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Citation for published version:

Rush, D, Gibson, L, Bankoff, G, Cooper Knock, SJ, Walls, R, Twigg, J, Hirst, L, Jordan, S & Spinardi, J 2019, Fire risk reduction on the margins of an urbanising world. in *Global Assessment Report on Disaster Risk Reduction 2019*. United Nations, New York, Geneva, Switzerland.
<<https://www.preventionweb.net/publications/view/66548>>

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Publisher's PDF, also known as Version of record

Published In:

Global Assessment Report on Disaster Risk Reduction 2019

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Fire risk reduction on the margins of an urbanizing world

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Fire and the urban margins

It is estimated more than 150,000 people die from fires or burn-related injuries every year. Over 95% of fire deaths and burn injuries are in low- and middle-income countries (LMICs)(WHO, 2018). For those who live within informal settlements, the risk that fire will be a cause of trauma, injury or death is particularly high. And yet, too little is known about the triggers, incidence and impact of such fires.

Urban growth is said to be one of the 21st century's most transformative trends posing massive sustainability challenges in terms of housing, infrastructure and basic services, amongst others (UN Habitat, 2016). Whilst levels of urbanisation vary widely across the globe (Potts, 2012) urban growth has been a defining feature of recent decades. Much of this growth is concentrated in developing countries, where urban areas grow by an estimated 70 million people each year (UN Habitat, 2015a). Low income countries have seen a 300% increase in area of built-up areas and a 176% increase in population in the past 40 years (Paresi *et al.*, 2016).

The distribution of fire risk across urban societies is a fundamentally political issue. Our entry focuses on the risks posed to residents within informal settlements and refugee camps; two spaces that are testament to the fact that risk reflects structural patterns of oppression and marginalisation¹. We introduce these two forms of space below before exploring three case studies that emphasise the importance of international, national and local factors in shaping fire risk in informal settlements in New Delhi, India, and Cape Town, South Africa, and in refugee camps across Lebanon.

Informal Settlements

Across the globe, affordable and accessible urban housing has not kept pace with rising population growth (Gunter and Massey, 2017). Consequently, people have been forced to live in low quality formal housing or within informal settlements. Both forms of housing expose people to increased fire risk. Below, we focus on informal settlement fires for, whilst literature on these fires is limited, it is still more extensive than the research on their

¹ To say that people are marginalised, in this context, is to speak of a relationship of power. When we talk of marginality we are not necessarily suggesting that people are completely peripheral and, as such, society could exist without them. Far from it. As Veena Das and Deborah Poole (2004) remind us, what is marginalised is often also that upon which society rests.

formal counterparts. To the degree that businesses form part of residential informal settlements, our entry will speak to fire risks within informal businesses. Our primary focus, however, are residential informal settlements.

We use the term ‘informal settlement’ to refer to informal dwellings in collective form. This term incorporates all settlements that did not have formal state permission when they were constructed. In our entry, we focus on informal settlements occupied by lower socio-economic groups, excluding elite settlements that may also exist without requisite state permission. To call a settlement ‘informal’ is not to insinuate that it is either illegitimate or temporary. Moreover, just because such settlements were not planned or permitted by the state does not mean they were unplanned *per se*: informal settlements can be designed and shaped by residents in a variety of ways.

The proportion of urban residents living within these settlements has declined in recent years, however the absolute number of informal settlement residents has grown by 213 million since 1990 (UN Habitat, 2015a). Fires within informal settlements are frequent and they spread with devastating speed. In February 2011, for example, a fire left 10,000 homeless in Bahay Toro, Philippines, in just three hours (Twigg *et al.*, 2017). Across the globe, English-language media online reported that 20,000 homes were destroyed by fire in 2018 alone². If we conservatively assume that an average of four people live in each household (where numbers are not directly reported) approximately 86,000 people have been displaced, with 168 people losing their lives (Gibson, Engelbrecht and Rush, 2019). There is a stark need for improved fire safety in these areas.

Camps

The definition of a refugee camp or camp for internally displaced persons (IDPs) is complicated by the variety of camps that exist, internationally. Camps can differ greatly in terms of size, infrastructure, building type and governance. Some are established and maintained by external organisations, like the UNHCR. Others are ‘self-settled camps’ or ‘autonomous settlements’, which are often more integrated in surrounding society and less contained, supported and controlled by external actors (Schmidt, 2003). The size, shape and governance of a particular camp can also shift markedly over time (Turner, 2006). In some cases, the inflow of people into a camp can produce a population size and density that mirrors or surpasses that of local cities. The Zaatari refugee camp,

² <https://www.iris-fire.com/downloads/media-reports-of-is-fires/>, - Accessed [12/03/2019]

for example, is now the 'fourth largest concentration of people in Jordan' (Crisp, 2015). To call it a city, however, is to overlook the lack of citizenship that characterises the daily lives of refugees (Crisp, 2015). These refugees are living in urban conditions but not within cities.

