Water, Engineering and Development Centre
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Fires in informal settlements in India and the Philippines

by

Christopher Westwell

A research project submitted in partial fulfilment of the requirements for the award of the degree of Master of Science of Loughborough University

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Chapter 1. Introduction

1.1 Introduction

The ability to make fire is one of society"s earliest and most essential innovations, but fire poses a significant threat when it gets out of control (Alam and Baroi, 2003, p.35). The impact of fire is frequently severe and has a devastating impact on its victims. Fires which affect the poorest of the poor are especially damaging; those people who are most vulnerable to the impact of fires yet least well equipped to deal with them (Ibem, 2011, p.27). Informal settlements (or slums) are widespread in the urban areas of many developing countries. Slums are particularly vulnerable to the risks posed by many disasters and are often home to impoverished communities who are frequently the poorest and most marginalised urban population (Pharoah, 2009, p.105). Figures 1 and 2 show the scale that informal settlement fires can easily reach and begin to show the difficulties fire fighters can face in tackling such fires.

Figure 1(left): Informal Settlement fire from Manila, Philippines leaves 10,000 people homeless. (Noel Celis/AFP/Getty Images, 2011)

Figure 2 (right): A slum once home to Slumdog Millionaire actress Rubina Ali is engulfed by a blazing inferno in a Mumbai (Shripad Naik/Barcroft India, 2011)

1.2 Problem Identification

The issue of fires in informal settlements is global, with large numbers of fire incidences reported in countries throughout the world. However, 95% of the 300,000 or more deaths attributed to fire related burns per year, are from low and middle-income countries (World health Organisation, 2011, p.iv). Existing literature has succinctly depicted the threats developing countries face in the forms of disasters such as floods. However, urban fires (particularly in informal settlements) are often disregarded or only mentioned in passing. The extent to which fires pose a threat to the poorest demographic of society is

inadequately documented and therefore poorly understood, particularly in Asia which is home to the largest number of the world"s slum dwellers (UN-Habitat, 2003, p.246).

"The urban poor do not lose much sleep at night worrying about earthquakes or even floods. Their chief anxiety is a more frequent and omnipresent threat: fire." (Davis, 2006, p.127)

The seminal work of the UN-Habitat (2003) is regarded as the most comprehensive assessment of the state of the world"s slums to date. Babaiah et al. (2006) present what constitutes as the most relevant precursor to this study as they attempt to establish the facts amongst the confusion following several slum fires which occurred in rapid succession in Bangalore. Stewart (2008) examines the complex process played out in the aftermath of a particular informal settlement fire in Cape Town following her work as a counsellor in the Trauma Centre for Survivors of Violence and Torture. The most notable assessment of informal settlement fires however has been by Pharoah (2009), who focussed on the urban disaster risk of fires in informal settlements in Cape Town. His work drew on the comprehensive MANDISA database which contains the data from over 18,000 informal settlement fires which have occurred in Cape Town, South Africa alone since 1990. The scale of the problem regarding slum fires in Asia (as both a continent and specific countries) is very unclear. What the existing literature fails to show is the number, frequency, scale and adverse impacts these fires cause on an annual basis in countries such as Pakistan, India, Indonesia, the Philippines and Bangladesh.

1.3 Study Aim

The aim of this study is to assess the extent to which fires in informal settlements are an issue in urban slums within India and the Philippines. The study examines the key factors which dictate the impact and severity of urban slum fires and assesses the influence that water source security has on this. It also investigates and identifies what can be done at community and institutional levels to reduce the risk and threat of fire to urban slum dwellers.

1.4 Research Objectives

In order to meet the aim of this project, three research objectives were identified. Dividing the research aim into specific objectives assisted in determining the structure of the research and aided in evaluating how successfully the study aim has been addressed. Each objective encompassed three to four research questions. The research questions related to specific issues that needed to be addressed in order to achieve the objective.

Research objective A: To quantify the issue of urban informal settlement fire incidences in India and the Philippines.

- How many people are killed, injured or displaced by slum fires in India and the Philippines each year?
- Identify patterns and similarities between fires from different informal settlements on a national and international basis within the project area.
- Establish which population demographic are most at risk or likely to be most adversely impacted by fires in informal settlements**?**

Research objective B: Identify the factors which dictate the severity and impact of urban informal settlement fires.

- What are the direct and indirect impacts of fires in informal settlements?
- Examine the direct causes of ignition of slum fires.
- Identify indirect causes of fires and factors which create an elevated level of risk. This refers to circumstances or conditions which increase the likelihood of accidentally or deliberately starting a fire.
- What factors dictate the severity of fires and how does water source security influence this?

Research objective C: Suggest measures to reduce the risk of fire incidences.

- What can be done at a community level to reduce the threat of fires?
- What institutional or governmental measures can be taken to protect informal settlement residents?
- Determine if lessons can be learnt from the management of other disasters such as floods or earthquakes?

The term „impact" is used in this context to refer to positive or negative effects which have a strong influence on somebody or something. It is hoped that the findings of this research may be used to inform policy makers, raise awareness of the issues highlighted throughout the study and provide the basis for continued research into reducing urban poverty, addressing low cost housing solutions, slum upgrading and social welfare in informal settlements.

At the end of this study, short and long-term measures are proposed which (if implemented) are strongly considered to reduce the negative impact fire causes for slum

residents. This project addresses informal settlement fires in both an emergency disaster response scenario and as a systematic issue within society.

1.5 Geographical Focus

In recent years, there have been a number of significant fires in the informal settlements in both India and the Philippines. These are by no means the only countries to have experienced such incidents however both countries have a very high number of urban slum dwellers and have had major fire events in recent years which adversely impacted significant numbers of people. Three of the top ten cities ranked as the largest urban areas in the world are in the Philippines and India (Delhi, Manila and Mumbai) (Demographia, 2011).

