels, fire extinguishers.

2. Engage with communities to understand their experiences and strategies to respond to different types and sizes of fires.

3. Awareness raising and training on appropriate responses to small fires (e.g., small waste basket fire, cooking pan fire). Considering women's role with cooking, it is particularly important these programs include and are tailored towards women.

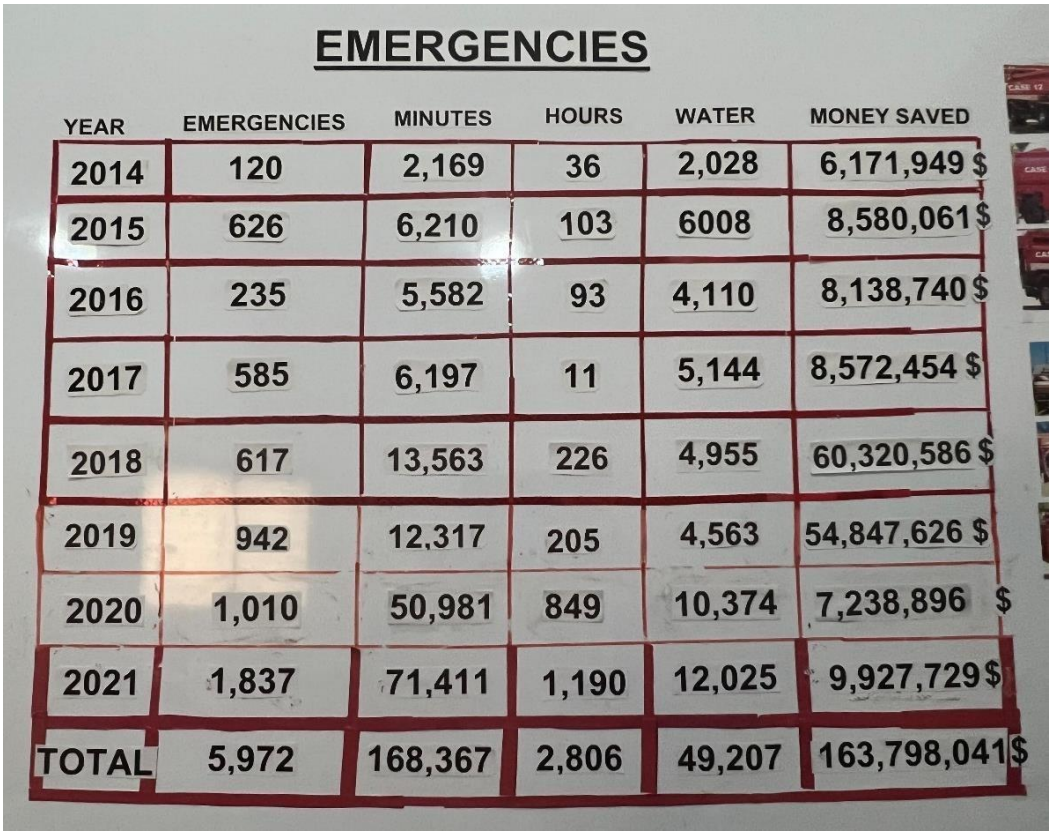
4. Encourage development of partnerships between Somaliland National Fire Service and community-based organizations to increase fire safety awareness.

5. Provide resources and appropriate training for responding to small fires – e.g., fire extinguishers, buckets of sand, pot covers, fire blankets

6. If there is interest and leadership within a community to establish a community-based firefighting team, then provide training, equipment, and support to enable their efficient and effective responses to fire in its early stages, before the fire services arrives. Provide coordination training to enable community-based firefighting teams to play a supportive role, if needed, to the fire services upon their arrival.