When discussing camps, it is important to remember that these are not the only spaces where refugees and IDPs live. Increasingly, many forcibly displaced people live outside camp structures and may form part of the marginalised urban populations mentioned above. In fact, an estimated 60% of the refugee population and 80% of the IDP population live in urban areas worldwide (UNHCR, 2011). Nonetheless, camps continue to play an important role in humanitarian interventions across the globe. Many, however, are far from temporary. The return of displaced populations requires political solutions that often prove elusive. At the end of 2015, more than 6.6million refugees had spent over five years in exile³. At the most extreme length of the spectrum stand the Palestinian refugee camps, which were founded in 1948, and the Eritrean refugee camps in Sudan, established in 1968. Given the numbers of people living in camps and the length of their encampment, fire safety in these settlements is clearly crucial. To date, however, it has been largely overlooked.

Having defined the forms of settlement on which this entry focuses, we move to our case studies, which seek to highlight the political, social and economic context in which fire risk is experienced.

³ <https://blogs.worldbank.org/dev4peace/how-many-years-do-refugees-stay-exile>

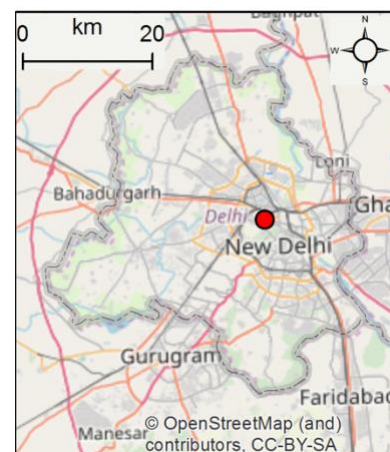
Case Studies

1. New Delhi

Urban fire is a hidden problem in India. It goes largely unseen and underreported despite the devastation it causes. Officially, police statistics report that there were 17,700 deaths by ‘accidental fire’ (i.e. excluding forest fire) in 2015 (NCRB, 2016). However, a study in 2001 suggests that this figure might be six times higher than that quoted in published sources, in excess of 100,000 deaths annually, which may also be an underestimation (Jagnoor *et al.*, 2009, Sanghavi, Bhalla and Das, 2009).⁴ This makes fire second only to traffic accidents as the main cause of death by ‘unnatural causes’, and 10 times all deaths caused by natural disasters (NCRB, 2016).



New Delhi is the capital city of India and one of eleven districts of the union territory of Delhi. New Delhi is the second most densely populated city in India after Mumbai and UN projections suggest that it will become the most populous city in the world by 2028 (UN, 2018). Population density through Delhi, however, varies greatly from a low of 4,057 persons per square kilometre in New Delhi district to a high of 36,155 in the North district (Delhi Fire Service (DFS), 2017). According to official statistics, there were 318 deaths and 1,767 people injured by fire in 2017-2018 (Delhi Fire Service (DFS), 2017). Given the under-reporting mentioned above, these figure are highly likely to be underestimates, yielding a possible death toll of around 1,900 per year or more, especially given that the underrepresentation of data in urban areas is more pronounced than in rural areas (Sanghavi, Bhalla and Das, 2009). There is anecdotal evidence that suggests large-scale urban fires occurring in the “colonies” (districts) of the outer suburbs are not fully recorded in the official statistics (Interview with Community Spokesperson 1, North West Delhi 27 July 2018). Official statistics are collated



⁴ This number was extrapolated from hospital registry data for urban areas and a survey of causes of death in rural populations.

by the Police Department who are required to attend all callouts of the Delhi Fire Service (DFS) but Satapathy and Walia, (2007), claim that ‘thousands’ of such incidences remain unrecorded.

Like many cities across the globe, New Delhi is highly unequal. This inequality fundamentally shapes the distribution of fire risk (Bankoff, Lubken and Sand, 2012). Fire regulations are broadly adhered to in the relatively affluent former colonial centre with its government buildings, embassies and upmarket residences; in the formal commercial and retail sectors with their multi-storey buildings; and in the city’s middle-to-upper class suburbs. Those regulations are specified in the National Building Code, the Delhi Fire Prevention and Fire Safety Act 1986, and provisions of the Delhi Fire Service Act 2007. If buildings are five stories or over, they also require a No Objection Certificate (NOC) from the DFS before occupancy. Of course, fires do occur in these more affluent spaces and not all landlords adhere to fire regulations. Notably, three lives were lost in a high-rise office building fire in 1986. The violation of existing safety regulations in this building prompted the passing of the Delhi Fire Prevention of Fire Safety Act in the same year⁵ (Interview with Senior DFS Officer 1, New Delhi 13 April 2018). Overall, however, people here have the economic resources to fulfil building regulations and are sufficiently policed – by occupants and the state – to enforce compliance. Here, only traffic limits fire services’ access to properties.

Elsewhere, construction materials, poor infrastructure, population density, and limited access combine to heighten fire risk. However, talking specifically about informal settlements on the urban margins is complicated in Delhi by the numerous settlement forms that exist, spanning the spectrum of formality and legality. As Bhan, (2009:131), highlights, only 23.7% of Delhi residents abide in ‘planned colonies that met all conditions of legality at the time of established and followed the classic plan-build-service-occupy order that urban planners preach’. The term ‘unauthorised colonies’ tends to refer to more affluent but illegal housing, whereas the poorer equivalents of these dwellings are referred to ‘JJ Clusters’ (Ibid). Those living in ‘slum-designated areas’ may be in a similar economic position to those who live in JJ Clusters but their areas were authorised through the 1956 Slum Areas Act (Ibid.). Complicating the issue further, those who have been displaced by development but rehoused may not be in areas designated as ‘slums’ but may still be authorised by the state (Ibid).