The Philippines as a country, is very prone to a wide array of natural and man-made disasters. It was ranked third in a list of countries most frequently hit by natural disasters in 2010 (Citizens‟ Disaster Response Centre (CDRC), 2011). The relative intensity of natural hazards such as typhoons, floods, landslides, tsunamis, earthquakes and forest fires has been classed as „severe‟ with a „moderate‟ natural hazard relative intensity of volcano activity (Whitehouse, 1999). The capital Manila has one of the highest population densities in the world and is home to 21,295,000 people (Demographia, 2011).

Fire disasters in the Philippines are estimated to have affected 94,875 people in 2010. The Philippines Disasters report (2010), indicates that fires were the second highest cause of casualties from a disaster with 43 deaths (CDRC, 2010). What the report fails to show is any explanation of what constitutes a disaster and distinctions between different types of fires such as urban or wild fires. Figure 3 shows the distribution of fatalities from disasters in 2010 in the Philippines. It can be seen that fires cause nearly twice as many deaths as flooding.

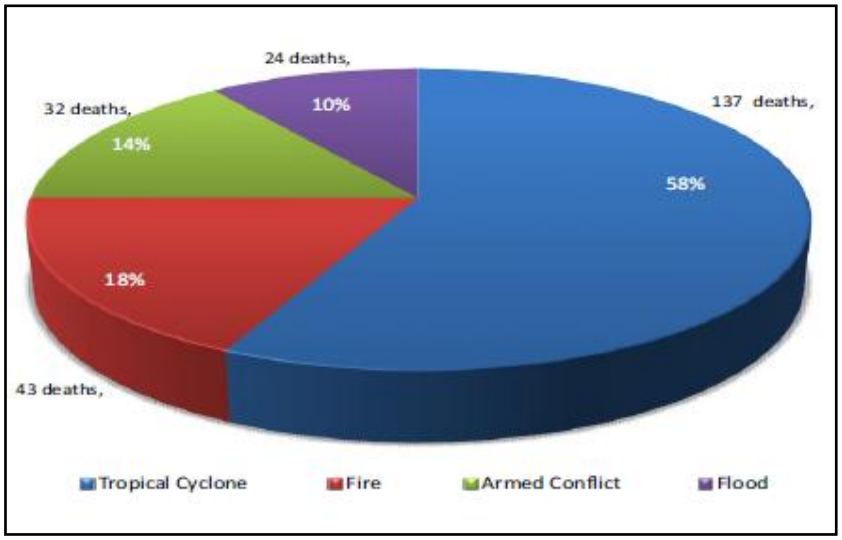


Figure 3: Top four disasters in the Philippines in 2010 according to casualties (CDRC, 2010)

In 2001, Kolkata, India had 1.5 million people (or one third of the city"s population) living in 2011 registered and 3500 unregistered slums, many of which were located on marginal or un-safe land (UN-Habitat, 2003, p213). Three Indian cities (Delhi, Mumbai and Kolkata) are in the top 15 largest urban areas in the world. Mumbai has the second highest population density in the world with 27,100 people per square kilometre and 28 Indian cities have population densities over 15,000 people per square kilometre. In comparison London has a population density of 5,100 people per square kilometre (Demographia, 2011). These extreme population density levels combined with high levels of urban poverty strongly contribute to the growth of slums. This is largely because space on which to build houses is at a premium.

1.6 Limitations

This study examines the contemporary situation surrounding fires in informal settlements in India and the Philippines. All work presented in this study was conducted between 28 February 2011 and 19 August 2011. It was not possible for the author to visit either of the countries which form the focus of the aim due to financial and logistical constraints.

The methodology adopted consisted of collecting primary data through three unstructured interviews and a questionnaire whilst secondary data was used to complete two case studies and collate a table of 20 examples of informal settlement fires which occurred in India and the Philippines

1.7 Structure of Report

Chapter one sets out the context and extent of this study. Chapter two examines the state of existing knowledge surround fires in informal settlements and identifies what is missing. The structure and explanation of the research methodology is set out in chapter three which explains what the research involved, why it was carried out and how it helped meet the research objectives.

Chapter four presents the collaborative findings from the research described in the methodology section. The findings are analysed and discussed in chapter five whilst the conclusion, recommendations and scope for future work presented in chapter six. Chapter six is followed by the list of references and finally the appendices.

Chapter 2. Literature Review

2.1 Methodology

2.1.1 The literature search

The literature review compiles and critically evaluates the work published by authors on the issues surrounding the research aim of this dissertation. It examines the contextual evidence relating to the concerns around the issue of fires in urban informal settlements. It will also examine the methodologies adopted by different authors to quantify and validate their theories and claims whilst examining which methods have been successful and why. A systematic and comprehensive approach has been adopted to ensure as much relevant information has been included and addressed as possible, yet in a succinct and concise manner. The literature review aims to identify literature from a broad array of sources in order to present a balance and well considered argument.

A rigorous and inclusive approach was taken in the search for relevant and accurate data which would help illustrate the importance and extent of the research problem. A computer based approach was used extensively to locate journals, books, news articles and videos from a variety of sources. The internet search engine „Google" and its add-on „Google Scholar" were used at length and helped locate a broad spectrum of useful information. The internet search engine „Bing" was also used as it was found different search engines return quite different results even when searching the same words. This provided and element of triangulation and helped avoid excessive bias from one search engine. The online database search engine „Metalib" was also used successfully to locate journals.