5.7.2 Somaliland Fire Service Response

The development of the Somaliland Fire Service represents a formal acknowledgement of the fire problem and need to address it in Somaliland. The fire service was established eight years ago in response to urban fires. In 2014, the fire brigade responded to 120 emergencies and in 2021, they responded to 1,837 emergencies, 15 times more incidents; see Figure 29. This increase in responses to emergencies, many of which are fire emergencies, is evidence of the increasing role of a fire brigade in Somaliland. There was insufficient time to review how fire incidence data is collected, stored, shared, etc., however, it is common for data management to be weak in Low- and Middle-Income Countries. Therefore, it is recommended that the data management system is reviewed in accordance with the principles outlined in the 2020 RICS report, *Developing a global standard for fire reporting.* [18]



EMERGENCIES

YEAR	EMERGENCIES	MINUTES	HOURS	WATER	MONEY SAVED
2014	120	2,169	36	2,028	6,171,949 $
2015	626	6,210	103	6008	8,580,061 $
2016	235	5,582	93	4,110	8,138,740 $
2017	585	6,197	11	5,144	8,572,454 $
2018	617	13,563	226	4,955	60,320,586 $
2019	942	12,317	205	4,563	54,847,626 $
2020	1,010	50,981	849	10,374	7,238,896 $
2021	1,837	71,411	1,190	12,025	9,927,729 $
TOTAL	5,972	168,367	2,806	49,207	163,798,041 $

Figure 29: Emergency response statistics from Somaliland National Fire Services

The fire brigade covers the entirety of Somaliland which has been split into 6 regions, with at least 2 fire response vehicles in each region. While some fire appliances were donated from Taiwan, the majority were purchased second hand from Dubai. The hose connections on the trucks are then modified by the fire brigade, who has a small shop for repairing and modifying vehicles.

Notification

The efficiency with which emergency calls are handled by emergency services should be coordinated to ensure any agency notified of an emergency that requires either another agency to respond or a coordinated response involving many agencies receives prompt and coordinated attention. Although a single three-digit reporting number has been established for fire emergencies (990), the police use a separate number (999) and neither agency has direct responsibility for handling medical emergencies. The fire service now handles many calls for emergencies other than fire, which often get reported first to police. Call handling protocols to ensure swift and coordinated reaction to these incidents is needed to ensure the right resources are mobilized and directed where required as quickly as possible. This may require the creation of a common call-answering point for all emergencies, which then has responsibility for engaging all response agencies to affect the necessary mobilization and coordination.

Wayfinding

The informal development and unregulated expansion of Hargeisa (with no address system) means most reports of emergencies rely on landmarks to identify location and facilitate wayfinding. The widespread adoption of and access to mobile phone services in Somaliland, facilitates more efficient and effective wayfinding without relying on conventional addressing of geolocation methodologies. What3Words is a smartphone app developed to assign three-word couplets to every 3-m^2 block on the surface of the globe. This system does not require a data connection to work and provides users with an efficient and effective way of communicating a very precise location to others without additional information or waypoints. For instance, the location within Waheen Market identified in Figure 30 is referenced as ///minds.order.initiates by What3Word; the Hargeisa fire brigade headquarters is located at ///bookcases.outlooks.firm. This location is also identified in many languages other than English depending on local settings in the app. Unfortunately, a Somali version of the app is not yet available. However, translations for Amharic, Arabic, Xhosa, Swahili, and Zulu are available.