⁵ <https://www.indiatoday.in/magazine/indiascope/story/19870731-ansal-bhavan-fire-highlights-gross-neglect-and-violation-of-safety-laws-in-delhi-799102-1987-07-31#close-overlay> – Accessed [10/8/18]

Given their similar architectural and socio-economic profile, it is unsurprising that there are similar challenges to fighting fires in areas designated as 'slums' and 'JJ Clusters'. In these areas, population density, the flammability of building materials and reliance on open flames energy sources all heighten fire risk. Fire services also face challenges tackling fires once they start. Traffic poses a huge problem for fire services in Delhi. The average speed for engines used to be 25 to 30 km/h but now can be down to 5 km/h during peak traffic times (Interview with Senior DFS Officer 1, New Delhi 13 April 2018). This means regular delays of 40 to 45 minutes for engines to reach the scene of a fire, with one informant reporting that she had to wait three hours for a fire engine to arrive⁶ (Interview with Community Spokesperson 1, North West Delhi 27 July 2018). Finding the precise location of fires is also very difficult due for fire fighters due to the absence of formal postal addresses. One station officer estimates that, at his station, engines are not able to find the scene of the fire in up to 30% of callouts (Interview with Station Officer 4, North West Delhi 11 April 2018). Even when an engine reaches its destination, it may not be able to approach the blaze due to the narrowness of the thoroughfares (see Figure 1). In these cases, multiple 100 metre hoses are linked together, regularly up to a distance of half a kilometre or more (Interview with Station Officer 3, South Delhi 12 April 2018). Water, too, is a problem as most areas in Delhi do not have fire hydrants and those that do exist may have low pressure or limited supply. Community involvement in fire-fighting – in terms of summoning fire services or tackling fires directly - has been under-researched. Exploratory studies by the authors have proved inconclusive. News reports outside Delhi, such as that on a high-school fire in Kumbakonam, Tamil Nadu, suggest that the community can play a crucial first-responder role (Satapathy and Walia, 2007:115). But we do not yet have systematic evidence on the prevalence of such responses in New Delhi, or beyond.

⁶ The time from fire detection to the call being raised to the fire service in this particular case is unknown.



Figure 1: Narrow lane in Shabbad Muhamdar (left) and informal housing - Railway Colony (right)

For their part, fire services have attempted to tailor their equipment to better tackle informal settlement fires, including smaller, four-wheeled vehicles equipped with hydraulic pumps or foam apparatuses and motorcycles outfitted with four foam-filled cylinders. For water, the DFS relies on a fleet of tankers ranging in size from 3,000 L capacity vehicles for narrower thoroughfares to giant 12,000 L tankers. Larger fires are fought by connecting engines to tankers and having a fleet of the latter continuously circulating between the water source and the fire. In many cases, though, the nearest source of water may be up to 12 km away and it may take a tanker between one and a half to two hours to refill and return to the fire (Interview with Senior DFS Officer 1, New Delhi 13 April 2018). Firefighting equipment, pumps, hoses, breathing apparatuses and flame-retardant clothing is generally regarded as adequate and in good working order. However, it is often described as “obsolete” because firefighters seldom want to don such heavy safety gear, modelled on western designs, in summer temperatures that regularly exceed 35°C, and where most buildings’ entrances and corridors are extremely narrow (Interview with Station Officer 2, South East Delhi 25 July 2018). This increases the fatalities amongst firefighters and encourages the fighting of fires externally rather than internally, despite senior officer’s claims to the contrary (Interview with Station Officer 4, North West Delhi 11 April 2018; Interview with Senior DFS Officer 1, New Delhi 13 April 2018).

Intersecting with the political and economic factors that heighten fire risk are factors such as gender. Data suggest that nearly two-thirds (106,000 out of 163,000 in 2001) of all fire deaths in India affect women, mostly between 15 and 34 years of age. This proportion is higher in urban areas than rural areas. Consequently, whilst specific data on Delhi is lacking, there is no reason to believe that fire risk in the city is not highly gendered. Whilst there are few official statistics that provide insight into the causes of these fire deaths, qualitative research suggests

that this may, in part, be attributable to the gendered social and economic roles of women who take primary responsibility for cooking in the domestic sphere. These cooking environments can be hazardous, particularly where there are open flames or poor electricity connections. In poorer homes, cooking is done outside over an open fire to minimise fire risk (Interview with Community Spokesperson 1, North West Delhi 27 July 2018). We also need to consider the prevalence of women within industrial spaces – such as textile factories – that are flouting fire regulations⁷. In addition to such risks, local studies suggest that over a third of fire-related deaths may be attributed to suicide-by-self-immolation or ‘dowry murders’ – a fatal act of domestic violence putatively in response to a bride’s proposed dowry (Kapur 2002, Sanghavi, Bhalla and Das, 2009).

There are also other criminal triggers of fire in Delhi, including arson for the purposes of insurance fraud or by land developers wishing to remove unauthorised settlements. In this manner, a whole “colony” of informal structures in Bawana in North West Delhi was set alight several years ago (date unspecified) with locals reporting that the fire brigade only arrived after the entire settlement had burnt to the ground (Interview with Community Spokesperson 1, North West Delhi 27 July 2018).