In conjunction with methods outlined briefly above, e-mail correspondence was sent to international organisations such as UNICEF, Save the Children, Plan International and World Health Organisation requesting unpublished information on the subjects addressed in this dissertation. Informal discussions were also carried out with a number of academic staff members at the Water, Engineering and Development Centre (WEDC), Loughborough University throughout the course of this research project to aid the identification of information sources. A semi-formal discussion was also held with a UK fire

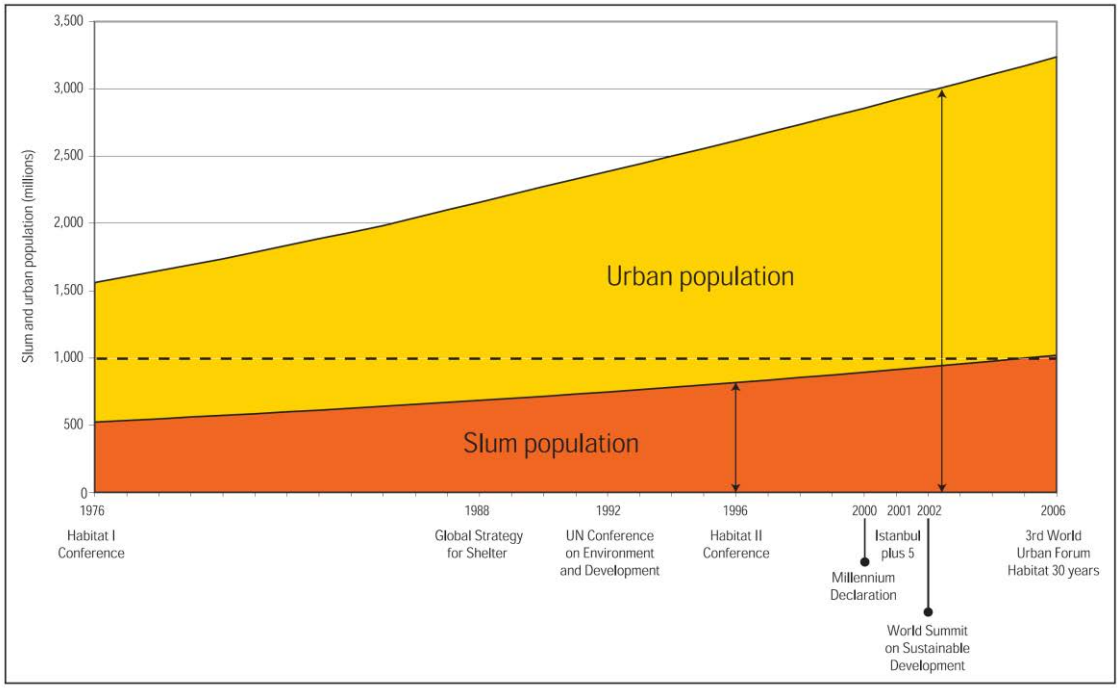
safety professional[1] to incorporate an industrial and institutional perspective to the search for relevant information. The library at the Fire Service College in the UK was also utilised to locate specialist texts.

A selection of key terms were used repeatedly and interchangeably throughout the search. These terms and variations of them were typed in the search engines and reflected the key themes of the study. The search terms used included: „fire in slums", „informal settlement fires", „urban fire in developing countries", „fire related burns, injuries and deaths", „shanty fire", „fire preparedness" and „disaster risk reduction". This list is not exhaustive but illustrates the approach taken. In addition, a useful technique adopted for finding further relevant literature, was to use the reference lists from articles to locate the original documents which could then be used. This helped identify further useful publications.

2.2 Informal Settlements

In 2003, nearly 1 billion people (or 32% of the world"s urban population) lived in informal settlements (slums); the vast majority of which were in developing countries (UN-Habitat, 2003, p.V). Asia accounts for the largest proportion of the world"s slums with Southern and Eastern Asia harbouring 80% of the continent"s slum dwellers (UN-Habitat, 2006). India alone accommodates approximately 17% of the world"s total number of slum dwellers which equates to 170 million people (UN-Habitat, 2006). It is projected that without firm and decisive action, the number of slum dwellers throughout the world will reach almost 2 billion people over the next 30 years (UN-Habitat, 2003, p xxv). An increasing global slum population is likely to exacerbate the already difficult conditions faced by many slum dwellers. Figure 4 graphical demonstrates the changing rates of global urbanisation and slum growth between 1976 and 2006. It can be seen that the rate of urban growth increases linearly but at a greater rate than that of the slum population growth, although that also appears to have a linear growth. The different growth rates may be attributed to factors such as governments increasing the priority of tackling urban poverty.

[1] Interview with Rod Harrison, Loughborough University Fire Safety Officer, Loughborough University, 10 June 2011.



Source: UN-HABITAT Global Urban Observatory 2005 and UN Population Division

Figure 4: Slum population and urban population growth in the world (1976 – 2006) (UN-Habitat, 2006)

There is an assortment of terms used for informal settlements and the houses within them. In India for example, the term „Jhuggi" is used to describe informal dwellings. In this dissertation, the terms: „informal settlement", „slum", „shanty town", „favela" and „squatter settlement" will be used interchangeably and synonymously to refer to:
"A heavily populated urban area characterised by substandard housing and squalor," (UN-Habitat, 2007).

However, further clarification and elucidation is required to reflect different cultural perceptions of what a slum constitutes. Some have described slums as a visible manifestation of urban poverty (UN-Habitat, 2007) which may illustrate how they are viewed by many people. In order to more effectively target intended improvement programmes for slums, a United Nations (UN) expert group developed an "operational definition" of slums. According to this definition, a slum area combines the following characteristics to varying extents:

- Inadequate access to safe water
- Inadequate access to improved sanitation and infrastructure
- Housing of poor structural quality
- Overcrowding; and
- Insecure residential status (UN-Habitat, 2007).

This operational definition of slums will be adopted for the duration of this study.

Urban migration and rapid population growth are anticipated to push the number of urban dwellers in the world to almost 5 billion people by 2030 (UN, 2007, p.27). By 2020, the number of people estimated to be living in slums will be nearly 1.48 billion. 57% of these people are predicted to be in Asia whilst another 27% will be in sub-Saharan Africa (UN-Habitat, 2003, p.249-252).

The lowest income residents in urban settings are regarded as the most vulnerable and the most “at risk” group to the impact of disasters such as fire, flooding, infectious diseases and earthquakes (IRFC, 2010, p.11). It is likely that with an increase in the number of people moving to informal settlements, the number of fire incidences within these settlements will increase also. This study aims to examine what can be done to reduce this threat.