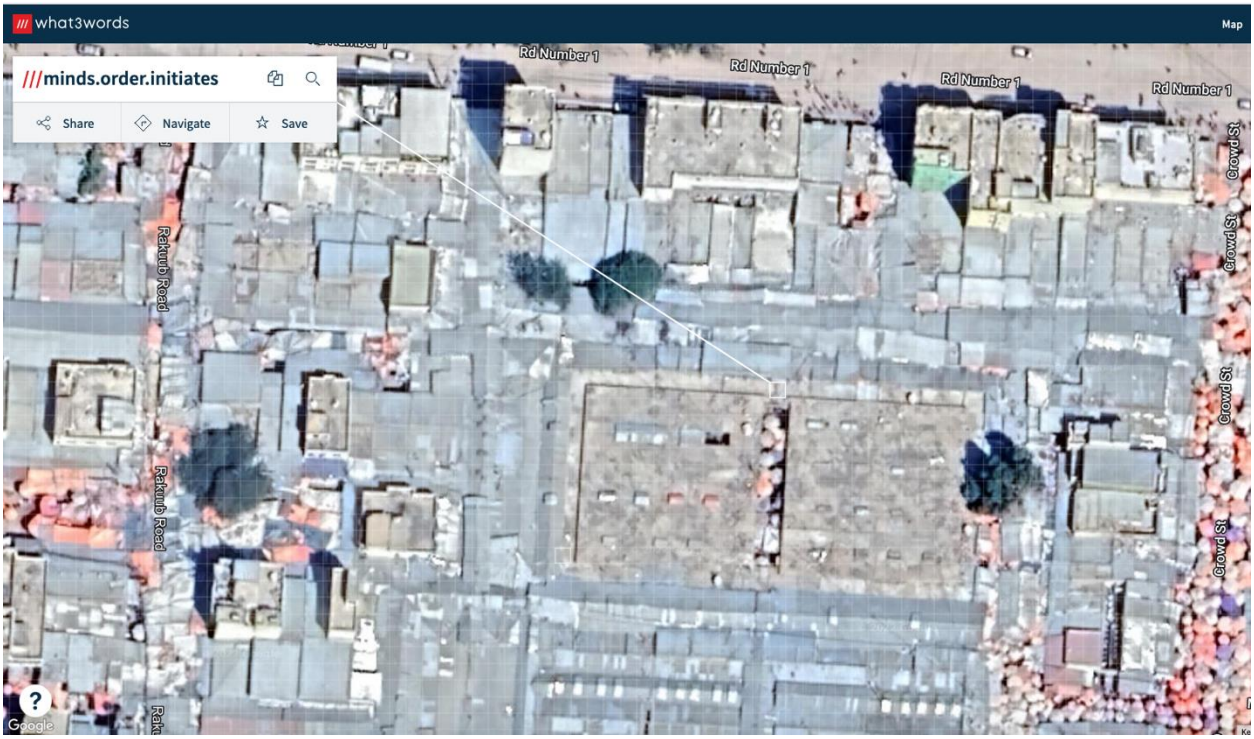


Figure 30: what3words location of Waheen Market

Access

The poor quality of road infrastructure in Hargeisa remains an impediment to the free flow of people, vehicles, goods, and services such as firefighting response. Many roads are unpaved and lack surfaces suitable for heavy vehicles. Roads enable access to buildings

and firefighting water supplies to facilitate firefighting efforts. Measures to ensure roads are not only in good condition but also remain unobstructed and readily accessible will enable fire service access.

Improving and maintaining access around the perimeter of marketplaces for fire response vehicles is critical.

Firefighter's Personal Protective Equipment (PPE)

Firefighter's Personal Protective Equipment (PPE), including fire resistant turnout gear, helmets, boots, flash hoods, gloves, and Self-Contained Breathing Apparatuses (SCBA), provide some level of protection from fire and hot, toxic gases. This equipment only enables firefighters to safely carry out operations if it is maintained and used properly, and if its use is limited to acceptable exposure conditions, e.g., PPE will not protect firefighters in a room experiencing flashover[25]. It is important there is sufficient PPE for firefighters in the appropriate sizes and maintained in good working condition. They require maintenance and refilling after each use, which requires SCBA refilling stations as well.

In addition to PPE, equipment that helps to communicate when firefighters are in danger and locate firefighters who may be incapacitated, is also essential to protect firefighters. Radio systems, devices that alarm if a firefighter doesn't move for a set amount of time, devices that geolocate firefighter locations, and thermal imaging cameras are examples of equipment that can support firefighter protection.

Recommendation: Fire Services PPE

The quality and quantity of PPE was not inspected as part of this assessment as the focus was on marketplaces specifically, rather than a detailed review of firefighting equipment, training, and performance of the fire brigade. However, it is important the fire brigade has sufficient resources and procedures to procure, operate and maintain this equipment.

We recommend the Somaliland Fire Service assess the quality and quantity of their existing stock of PPE annually and publish a report describing PPE deficits and associated costs. This information can be used to advocate for resource allocation from government and non-government sources. This report could also highlight the needs for additional vehicles, response equipment, personnel, and training.

[25] See Section **Error! Reference source not found.** for a definition of 'flashover'.

Water

Water in sufficient volume and at adequate pressure to accommodate firefighting is among the most important fire safety considerations in any urban community. Water is usually the most cost-effective, abundant, and efficient resource for combatting fires. However, water is a scarce commodity in Somaliland, especially in the current drought conditions.