Both fire ignition and fire spread in Delhi are impacted by seasonal dynamics. Stations receive fewer callouts in winter – on average only one or two each day – than in summer (April to July) when there may be as many as six calls every 24 hours with the fire risk exacerbated by high temperatures (Interview with Station Officer 2, South East Delhi 25 July 2018). Somewhat counterintuitively, fires are also more frequent during the monsoons because rainwater causes appliances to short-circuit with disastrous consequences. Sparks, however, can be generated at any time of the year as the intermittent power supply to many areas of the city causes power surges in subpar or faulty wiring (Interview with Station Officer 1, South Delhi 26 July 2018). In turn, regular ‘brownouts’ (electricity reductions) mean that many local residents must use candles for illumination, posing another major source of fire (Interview with Community Spokesperson 1, North West Delhi 27 July 2018). Festivals also add to the seasonal rhythms of fire. During Diwali, for example, private and public spaces are illuminated by lights or oil lamps called *diyas* and fireworks are launched. The convergence of so many naked flames, crowds and festivities results

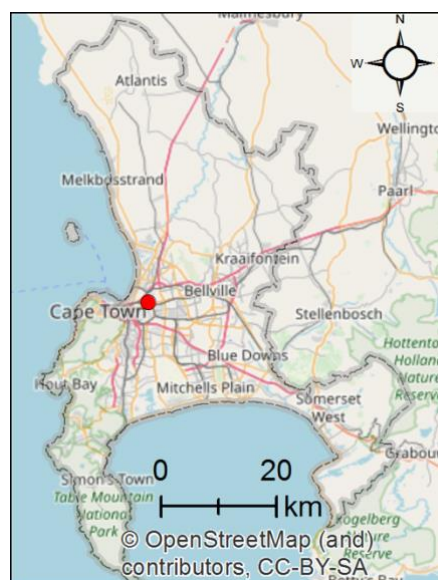
⁷ For instance - <https://www.aljazeera.com/news/2016/11/fire-kills-factory-workers-india-sahibabad-161111072912321.html>

in the DFS receiving as many as 200+ callouts between 4pm and 1am on that single night (Interview with Senior DFS Officer 1, New Delhi 13 April 2018).

2. Cape Town

South Africa is the world's most unequal country. In 2011, approximately 1.66 million households resided in informal residential areas, from a total population of 51.8 million.⁸ More recent estimates suggest that somewhere between 18% and 33% of the population live in 'backyard dwellings' (informal structures erected on formal housing sites) (Pharoah, 2009).

The Fire Protection Association of South Africa (FPASA) compiles data on fire from brigades across the country but this is not without its challenges, including incompletely documented or unreported fires (FPASA, 2018). Consequently, their data typically underestimates incidence data. In 2016, FPASA recorded 41,873 fire callouts nationally, which translates to approximately 115 fires per day. Between 2003-2016, the number of fires increased between 1.5-1.7% per annum with the number of fatalities rising between 5-10% per annum (FPASA, 2018).. The latter refers to fatalities recorded by fire services at the site of the fire. Injuries that result in later fatalities are not included in these statistics. Notably, mortuary data from 2011



demonstrates that 2,243 people died from 'exposure to smoke, fire and flames' – a total of 8.0% of all 'accidental injuries' (StatsSA, 2014). This figure is 447% higher than the FPASA statistics, highlighting the large number of deaths unrecorded by the fire services.

⁸ <https://data.worldbank.org/indicator/SI.POV.GINI?locations=ZA> – accessed 5/9/18

The absolute number of fires within formal and informal dwellings are similar (Figure 2) but with an estimated 18% of the population living in informal settlements, the informal settlement residents are 4.8 times more likely to be affected by fire. The burden of fire disasters is often borne by the poor.

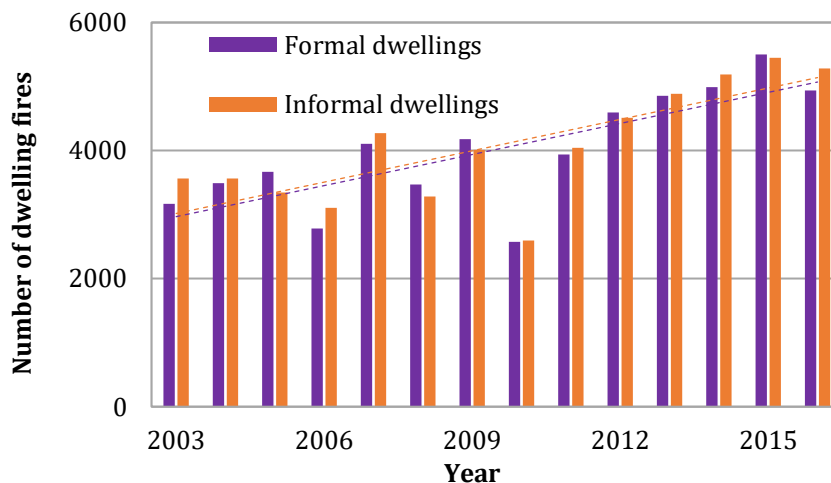


Figure 2: Total number of dwelling fires recorded by fire services in SA for formal and informal dwellings