2.3 Quantifying the threat of fires in slums

Davis (2006, p.127), makes the bold claim that slums, not Mediterranean brush nor Australian eucalypti (that he claims many text books would have you believe), are the world"s most premier fire ecology. His point is clear, that fires in slums are a “recipe for spontaneous combustion” however little evidence is presented to substantiate his claims. Massive fires in slums and squatter settlements are all too frequent (UN-Habitat, 2003, p.69). While it can be seen that many countries including India and the Philippines have very high slum populations, very little research appears to have been carried out into the risks posed by fires to densely populated slum settlements. This is despite frequent and often severe outbreaks of fire which are regularly reported by local, national and international media organisations. In Karachi alone, fires in informal settlements have rendered nearly 18,000 people homeless, killed 35 adults and 50 children since 1997. 28 children and 24 adults were killed just in 2009 (Urban Resource Centre (URC)], 2010, p.2). These figures only account for the recorded number of fires so the actual figure is likely to be higher as many fires may have not been reported.

Statistical data and records of fires have been very difficult to obtain. The literature collected has many statistical excerpts representing fire data from small areas or cities but no regional or national fire statistics were able to be obtained from municipal fire departments. Government disaster management centres and organisations were

identified in both the Philippines and India: the Disaster Response Operations Monitoring and Information Centre (DROMIC) in the Philippines and the National Institute of Disaster Management (NIDM) in India. However, fires records were difficult to locate and frequently inconsistent or incomplete. Fortunately, small amounts of fire data were obtained from organisations such as Delhi Fire Service (DFS) and the Philippine"s Bureau of Fire Protection (BFP). Figures were released by DFS for the period 2009-2010, however it is unclear how to interpret them. They report that DFS responded to 217(10202) J.J Cluster fires during 2009-2010, as shown in table 1, which was exactly how the data was presented (DFS, 2011). It is strongly suspected that J.J. cluster refers to an Indian slang term for slums which is „Jhuggi Jhopari" although this unconfirmed. This statistic could be interpreted to mean that the fire service responded to 10,202 fires of which 217 were in informal settlements, but the ambiguous nature of the data means this cannot be said with much confidence. This lack of clarity demonstrates part of the problem.

Year	JJ Cluster	High Rise	Industrial	Residential
2009-10	217(10202)	73	363	5071

Table 2: Occupancy wise breakup of fire incidents during the calendar year (DFS, 2011)

If the interpretation of these figure outlined above is correct, it would give the first indication as to how informal settlement fires compare to other fires in terms of proportions. 217 fires equate to just over 2% of the total numbers of fires, where as residential fires account for nearly 50% and industrial fires account for 3.6%. The main issue is that if this analysis is correct, then there are 4478 unaccounted for fires. It is likely that these refer to fires such as those from road traffic incidents although this is purely speculation.

In Bangalore, the “scary frequency” of slum fires motivated a team of human rights activists to conduct a fact finding mission in the various slums within the city. The team sent to investigate used interviews with stakeholders such as slum residents, councillors, and police officers to compile case studies of three slums. They identified that local councillors were attempting to evict the slum dwellers from the plots of land they were living on. When residents failed to leave voluntarily, heavy handed tactics and brute force were used along with frequently deliberately setting the slums on fire. Five fires were reported within the space of 10 days, which destroyed more than 300 homes (Babaiah *et al.*, 2006).

2.3.1 Deaths, Injuries and displaced people

The number and frequency of sudden outbreaks of fire in informal settlements is both overwhelming and shocking. Government data and statistics to validate this however, are very difficult to find. No records of urban fires are recorded in databases such as EM-DAT (The International Disaster Database) even though wild fires are recorded.

Between 1995 and 2004, there were 8,554 fire incidents in informal settlements in Cape Town, South Africa alone. These fires are estimated to have directly affected the lives of over 40,000 people (MANDISA cited in Pharoah, 2009, p.112). The various different slums within and surrounding Cape Town have experienced a huge number of fires each year which have been recorded in unprecedented detail and scope as can be seen from statistics such as this. Whilst South Africa is not necessarily in this study"s focus area, a notable amount of research has been conducted investigating fires in Cape Town"s informal settlements. Between 1990 and 2004, a total of 18,504 fires were recorded by MANDISA (Monitoring, Mapping and Analysis of Disaster Incidents in Southern Africa) in Cape Town. This includes fires which affected formal and informal dwellings, commercial properties, industry and institutional buildings.

To put urban slum fires into context, informal settlement fires accounted for an average of 47.5% of the total number of fires recorded over this period. This equates to 8,787 fires (MANDISA cited in The Disaster Mitigation for Sustainable Livelihoods Programme (DiMP), 2006, p.11). Both DiMP (2006) and Pharoah (2009) quote MANDISA however their figures differ. Although the time periods also differ, the table DiMP quotes as being from MANDISA indicates that only 7,426 informal settlement fires occurred over the period 1995 to 2004 as opposed to Pharoah"s 8,554. Reasons for this discrepancy could be attributed to factors such as additional data coming to light between DiMP (2006) and Pharoah (2009) publishing, misinterpretation by either author however unlikely or the authors using different constants or parameters to interpret the data. The number of „disasters" attributed to fires, transport and industrial accidents is much higher in low and middle-income countries than high-income countries (IFRC, 2010, p.13).

The Philippines Disaster Report 2010 reported that there were 123 fire incidences in the Philippines in 2010, the majority of which occurred in "urban centres, particularly in congested urban poor communities," (CDRC, 2010). It is difficult to substantiate this figure as no explanation of how it was calculated or how fires were recorded is given. It is even more difficult to digest when Jannaral (2011) states that statistics released by the BFP

report that in the National Capital Region (NCR) (Metropolitan Manila) there were 1,576 fires in the first quarter of 2010 alone. In first quarter of 2011, 1,040 fires have been reported in the NCR. Region 6 (or Western Visayas) has the second highest number of fires reported with 793 fires in the first quarter of 2010 and 227 between January and July 2011 (Jannaral, 2011).

The NCR refers to the metropolitan region encompassing the capital and its surrounding areas (see figure 5) which comprises of 16 cities in total. The only data that could be found published by the BFP, related to fire incidences in the second quarter of 2010 and 2011. The NCR is of most relevance when considering fires in informal settlements in the Philippines as it encompasses the most densely populated areas (the major cities). The full table with fire data from each district can be seen in appendix A however a summary of the data from the NCR is presented below in tables 2 to 5. Crucially though, none of this data reflects the number of fires that occur in informal settlements as no detail is given at all.