In the event of fire, the firefighting capacity of the Somaliland Fire Service is limited by the water carried on the responding fire appliances. This may only be sufficient for a few minutes of active firefighting. Consequently, any significant fire requires the mobilization of additional water tenders. The number of such tenders under the direct control of the fire service is also quite limited. In the case of the Waheen Market fire, the voluntary services of private water haulers supplemented fire service operations but remained insufficient to satisfy firefighting demand beyond some degree of exposure protection around the perimeter of Waheen Market.

Interviewees indicated that most wells supplying water to private water haulers are drilled and operated by private owners. No water rights regime was reported for to control or limit extraction of ground water or the location of wells.

Access to water may require regulation, especially as demand grows and scarcity increases. At present, the right to extract and use water remains unregulated. This has proven unsustainable in many other places and should receive urgent attention in Somaliland given the ongoing drought conditions. Efforts to assess the available water supply and allocate extraction and use rights will enable officials to ensure the stewardship of this resource for the highest priority uses, including human consumption, sanitation, and firefighting.

The mayor and city councilors of Hargeisa confirmed the local government is in the process of developing a water distribution system by installing a below ground piping network in the central business district. The water distribution system will facilitate the delivery of water to individual premises and allow metered connections to recover tariffs for access to this resource. The installation of permanent fire hydrants on the new water distribution network will provide firefighters with some improved access to water for their operations. However, the number of fire hydrants, their interoperability with the fire services' vehicles and equipment, the expected performance and reliability of the hydrants was not discussed at this time and would need to be better understood to assess the value of this new resource to fire safety.

Another valuable resource is fire hose valves with outlets for firefighters to connect their hoses. This can help firefighters control fires without relying on hoses connected directly

to their pumping appliances. This expedites response and makes firefighting interventions more efficient.

Incident Command – Interagency Coordination

Large fires like the Waheen Market require a strong incident command system with significant coordination amongst key decision makers. The Director General of the Somaliland Fire Service noted that the absence of an incident command center with communications equipment[26] and mechanisms to bring key actors[27] together during a fire incident is their biggest problem.

In the Waheen Market fire, interviewees indicated the coordination amongst decision makers was ad hoc and accomplished largely through phone and other communication methods. Most interviewees recognize the need to gather key decision-makers in one place at the same time to improve situational awareness and create a common operating procedure. Situational awareness refers to providing everyone responsible for decisions and actions with the information they need in the most efficient and effective way, which ensures coherence, consistency, and confidence. Managing the flow of information in this manner facilitates the creation of a common understanding of both what the situation requires and how decisions and actions affect its outcome and collateral effects.

Beyond Firefighting

The Somaliland Fire Service already responds to many non-fire related emergencies, including serious medical conditions, traumatic injuries, motor vehicle collisions, and the uncontrolled release of hazardous materials. However, this role may not be adequately recognized in enabling legislation or funded to the extent necessary to meet growing demand and heightened public expectations. Several interviewees identified the need to resource, equip, and train firefighters for these expanded roles and growing demand for these services. The importance of the fire service as an element of critical community infrastructure will only increase over time. Enabling and empowering the fire service to leverage its capabilities to meet societal expectations represents a good investment so long as the service places a priority on engagement and empowerment through partnerships with private sector entities and community-based organizations to reduce community risk.

Although interviewees praised firefighters' efforts in combatting the Waheen Market fire, many wondered whether the fire brigade was adequately staff and equipped to perform its role. The Director General of the service itself recognized the scope of services provided by his personnel was growing as was demand for these services. He expressed

[26] E.g., telephones, radios, computers, notepads, televisions

[27] E.g., President, Ministers (e.g., Interior, Health, and Finance), Mayor, Governor, Police Commander, Military Commander, water supply companies, electric utility companies

concerns about the capability and capacity of the service to satisfy these expectations. This situation is common to many, if not most fire services around the globe.

Perhaps the most notable fire service capability observed was the quality of the personnel recruited into the force. Globally, few fire service organizations secure the services of university graduates for entry-level firefighting positions. These jobs are often held by individuals with a secondary school education. Most vocational training occurs after induction. The Somaliland National Fire Services, however, has recruited university graduates, including many engineers, which have strong potential for direct entry into supervisory and mid-management positions requiring higher skill levels and the exercise of judgment and discretion.