Cape Town, home to four million people, is the world's fifth most unequal city and still bears the marks of apartheid segregation. Since apartheid, the economic and spatial transformation of the city has been limited. Unemployment remains approximately 27% across the country and whilst the government has delivered housing since 1994, an estimated backlog of 350,000 housing units remains (StatsSA, 2018). Much of the housing that has been delivered has reinforced the spatial marginalisation of economically deprived citizens, and has often been of mixed quality. The shortage and unsuitability of housing stock has meant that the number of people living within informal settlements and backyard dwellings continues to grow. Whilst these settlements are not, by definition, authorised by the government, their layout may be governed – to a greater or lesser degree – on the ground. Therefore, some settlements have clear walkways and gaps between homes, while others are very densely populated with narrow passages (Figure 3).



Figure 3: Imizamo Yethu informal settlement in Cape Town showing: a) close proximity of homes with roof structures possibly covering multiple households; b) narrow gaps between dwellings; and c) variety of building materials used in construction



Figure 4: Fire spread through Imizamo Yethu in 2017 (used permission of Ryan Heydenrych, Vulcan Wildfire Services)

Fire risk is extremely high within informal settlements. As many as 10,000 people can be left homeless in a single fire event (Pluke, 2017). In 2017, for example, a fire in Imizamo Yethu (**Error! Reference source not found.**),

left 2194 homes destroyed, despite the blaze being fought by 176 firefighters (Kahanji, Walls and Cicione, 2019). These fires take a devastating toll in terms of lives and possessions. The disaster management and recovery from this incident cost the municipality over R100m (\$7m) (Pluke, 2017), which is approximately the cost of construction 650 low-cost homes.

An analysis of fire incident statistics collected by the City of Cape Town showed that between 2009 and 2015 the number of informal settlement fires doubled from just over 150 to over 320 fires per year. Approximately two thirds of fires affect only a single dwelling so leaving significant numbers of fires that affect two or more homes. On average the fire service will be called out to an informal settlement fire once a day, and every week a fire will affect more than 20 dwellings. A spatial distribution analysis of fire incidents⁹ (**Error! Reference source not found.**) reveals that there are some settlements which are prone to many fire incidents and in which many structures are destroyed, highlighting areas within the city at highest risk of experiencing devastating fires.

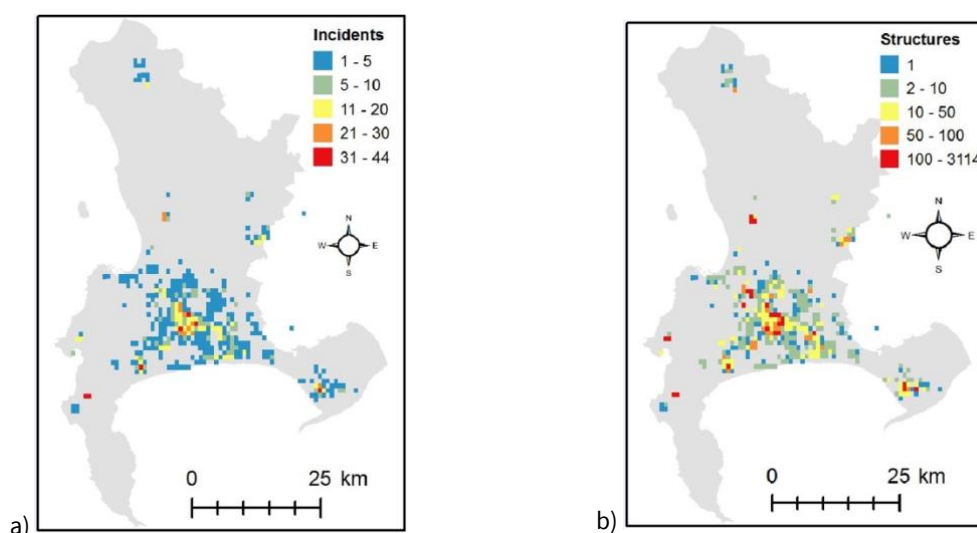


Figure 5: City of Cape Town fire incidence data for seven years from 2009 to 2015 showing; a) number of informal settlement fire incidences; and b) total number of structures destroyed in this seven year period.

⁹ Data is gathered from City of Cape Town, Fire incidence data, (2018). Available at: <https://web1.capetown.gov.za/web1/opendataportal/DatasetDetail?DatasetName=Fire%20incidence> [Accessed 9 July 2018].

The points of ignition within a settlement are varied in Cape Town, as they are in our other case studies. They have been similarly underreported. Electrification of dwellings is typically viewed as a method of improving fire safety, as inhabitants could move away from using open fires or paraffin (kerosene) stoves. However, even when inhabitants are provided with metered electricity around 67% of inhabitants may still employ “energy stacking” where they use both electric and non-electric (typically paraffin) energy sources due to the higher cost of electricity compared with other energy sources (Francioli, 2018).