Figure 5: Map showing regions of Metropolitan Manila (Metro Manila) (Island Properties, 2002)

	2010			
	APR	MAY	JUN	Total
No. of fires	531	413	261	1205
Estimated damages (PhP)	80,500,000	139,000,000	17,500,000	237,000,000
Estimated damages (£"s)	1,160,000	2,000,000	252,000	3,410,000

Table 3: Fire incidences in NCR, 2010 (BFP, 2011)

	2011			
	APR	MAY	JUN	Total
No. of fires	469	354	295	1118
Estimated damages (PhP)	118,000,000	40,200,000	45,400,000	204,000,000
Estimated damages (£"s)	1,710,000	579,000	654,000	2,940,000

Table 4: Fire incidences in NCR, 2011 (BFP, 2011)

Key: Fire fighter (F), Civilian (C)	2010						
	APR		MAY		JUN		Total
	F	C	F	C	F	C	
No. of injuries	4	22	2	13	2	22	65
No. of fatalities	0	3	0	4	0	1	8

Table 5: Fire casualties in NCR, 2010 (BFP, 2011)

Key: Fire fighter (F), Civilian (C)	2011						
	APR		MAY		JUN		Total
	F	C	F	C	F	C	
No. of injuries	3	35	4	3	1	3	49
No. of fatalities	0	10	0	3	0	1	14

Table 6: Fire casualties in NCR, 2011 (BFP, 2011)

A number of significant points can be taken from table numbers 2 and 3. Firstly, the NCR has a significant number of fires. If these figures represented an average quarter then there would have been over 9000 fires in two years equating to £16.5 million worth of damage. On any level this is a huge amount of money and demonstrates that fires have a significant impact financially. What hasn"t been evaluated is the proportion of this cost attributed to fires in informal settlements. There is significant room for interpretation in

these figures as only a portion of the annual data is shown. The months with the lowest rainfall in Manila are typically January to April (World Weather, 2011) which would suggest that the previous quarter may have had a higher number of fire incidences and the subsequent quarter would have fewer fires as it would be monsoon season typically.

The casualty rates from the fires seen in tables 4 and 5 are also alarming. The number of injuries reduces from 2010 to 2011 however the fatalities increase markedly. Assuming these figures again represent average quarters for 2010 and 2011, over 450 people would have been injured and nearly 90 people killed over the two years. This would have a substantial impact of on the lives of the victims and their families. What is not clear, are the profiles of the victims in order to identify who is most vulnerable to these fire incidences.

Obanil (2011), states that according the BFP in Manila, fire incidents in the Philippines have increased dramatically in recent years. It"s claimed that there was a huge increase from the 2009 figures by 3,500 incidents which is an enormous leap considering only 4,850 fires were recorded in 2010. It"s difficult to believe this completely, especially if this dramatic increase is solely influenced by increasing numbers of fire outbreaks. It is possible that the way in which fires are recorded by the BFP may have been significantly improved resulting in a much more accurate representation of fire events and therefore many more being recorded. It is also possible that the data may have been misinterpreted by Obanil (2011) as the article is from a news agency as opposed to a peer reviewed journal where there is more quality control. Nevertheless, if the information is to be believed, 3,700 out of the 4,850 fires reported, occurred in residential areas. Unattended candles, stoves and cigarettes were common causes with electrical faults accounting for the most fires. What is not said, is the proportion of these fires which occurred in informal settlements which is likely to be a large number.

Little is understood about how individuals survive when faced by a disaster and even less is known about recovery, which is argued to be the least understood phase of disasters (Stewart, 2008, p2).

Fire Size

Pharoah (2009, pp.119-120) identified that in the majority of informal settlement fires in Cape Town (63%), fewer than 10 dwellings were destroyed. Just under one third of fires

(31%) destroyed no dwellings at all whilst 6% destroyed more than 10 houses. This data relates to fires recorded between 1995 and 2005. During that time, only a minority (49 incidences out of 7426) destroyed more than 49 homes with the exception of one area where 6% of fires destroyed 50 dwellings or more and 28% of incidences destroyed more than 9 dwellings. This data suggests that the vast majority of fires are relatively small. The significant implication of this is that many of these fires are unlikely to be reported on a large scale by the media. In this event, if a similar situation is occurring in the Philippines and India then it is unlikely that information of small fires will be available if records from fire departments cannot be accessed. It is likely that information on larger fires (those which destroy 10 houses or more) will be more readily available.

2.3.2 Who is most at risk?

The research of Marsh *et al.* (1996) investigated the epidemiology of adults hospitalized with burns in Karachi with particularly interesting results. The profile of a typical adult burns victim was that of a:

"Young, uneducated woman, wearing loose clothing, injured in the kitchen, around a stove, who ignorant of fire safety, experienced prolonged contact with fire, received no first aid training, was transported to the hospital in a common carrier, had 57 per cent TBSA [total body surface area] burned, and died after 2 days." (Marsh *et al.* (1996)).

This profile describes a number of aspects which may be representative a female slum dweller although it is not possible to accurately confirm this. However, in their study, Marsh *et al.* (1996) estimate that 40% of the 10,000,000 people who live in Karachi, live in slums and that under the present conditions, a 15 year-old girl has a 1.3% chance of burning to death before her 60th birthday. In addition, burns injuries account for three times as many deaths for woman as they do for men (3.6% for woman as opposed to 1.2% for men) (Marsh *et al.,* 1996, p.225).

In 2004, 9.1% of all under 17 year-olds deaths caused by injury, were as a result of fire related burns. The total number of deaths as a result of injuries for under-18-year-olds over the same period was 950,000. The number of children killed as a result of fire or flames in low-income countries is 11 times higher than that of high-income countries (Towner and Scott, 2008, p.4-6).