Recommendations: Somaliland Fire Service Response

1. Detailed review of fire brigade's resource deficits, as noted in Section **Error! Reference source not found.**
2. Invest in expanded capability and capacity of Somaliland National Fire Service to manage all-hazards incident responses through purchase of additional vehicles and equipment, recruitment, and by training personnel.
3. Review fire incidence data management system.
4. Integrate location and navigation service What3Words into fire services response system and promote use of What3Words to public.
5. Promote use of 990 number to reach fire services directly.
6. Develop and coordinate procedure for police to hand over fire calls more quickly.
7. Establish a common call-answering point for all emergencies, which then has responsibility for engaging all response agencies to affect the necessary mobilization and coordination.
8. Improve road conditions to increase capacity, improve safety, and to decrease fire services response times.
9. Maintain access around the perimeter of marketplaces for fire response vehicles.
10. Regulate water rights to maintain adequate supply and reserves for human health, sanitation, and firefighting.
11. Continue installing water mains and fire hydrants to ensure equitable access and consistent supply; ensure interoperability with Somaliland Fire Service vehicles and equipment.
12. Design, install, and maintain equipment to support the fire services response, e.g., building access, fire department connections, fire control room, fire hose valves.
13. Establish an interagency coordination centre (incident command) to manage disaster response by providing leaders with a place to gather and collaborate on decision making. Equip with communications equipment.
14. Establish legislative and procedural mechanisms to bring key actors together (ideally at an incident command centre) during a fire incident.
15. Leverage the education of firefighters to support wider fire safety development, e.g., building regulatory system development and enforcement, fire safety education delivery.
16. Recognize and authorize expanded role of Somaliland National Fire Service in

5.8 Fire Recovery

At an operational level, NADFOR is the government agency responsible for disaster related crises in Somaliland, and coordinates all activities related to the monitoring, preparedness, response, and mitigation of emergencies. This includes collection of early warning indicators, planning and design of early warning and coordinated response with emergency action plans at all levels. Its policy instruments include the National Disaster Preparedness Strategy and National Disaster Contingency Plan. However, it is noted that implementation has been lagging due to financial and human resource issues. NADFOR largely focuses on recent ongoing crises of drought, food security and cyclones, and its involvement in response to the Waheen fire was minimal.

In general, it is recognised that institutional capacity building and strengthening is required in Somaliland, and there are gaps in institutional capacity to create strong disaster risk management mechanisms. Gaps in coordination, competing priorities and financial resources affect implementation. Both local and international NGOS provide capacity strengthening and substantive support where there are gaps in state provision, for example ICRC provided volunteers to help fight the Waheen fire and provided financial support to victims. In terms of fire safety, a coordinated and collaborative approach is therefore vital, between government and the NGO community to maximise available capacities, resources, and expertise, as well as build an inclusive and transparent approach to fire safety.

On the 2nd of April, President Muse Bihi established the National Response and Relief Committee (NRRC) which is composed of representatives from the Hargeisa municipality, the Chamber of Commerce, and relevant ministries. [8] NRRC does not include a representative from NADFOR, despite their expertise and experience in coordinating disaster response and recovery for other disaster types in Somaliland. This means NRRC is not benefiting from NADFOR's experience and NADFOR will not directly benefit from the learning with the Waheen fire recovery.

There is a need for cooperation and coordination between the Somaliland National Fire Service, NADFOR, and other key governmental organizations. Integration of fire into existing mechanisms for multi-hazard disaster management would enable coordination of relief and recovery across ongoing disasters, such as the ongoing drought and Waheen fire, which were competing for resources. This integrated approach aligns with our recommendations to support the fire services in acting in an all-hazards response role, and leverages existing resources, systems, and knowledge (fire and disaster management) to streamline relief and recovery. It also promotes institutionalization of lessons from each incident, so knowledge can be accumulated, and policies, procedures, and resourcing can be adapted. As part of this effort, it is recommended that the disaster management committee is expanded to include fire safety representation, including from the fire services. In addition to helping to improve communications, coordination, and

collaboration, this would create an opportunity for the fire services to engage directly with international agencies, such as UN-OCHA, and to advocate for their support in addressing fire safety challenges in Somaliland.

Recommendations: Fire Recovery

1. Establish a Memorandum of Understanding (MOU) between the Somaliland Fire Service and NADFOR governing interagency coordination of response to major disasters.

2. Carry out an evaluation of the NRRC performance and share lessons learned with NADFOR and other key actors to inform future fire recovery efforts.