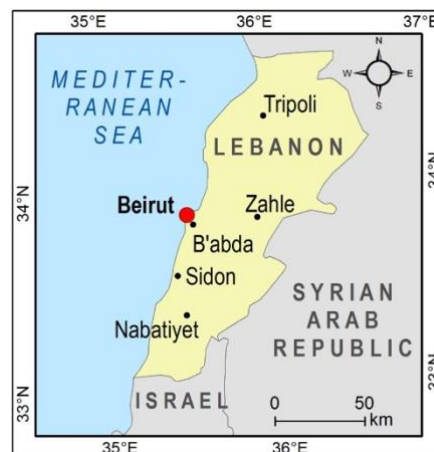
Smoke and fire detectors have been rolled out by municipalities. However testing has shown that certain devices, for instance those relying on rate-of-temperature-rise, will not activate in smouldering fires, which could be lethal (Walls, Olivier and Eksteen, 2017). A smouldering fire is a low temperature fire with no visible flames (Quintiere, 2016). In the Wallacedene TRA settlement, a recent study investigated the rollout of 1,400 photoelectric smoke alarm devices, and follow-up occurred for a period of one year (Zweig *et al.*, 2018). Results show that the devices successfully reduced the incidence of fatal and damaging fires through early warning, and it is planned to introduce the programme in other settlements. However, further refinements need to be made to the devices to reduce the amount of false alarms, and make them more resilient and suited to the realities of everyday life.

Another intervention which has received significant attention in Cape Town is the application of intumescent paints, which are paints that expand upon heating and provide an insulating barrier but the effectiveness of these products may be hampered by factors such as cost, UV resistance, durability and performance in fire (Krishnamoorthy and Bailey, 2009). Recent, unpublished, full-scale informal settlement dwelling fire tests indicate that the openings that exist between walls and roofs significantly reduce the effectiveness of such paint systems, unless they are combined with systems to firestop openings. Furthermore, degradation due to weathering and ageing may inhibit performance and paint expansion (Vahabi, Sonnier and Ferry, 2015).

Finally, reblocking has been attempted as a means of remodelling informal settlements to create space for services and access by providers such as the fire services (Sokupa, 2012). This process can be highly contentious, though, as it involves the relocation and reconstruction of some people’s homes. It is typically managed by local social movements and NGOs, acting as mediators for the municipality. Whilst some movements have reported success other reblocking exercises have been forced to cease due to local opposition.

3. Lebanon

In Lebanon, the one million registered Syrian refugees make up over 20% of the population (UNHCR, 2016). Large refugee flows to Lebanon started in March 2011, when up to 5,000 refugees fled the civil war within Syria into Lebanon. In December 2012, the countries neighbouring Syria were hosting half a million refugees, this rose to two million by September 2013, and by April 2014, there were one million registered refugees in Lebanon alone (UNHCR, 2016), a number that has stayed constant at the point of writing.¹⁰ Lebanon also hosts a Palestinian refugee community of approximately 250,000 people (UNHCR, 2016).



More than 70% of the refugees within Lebanon live in poverty (UNHCR, 2016), as a combined result of the economic toll of displacement and the declining levels of growth and investment in Lebanon as a whole (Inter-Agency Coordination Lebanon *et al.*, 2018). Consequently, many are living in hazardous, inadequate and overcrowded shelters (*ibid.*). For political reasons, the Government of Lebanon restricts materials that can be provided to refugees and the creation of refugee camps is banned, hampering the improvement of building conditions (Inter-Agency Coordination Lebanon *et al.*, 2018).

Whilst local authorities and humanitarian agencies have collaborated to enhance services and infrastructure for both refugees and host communities (UNHCR, 2016), fire safety has not been prioritised, despite high fire risks. Provision for refugees in Lebanon is coordinated through nine sectors, drawing in both the Lebanese government and the UN (Mansour, 2017). There are few or no fire experts or specialists working within humanitarian agencies, and national firefighting capacity and fire safety is low. Therefore, fire risk as an issue in refugee contexts in Lebanon has often 'fallen through the cracks' between sectors and agencies. Redressing this gap is no easy task: political and social relations between and within host and refugee communities, humanitarian agencies, fire responders and

¹⁰ https://data2.unhcr.org/en/situations/syria/location/71#_ga=2.93753940.897836095.1536781487-1086130436.1530004088 – Accessed [12/9/18]

different levels of government must be understood and engaged with strategically, a reflection of the fact that fire risk and fire risk reduction is as political as it is technical and is often overlooked.

This oversight is not unique to Lebanon (Y. Kazerooni *et al.*, 2016). Many displaced Syrians and Palestinians live in tented informal settlements (18% of registered refugees, residential (73%) or non-residential (9%) buildings), scattered across the country (Ibid). There are approximately 7,000 mapped informal settlements in Lebanon, ranging from 1 to 238 tents; over half of the settlements have four or less tents. Of the residential and non-residential building used for habitation, 25% and 48% respectively are deemed below the minimum physical humanitarian standards (Inter-Agency Coordination Lebanon *et al.*, 2018). These substandard buildings (SSB) such as garages, apartments, and unfinished buildings usually lack windows or doors (Zelkowitz, Khattar and Doherty, 2017). Fire risk is high across all categories of residence (Zelkowitz, Khattar and Doherty, 2017) but building a comprehensive picture across settlements is difficult given the inconsistencies in fire reporting between and within stakeholder groups. The Lebanese Civil Defence data on fire incidence show that between Jan 2016 and November 2017, there were approximately 1,800 reported fires in residential and non-residential buildings, and approximately 300 reported fires in informal settlements (Inter-Agency Coordination Lebanon *et al.*, 2018). Numerous fires, however, may not be reported directly to the Civil Defense but to other humanitarian agencies, or indeed not at all. Anecdotal evidence suggests that these fires usually affect more than one home but again, we do not have reliable data on such spread.