One of the most vulnerable groups of people within these settings is commonly children. Left alone for periods of time while parents are working, searching for jobs or buying food,

there have been numerous incidences where children have perished in fires, unable to escape. There have also been incidences when unsupervised children have caused fires as they attempt to keep warm or cook with open fires and stoves which all too frequently end in tragedy (The Times of India (TOI), 2010) .

Children are particularly susceptible to the dangers of disasters; they may not know when to flee or where to flee to but they are even more vulnerable when separated from their parents and families. It may be difficult for children to understand exactly what is happening and they can easily become distressed. In most disasters (not just fires), children account for more than half of those affected or killed (Save the Children, 2011).

In 2004, it was estimated that nearly 96,000 children (under the age of 20) were fatally injured as a result of fire-related burns (WHO, 2008 p.80). This type of injury is the 11th leading cause of death amongst 1 to 9 year-old children. In addition to this, fire related burns are the most prevalent cause of disability-adjusted life years (DALYs) lost in low and middle income countries (WHO, 2008 p.80). The proportion of child deaths attributed to fire-related burns can be seen in figure 6.

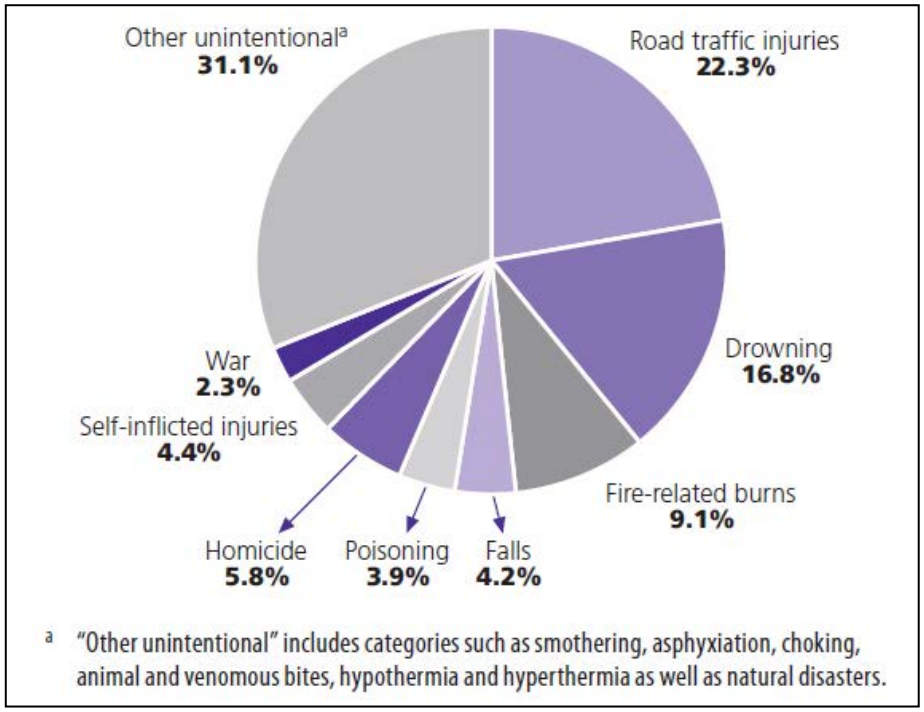


Figure 6: Distribution of global child injury deaths by cause, 0-17 years, World 2004 (WHO, 2008).

In 2004, fire related burns were the world"s 7th highest cause of death in people aged 15 to19 years old (Towner and Scott, 2008). Burns are also a leading cause of adult death in Karachi slums (Marsh *et al.* 1996).

The urban poor have little means to recover after serious fires. Babaiah *et al.* (2006) make the significant point that fires often destroy in a few hours, what families have built up incrementally over a period of years. What little money families have to spare, is used to improve their standard of living a small measure at a time.

The location of where people live also plays a role in the risk they face from fire. Residents who live in the middle of slums have further to travel to escape a fire and less time to react than people living at the edge who may be to escape very quickly. Multi-storey dwellings are also a higher risk than single story dwellings (Pearlman, 2011).

2.3.3 Identifying patterns and similarities between fires

Sharma (2009) draws attention to the significant disparity in the lack of reporting and media attention that urban slum fires incidences in Mumbai, India receive. She observes that wealthier areas in the city feature much more prominently in the local media in the event of a fire than informal settlements. She also claims that the root causes of these accidents or disasters are not taken seriously nor investigated appropriately.

The issue of fires in informal settlements often raises mixed emotions and highlights other underlying issues within urban society. In many cases, slum dwellers feel ignored or rejected by municipal bodies and governments who wish to deny the slum"s existence.

There is an increasing need for awareness of urban risks in the world"s rapidly urbanising population (IFRC, 2010, p.11). Overcrowded housing conditions, poor quality construction materials and shoddy electrical wiring pose a significant risk of causing a fire outbreak in informal settlements (Amnesty International, 2011; Ono, 1997, p.21). Moreover, high population densities, disordered occupancy and narrow, congested access routes further exacerbate the situation (Ono, 1997, p.21).

In the Philippines, it is acknowledged that there is an elevated level of fire risk during festive periods due to the use of firecrackers, excessive use of electrical lights and late night parties. Although no official figures could be found, the Philippine"s chief inspector

Honee Fritz Alagano spokesman is reported to have indicated that most fires in Metro-Manila occur in the city"s half-a-million slum houses (IRIN, 2011).

It is common for local authorities to refuse to extend services such as water distribution networks and sewers to informal settlements (Bapat and Agarwal, 2003, p.71). No statistics are available on the proportion of urban populations covered by good quality fire services (IFRC, 2010, p.17).

Factors surrounding fires in informal settlements are often complex. Murphy (2011), a social commentator and urban poor activist in the Philippines, claims social observers can see a positive correlation between the government"s desires to clear land and fires, particularly if legal challenges to clear the land are unsuccessful. The claims Murphy makes (2011) are further fuelled by Rutledge (2011) who observes an „alarming trend" in the number of fires in areas of urban poverty which are followed by forcible eviction. Rutledge (2011) claims that in certain areas of Manila, after a fire has been extinguished, residents have been prevented from returning to their homes without the provision of alternative housing or compensation further exacerbating the losses already encountered.