3. Review and refine policies governing emergency and disaster declarations to clarify thresholds and authorities, such as who decides, how long, what conditions, what authority, how revoked or terminated.

4. Integrate fire into existing mechanisms for multi-hazard disaster management to coordinate relief and recovery across ongoing disasters, and to institutionalize knowledge from each incident.

5. Fire safety representation on disaster management committee to contribute to the above and create a direct link between fire and international assistance.

6. Form interagency group within government and public-private partnerships to extend engagement to develop and implement an integrated Somaliland risk reduction strategy beginning with a fire focus then expanding to other natural and technological hazards.

7. Invest in transport infrastructure to link marketplaces, enabling more decentralized shopping options, to relief pressure (density) in individual marketplaces.

6 Conclusion

While it should be acknowledged that difficult choices between competing needs and risks contribute to the lack of safety prioritization, it is possible to build a strong safety culture grounded to Somaliland's specific context. But it is important to reiterate the highly emergent nature of fire risk makes it difficult to address.

There is no one solution or intervention that can be implemented to achieve fire safety. It is a distributed yet shared risk requiring multiple responses at different levels. There is a role for policy interventions, organizational interventions, infrastructure investments, investments in buildings, financial interventions, community-based interventions, and more.

Adopting a hybrid approach to fire safety is recommended, which comprises of engineered fire safety systems (e.g., building regulations, fire service responses) as well as ad hoc fire safety subsystems which emerge and adapt (e.g., community-based fire response teams, fire safety education in schools). [1]

Kindling advocates for a supporting and enabling approach that recognizes that communities and residents must be worked with to inform holistic fire safety solutions which navigate local barriers and leverage resources. Helping communities to strengthen their capacities to protect themselves from fire and fostering an enabling environment that supports and encourages the emergence of local fire safety practices may be the most achievable and scalable way to improve fire safety and fire resilience and should therefore complement more traditional institutional fire safety responses.

7 References

[1] D. Antonellis, L. Hirst, J. Twigg, S. Vaiciulyte, R. Faisal, M. Spiegel, G. Faller, R. Walls, N. Flores Quiroz and B. Messerschmidt, “A comparative study of fire risk emergence in informal settlements in Dhaka and Cape Town,” Engineering X, London, 2022.

[2] H. Farah, “‘It’s all gone’: the women left bereft when Somaliland’s largest market burned down,” The Guardian, 25 April 2022. [Online]. Available: https://www.theguardian.com/global-development/2022/apr/25/somalilands-largest-market-burned-down-waheen. [Accessed 30 July 2022].

[3] B. Wisner, P. Blaikie, T. Cannon and I. and Davis, “At Risk: Natural Hazards, People’s Vulnerability and Disasters,” Routledge, 2004.

[4] C. Levy, *The Process of Institutionalising Gender in Policy and Planning: The Web of Institutionalisation,* London: UCL, 1996.

[5] Kindling, “A Comparative Study of Fire Risk Emergence in Dhaka and Cape Town,” Royal Academy of Engineering, London, 2022.

[6] “The Informal Economy in Civil War: Hargeisa - Somaliland,” Cardiff University, 2017. [Online]. Available: https://www.cardiff.ac.uk/__data/assets/pdf_file/0007/1057732/The-informal-economy-in-civil-war-Hargeisa.pdf. [Accessed 7 August 2022].

[7] E. Cavanough, “'I lost everything': Somaliland market fire upturns life, economy,” Al Jazeera, 26 April 2022. [Online]. Available: https://www.aljazeera.com/features/2022/4/26/i-lost-everything-somaliland-market-fire-upturns-life-economy. [Accessed 14 August 2022].

[8] “ Rebuilding Waheen Market in Hargeisa: Challenges and Opportunities,” Academy for Peace and Development and Institute for Public Policy, 2022.

[9] P. Blaikie, T. Cannon, I. Davis and B. Wisner, At Risk: Natural Hazards, People Vulnerability and Disasters (1st edition), London: Routledge, 1994.

[10] S. Guevara Arce, C. Jeanneret, J. Gales, D. Antonellis and S. Vaiciulyte, “Human behaviour in informal settlement fires in Costa Rica,” *Safety Science,* vol. 142, 2021.