The number of injuries caused by these fires is high. The Save the Children report highlights data from UNHCR showing 120 displaced persons with severe burns during 2015, with children aged under 5 being half of those injured. However, this is likely to be the “tip of the iceberg” as the UNHCR only has the capacity to treat severe life-threatening cases, and there may be many more injuries, like smoke inhalation, non-fatal burns, and psychological trauma that are treated elsewhere or remain untreated (Zelkowitz, Khattar and Doherty, 2017). The fire fatality rate for Lebanon has been quoted as approximately 1.4 fatalities/100,000/year (UK is 0.31)¹¹ but the origin of this data is unclear. That said, IAC reports suggest that fire fatalities are frequent, with 14 recorded deaths (12 children) in informal settlements between July and December 2017 (a rate of 11.2 fatalities/100,000/year) (Inter-

¹¹ <http://www.worldlifeexpectancy.com/cause-of-death/fires/by-country/> - Accessed [12/9/18]

Agency Coordination Lebanon *et al.*, 2018). Refugees also face a loss of property to fire. The loss of documentation, in particular, can have particularly stark consequences for these refugees seeking socio-economic opportunities and assistance (Zelkowitz, Khattar and Doherty, 2017).



a)

b)

Figure 6: a) Tents in an informal refugee settlement in the Akkar region, where tyres are used to keep tents secure but contribute to a high level of fire loading and source of fuel. and b) The immediate aftermath of a tent fire in an informal refugees settlement

The high density and multi-usage of spaces in which most refugees live lead to a high risk of rapid fire spread. Beyond that, variations in structure shape fire risk. The points of ignition for fire within informal refugee settlements are similar to those found in other informal settlements in New Delhi and Cape Town. Open flames or informal electricity connections are used for cooking, heating and lighting in most settlements because residents are banned from obtaining formal electricity connections. Equipment for heating and cooking may also fail, resulting in fire. Whilst it is not the primary focus here, it is worth noting that in sub-standard buildings, electrical faults are also a risk due to poor quality wiring and connections, enabled by poor dissemination and policing of fire safety regulations. Often families in such buildings live there whilst construction is ongoing or stalled due to lack of funds. Arguably, sub-standard buildings pose a greater risk of fire fatalities and injuries due to limited means of egress, compared to single level, simply laid out tented settlements (Inter-Agency Coordination Lebanon *et al.*, 2018). In both informal settlements and sub-standard buildings, construction materials such as tarpaulin, wood, plastic, cardboard and rubber tyres to weigh-down roofs may aid the spread of fire (Figure 6). As in New Delhi and Cape Town, seasonal dynamics matter, particularly within informal settlements. Summertime, which is hot, dry and windy in Lebanon, is particularly hazardous. Arson is also a cause of some refugee settlement fires. The wider

literature on fires in refugee settlements has highlighted the role of conflict-related arson (e.g. Olsen and Rodriguez, 2004) but in Lebanon fire-setting by children left at home by working parents has also been observed.

Whilst the political and socio-economic position of refugees puts most at a relatively high risk of fire; this risk is not spread evenly across the refugee population. As mentioned, children are particularly vulnerable to fire within Lebanon, but the elderly and people with disabilities are also vulnerable due to health, sensory and mobility issues. Women who are the predominant cooks using fire and open flames on a regular basis, and young males who attempt to fight fires are at risk too (Inter-Agency Coordination Lebanon *et al.*, 2018). This leads to fire being perceived (within informal settlements at least) as one of the most significant hazards, higher than health and access to education (Inter-Agency Coordination Lebanon *et al.*, 2018).

To combat fire risk and to harmonize risk mitigation interventions across Lebanon, the Inter-Agency Shelter Sector Coordination Working Group produced Guidelines for Fire Prevention, Preparedness and Response [FPPR] (Inter-Agency Coordination Lebanon *et al.*, 2018) in January 2018. This document highlights not only the low level of fire safety knowledge amongst displaced populations and humanitarian agencies, but also outlines the technical and soft prevention, preparedness, and response measures required to mitigate fire risks in refugee and host communities.

Technical responses outlined for informal settlements centre around settlement level interventions such as fire breaks (regulated and including methods to create breaks in case of fire) and community first-responder equipment such as fire extinguishers and beaters located at fire points throughout the settlement determined by population density.

The soft component of the prevention and preparedness activities recommended relate to capacity building within humanitarian staff and awareness raising in the refugee and host communities of fire risk and risk reduction techniques. The FPPR also pushed for the training of community-based first responder teams, particularly within informal settlements. To date, awareness raising has been gendered, attempting to mirror existing gender roles and norms. For men, community level hazard assessments, evacuation drills, fire break techniques, and training with appropriate equipment to tackle the fires were key components; for women household level hazard assessments of risks (cooking, heating, electricity etc.) and how to use fire extinguishers were the key issues. Awareness raising has also targeted children with key messages about what to do if a fire breaks out, who to call and what to say, evacuation drills and other key personal fire safety issues. Research is now exploring the implications of having a gendered approach to fire risk management.