2.4 Factors which dictate the severity and impact of slum fires

2.4.1 Direct and Indirect impacts of fire

In the immediate aftermath of major fires, much of the devastation is easy to see. However, fires can have a knock-on impact to other services. Less obvious impacts can include the loss of service provisions such as water supply and sanitation facilities. Water tankers and mobile toilets were needed following a fire which destroyed a large number of houses in Bandra, India (The Hindu, 2011). In cases such as this, residents may not only have lost their dwelling and worldly possessions but also access to sanitation and with that potentially an amount of dignity and security (Amnesty International, 2011).

The less obvious impacts also include residents displaced by a fire outbreak regularly and indirectly put pressure on friends and relatives who feel a moral and emotional obligation to help (Bahaiah *et al.*, 2006; Amnesty 2011)). There is also increased financial pressure on fire victims not only from the loss of property by the loss of a means to earn a living and therefore a livelihood. Seabrook (1996, p.272) points out that many slum residents in Manila are pedicab drivers for which they rent an 8,000 pesos pedicab out from the owner for 55 pesos per day. If a rented pedicab were to be destroyed in a fire, the financial

pressure on the individual to repay the debt would be huge. Sharma (2009) claims that in Mumbai more than half the population live and work out of slums. Bahaiah *et al.* (2006) observes that in slum fires in Bangalore, a large number of pushcarts were destroyed which many people relied on to help earn a living. All these factors negatively impact the ability of fire victims to recover after a fire by also destroying their means to earn a living.

Education may be affected by fires even if school premises are not damaged. Individuals" personal documentation is often destroyed if a fire spread very quickly or residents are not at home to save their possessions. Amnesty International (2011) has brought attention to the importance of documentation (such as birth certificates) required to register children for primary schools for example.

The constant threat of eviction for many slum dwellers is terrifying. Awareness of incidences where fire has been used as an eviction tool are easy to find in newspaper reports. Whilst the threat of fires may seem obvious, proactive fire strategy planning seems completely absent in many slums. Little if any research has been carried out to determine how the threats parents face as tenants (either legal or more often illegal) affect the children in their care. This goes beyond the immediate impact of losing a sibling, parent, other family member or friend and incorporates the much less well documented aspects such as DALYs, loss of education, loss of family income and impact on water and sanitation.

2.4.2 Direct causes of fires

The illegal use of electricity for heating and cooking devices malfunctioning can easily ignite the inflammable materials informal dwellings are often made from (City of Cape Town, 2009). Materials selection for building informal dwellings have been repeatedly identified as a primary factor in the easy ignition and rapid spread of slum fires (Davis, 2006, p.127; Sharma, 2009; Pharoah, 2009, p.113)

One of the most alarming and disturbing causes of fires in slums is arson. Fire is commonly used by property developers as an eviction tool (Seabrook, 1995, p.271; UN Habitat, 2003, p.69; Davis, 2006, p.127; City of Cape Town, 2009). Singh (1985, p.2242) identified the use of fire by criminals to evacuate people from their houses which were then looted before the fire reached them. Berner (cited in Davis, 2006, p.127) is quoted describing a horrific way that certain Filipino landlords set fires to slums. It involves soaking a rat or cat (as “dogs die too fast”) in kerosene, setting it alight and then chasing it

into an “annoying settlement” which can set fire to a number of shanties before it dies creating a fire which is hard for fire fighters to fight (Berner cited in Davis, 2006, p.127).

Electrical faults are reported as frequent cause of fires in many slums (Junbesh, 2011). Alam and Baroi (2003) identify that 34% of fires in Dhaka city are attributed to electrical faults. It is acknowledged that a lack of service provision in terms of legal and regulated electrical connections forces residents to rely upon flammable sources for heat and light (Pharoah, 2009, p.112; Davis, 2006, p.127). Fires in Sao Paulo favelas are frequently attributed to the misuse of 13Kg liquefied petroleum gas cylinders used for cooking (Ono, 1997, p.21).

Davis (2006, p.128), identifies the potential benefits for slum leaders in Bangalore of deliberately using fire as a means of forcing the government to compensate and redevelop communities which they can then cash in on. Pharoah (2009, p.113) notes that research into informal settlement fires in Cape Town suggests that fires may be closely linked with alcohol abuse and domestic violence.

2.4.3 Indirect factors and causes

Rapid urban growth has been identified as a major contributing factor to the sprawling growth of unsuitable and unsafe housing in cities. Many families have no alternative other than to live in appalling conditions. In cities such as Sao Paulo, old residential houses which have fallen into disrepair now accommodate multiple families resulting in cramped and unpleasant conditions (Ono, 1997, p.21).

The speed at which a fire spreads is a fundamentally important issue as it dictates how long people have to escape. Haphazard electrical wiring which often connects homes, has been identified as a common route for fire to spread (Amnesty International, 2011).

The flammability of child clothing (especially night ware) has been identified as a notable problem. Addressing the fire resistance of fabrics through legislative enactments has shown to virtually eliminate this type of burn in certain cases (WHO, 2011, p. ix).

Slums are frequently located on illegal land, land with an ambiguous legal status or as Gehander and Mörnhed (2008, p.20) observe, land which is often hazardous for building and living on. This is often a result of rapid urban growth which forces people to build shelters in locations which they would normally avoid such as rubbish dumps (Manila),

flood plains (Cape Flats), swamps and even rivers (Lagos). In the Philippines, it"s claimed that authorities have turned a blind eye to mushrooming slums in precarious locations such as near river banks, along waterways an in the city dumps (Integrated Regional Information Networks (IRIN), 2011). In Mumbai, more than half of the city"s population do not have the legal tenure of the land their property occupies (Patel, 2004, p.339).

Ono (1997, p.20), makes the case that masonry structures, prevalent in Sao Paulo, Brazil at the start of the 20th century, were a significant contributory factor in the low number of fire incidences at the time. Ono (1997, p.20) also states that: "...fire losses recorded in the province of Sao Paulo were small due to the way its buildings were constructed." The flammability of slum dwellings is largely due to the low cost and flammable nature of the materials used for construction such as wood and plastic (Junbesh, 2011). More expensive materials such as concrete are much less susceptible to fire and offer greater fire resilience.