[11] N. Flores Quiroz, R. Walls, A. Cicione and M. Smith, “Fire incident analysis of a large-scale informal settlement fire based on video imagery,” *International Journal of Disaster Risk Reduction,* vol. Vol 55, 2021.

[12] A. Cicione, R. Walls, M. Beshir and D. Rush, “Full-Scale Informal Settlement Dwelling Fire Experiments and Development of Numerical Models,” *Fire Technology,* 2019.

[13] V. Kodur, P. Kumar and M. M. Rafi, “Fire hazard in buildings: review, assessment and strategies for improving fire safety,” *PSU Research Review,* vol. 4, no. 1, pp. 1-23, 2020.

[14] Standards Setting Committee, “International Fire Safety Standards Common Principles,” International Fire Safety Standards Coalition, London, 2020.

[15] “Building Regulation for Resilience: Managing Risks for Safer Cities,” World Bank, Washington DC, 2015.

[16] S. M. Gwynne and E. R. Rosenbaum, “Employing the Hydraulic Model in Assessing Emergency Movement,” in *SFPE Handbook of Fire Protection Engineering, 5th Edition*, London, Springer, 2016, pp. 2115-2149.

[17] D. Wales, “Putting the customer at the heart of response,” *Crisis Response,* pp. 16-19, 2020.

[18] B. Meacham, “Developing a global standard for fire reporting,” Royal Institution of Chartered Surveyors (RICS), London, 2020.

[19] D. Mattos, “Community Capitals Framework as a Measure of Community Development,” University of Nebraska-Lincoln, Agriucultural Economics Department, Cornhusker Economics, 2 September 2015. [Online]. Available: https://agecon.unl.edu/cornhusker-economics/2015/community-capitals-framework#:~:text=Cornhusker%20Economics%20September%202%2C%202015,the%20dynamics%20of%20community%20change.. [Accessed 26 April 2022].

[20] A. A. Sheikh, F. F. Fakunle and A. A. Fashina, “The status quo of building codes and construction practices in Somaliland: practitioners' perceptions,” *SPC Journal of Environmental Sciences,* vol. 2, no. 1, pp. 4-11, 2020.

[21] G. Bankoff and G. Frerks, Mapping Vulnerability: Disasters, Development and People, London: Routledge, 2004.

[22] M. Muhamed, “Somaliland Trade, Exports and Imports: An Overview,” *Developing Country Studies,* 2016.

[23] “What Somaliland can teach the rest of Africa about peace and stability,” World Economic Forum, 17 March 2016. [Online]. Available: https://www.weforum.org/agenda/2016/03/what-somaliland-can-teach-africa-about-peace-and-stability/. [Accessed 22 July 2022].

[24] Central Statistics Department, “The Somaliland Health and Demographic Survey,” Ministry of Planning and National Development, Somaliland Government, Hargeisa, 2020.

[25] B. Carter, “Strengthening gender equality in decision-making in Somaliland,” 2021. [Online]. Available: https://opendocs.ids.ac.uk/opendocs/bitstream/handle/20.500.12413/16599/947_Somaliland_decision_making.pdf?sequence=1&isAllowed=y. [Accessed 28 July 2022].

[26] E. Kuligowski, “Human Behavior in Fire,” in *SFPE Handbook of Fire Protection Engineering, 5th Edition*, London, Springer, 2016, pp. 2070-2109.

[27] K. Bigda, “Basics of Means of Egress Arrangement,” National Fire Protection Association, 15 October 2021. [Online]. Available: https://www.nfpa.org/News-and-Research/Publications-and-media/Blogs-Landing-Page/NFPA-Today/Blog-Posts/2021/10/15/Basics-of-Means-of-Egress-Arrangement#:~:text=Travel%20distance%20is%20the%20maximum,closest%20exit%20is%20not%20regulated.. [Accessed 15 August 2022].

[28] A. Cicione and R. S. Walls, “Towards a simplified fire dynamic simulator model to analyse fire spread between multiple infromal settlement dwellings based on full-scale experiments,” in *Interflam*, London, 2019.

[29] P. Chamberlain, “Post: "In the event of a wildfire...",” LinkedIn, August 2022. [Online]. Available: https://www.linkedin.com/feed/update/urn:li:activity:6959020385602351104/. [Accessed 15 August 2022].