Comparative insights and future developments

Informal settlement fires have deadly implications across the globe. Yet, as all three case studies demonstrate, these fires receive comparably little attention from policy makers and the general public. Even statistics for fire-related incidents are, at best, lower bound estimates (Twigg *et al.*, 2017). The fact that people's deaths are not accurately counted is symptomatic of the fact that, all too often, populations within informal settlements do not 'count' politically: the same marginalisation – politically, economically and socially - that forces people to remain within informal settlements, with increased fire risk, also means that their injury and death are less likely to be recorded and recognised. The fact that informal settlement residents are marginalised, however, does not mean that fire risk within informal settlements is distributed equally. Rather, it intersects with factors like gender, age, health and disability. Of course, marginalised populations do not solely live within informal settlements and sub-standard buildings pose their own dangers when it comes to fire risk, and may be equally as deadly. Nonetheless, fire within informal settlements remains a potent and political issue.

Our case studies demonstrate that whilst arson can play a role in fire risk, the majority of fires within informal settlements are started accidentally as people live their everyday lives within contexts of limited infrastructure, space, and resources. When an ignition occurs, the materials within, and of, informal dwellings are usually readily ignitable woods, plastics and cloths that release large amounts of stored energy into a developing fire. When a fire develops, it can easily spread due to combustible construction materials, the storage of fuel within and around homes, the proximity of adjacent homes and the density of the settlement. In sub-standard buildings fires spread due to the lack of a barrier between dwelling units. The fire either finds a natural barrier and burns itself out, or humans intervene and put out the fire. The latter requires good access (rarely the case in space constrained informal settlements), sufficient water supply (which is being challenged by both urban infrastructure capacities and global warming), proximal response teams, and a means with which the public can easily contact those teams and tell them where they are required.

Fundamentally, the provision of accessible, affordable, safety-compliant housing is needed to mitigate fire risks. In the interim, incremental improvements can be made with careful attention paid to the social, political and economic contexts of the communities involved. Community-led mapping of risk at a local level can be a helpful means of engaging with this contextual picture to help minimise risk and build resilience (Aphaylath *et al.*, 2004; MacGregor *et al.*, 2005; Rahmawati *et al.*, 2016). This can be paired with context-appropriate training, education and equipment to improve a community's capacity to act as a fire responder (World Health Organization (WHO), 2011;

Zweig *et al.*, 2018). Both these approaches can help people to effect meaningful change. The danger, however, is that such initiatives ‘responsibilise’ communities and lessen pressure on the state or other governing bodies to change the broader structural picture that pushes people into situations of risk in the first place. These governing bodies must, as a matter of urgency, prioritise the provision of interim services, such as the safe provision of affordable electricity and the wholesale provision of sustainable, formal housing.

Conclusions and final remarks

Urban areas are increasingly being seen as places where economic, social and environmental development can take place through Sustainable Development Goals (SDG) (Koch and Ahmad, 2018) but this is threatened by fire hazards and disasters through loss of human life, damage to infrastructure and the associated economic costs in rebuilding. SDG 11 aims to “make cities and human settlements inclusive, safe, resilient and sustainable” and to substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inter alia resilience to disasters by 2020 (UN Habitat, 2015b, 2016). Furthermore, the Sendai Framework (UNISDR, 2015) aims to substantially reduce global disaster mortality by 2030 through priorities for action which include “Build Back Better” in recovery, rehabilitation and reconstruction. In line with the Sendai Framework for Disaster Risk Reduction 2015–2030, the resilience of cities should be strengthened through development of quality infrastructure and spatial planning to reduce vulnerability and risk in informal settlements. This includes the development of infrastructure that is resilient, resource efficient and will reduce the risks and impact of disaster (UN Habitat, 2016).

Urban fires, particularly those in informal and low-income settlements, have been shown to be a significant extensive risk, created by a complex interaction of political, economic, socio-cultural, and physical or technical factors. Yet urban fires are still relatively invisible and neglected in disaster management policy and practice; they are the only major hazard not included as a category in the IFRC’s annual World Disaster Reports (IFRC, 2016). This neglect is due in a large part to the lack of accurate, consistent and comprehensive data on fire incidence and causal factors (LMICs generally lack the resources and capacities to create strong datasets that could inform and stimulate more effective action), partly to the lack of formal fire management capabilities and resources, and partly because tackling fire in a comprehensive manner would require a political response from all levels of government, led by community needs and interests.

Any attempts to mitigate fire risk prior to a comprehensive political response that tackles the causes of fire must also be community led. The complex socio-politico-economic landscape of each settlement means

solutions that fit one situation cannot necessarily be used in another. Therefore, community involvement is vital to ensure that any potential intervention is appropriate, achievable, and sustainable within the local context. Also vital is the participation of fire services and their roles in both risk management and response to fires, and their active engagement in developing new strategies and working methods for urban fires is essential if we are to reduce fire risks.

The challenges posed by urban fires need to be addressed under SDG 11. Effective evidenced-based fire engineering strategies implemented post-fire will help increase communities' resilience to urban fire risk, and ultimately help to create sustainable cities.

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