As many slum dwellers are extremely poor, a large majority of them don"t pay taxes and are subsequently seen as criminals (IRIN, 2011). It took two major fire tragedies to draw enough attention to a complete lack of fire regulations in Sao Paulo, Brazil for action to be taken. In these two high-rise building fires, a total of 195 were killed and more than 329 injured (Ono, 1997, p.20).

The impact of water

Slum characteristics often prevent fire fighters from reaching the origin or epicentre of a fire (Ono, 1997, p.20). Access routes for emergency services into slums (which are typically very densely populated and overcrowded (UN-Habitat, 2003, p.5)) are frequently blocked by debris and clutter or are too narrow to accommodate even small emergency vehicles (IRIN, 2011; Sharma, 2009; Gehander and Mörnhed, 2008, p.20). This lack of access slows or completely prevents emergency services taking fire fighting equipment closer to a fire thereby increasing the time it takes to begin fire fighting and reducing the effectiveness of their fire fighting capacity (Amnesty International, 2011). Fire services are also faced with the difficulty of sourcing reliable and sufficient quantities of water in order to effectively attempt to quell fires (Ono, 1997, p.21). A lack of publicly provided fire-fighting systems has also been acknowledged by UN-Habitat (2003, p.69) as factor in frequent outbreaks of slum fires. In countries such as the UK, legislation requires building owners and landlords to provide a way to extinguish a fire such as fire blankets,

extinguishers, sprinkler systems or fire hoses. No evidence of such precautions was found with regards to equipping the public in slums in a similar fashion.

As slums are often not recognised by local authorities they infrequently have a piped water connection. A lack of water diminishes the capacity of fire services to fire fight effectively, which allows the fire to spread quickly and easily between buildings (Amnesty International, 2011). Even when water mains are available in close proximity to slums, very few may actually work. An example of this is in Mumbai where Sharma (2009) claims that half the population live and work in slums yet only 1,503 hydrants out of more than 10,300 actually work. However, Ashar (2010) reveals that a Brihanmumbai Municipal Corporation (BMC) report found that 66% of fire hydrants in all of Mumbai were not in working condition. Ashar (2010) claimed that 6,223 of Mumbai"s 9,499 hydrants were not operational and need repairs. This discrepancy between the numbers of fire hydrants is quite large. However, the point both authors are attempting to make is that there is a severe lack of capacity in the water infrastructure to enable the fire service to effectively combat fires in Mumbai. This may be as a result of a number of issues but the net effect is that the fire fighting capacity of the emergency services is greatly diminished. This is likely to increase the severity of the impact fires have on Mumbai"s population.

Delhi Fire Service (2011), report that the water sources they utilise for fire fighting are somewhat restricted. Fire Hydrants are available in the city but only for a few hours in the morning and evening each day. 302 static underground water tanks are the main sources of water supply for the fire services. The fire service is also able to draw upon 7640 fire hydrants, two canals and one river in the National Capital Territory. Sharma (2009) identifies that fire fighters may not be trained or well enough equipped to deal with fires in such densely populated areas. She claims that at a public hearing into a fire in a slum in Behrampada, Mumbai, a fire officer explained that the hoses they were equipped with were not long enough to reach into the centre of the slum where the fire was. Fire appliances were unable to get any closer to the fire due to restricted access.

The USA National Fire Protection Association (NFPA) suggests that the apparatus of fire services should include pumps which are capable of delivering between 3785 l/min and 5678 l/min to protect large industrial districts (Rosenhan, 1981, p.15-65). Delhi Fire Service (DFS) has 98 water tenders which have a water storage capacity of 5000 litres with pumps capable of discharging 1800 l/min (DFS, 2010). This is the minimum size recognised by most insurance rating groups according to Rosenhan (1981, p.15-65). DFS also has 23 water tankers which can carry 12,000 l of water. The largest assets DFS has

are six aerial ladder platforms which have pumps capable of discharging 3000l/min (DFS, 2010). At maximum discharge, a water tender would empty itself and a full water tanker in less than 10 minutes. An aerial ladder platform could empty a water tanker in four minutes. This demonstrates the amount of water used in a fire and how significantly a lack of water infrastructure to provide this may be. Many fires are reported to take a number of hours to extinguish.

In Bombay, reports of water being held to ransom have been identified. In communities where water supplies are not secure, local thugs have illegally connected to water mains intended for fire fighting purposes as no other water supplies come near the informal settlement. If thugs are challenged, they cut off the entire water supply (Bapat and Agarwal, 2003, p.81).

2.5 Reducing the threat of fires

In developed countries such as the UK, fire safety measures and regulations may be seen to be taken for granted and have become well engrained in society. Examples are: school registers, fire alarm drills and emergency signage.

2.5.1 Community initiatives and interventions

The severity of a fire and how quickly it is brought under control after the alarm has been raised is directly related to the fire"s overall impact. No literature could be found to suggest to what extent smoke alarms are used in India or the Philippines let alone in informal settlements. In the UK, it is claimed that people are more than twice as likely to die in a fire at home if they do not have a smoke alarm. A fire alarm is the cheapest and easiest way to alert people of the danger of fire and enable them to escape (Directgov, no date).

Fire services in Cape Town urge informal settlement communities to be very wary of starting fires and to be vigilant in reporting fires as they have identified a tendency of people not to report fires as they think someone else has done so already (City of Cape Town, 2009).

In the event of a fire, suppressing the flames as quickly and effectively as possible would significantly reduce the likelihood of a fire becoming out of control. Disposable, one use, powder or water fire extinguishers are quite low cost and would be very well suited to this

purpose. Little information was available to say that thought had been given to trialling a similar idea. Fire blankets may also be suited to similar applications.

Save the children have carried out youth group training in slums in Dhaka which involves children identifying hazards and dangers themselves by walking around the area they live in and discussing what they see as a group (Pearlman, 2011). Such precautions place the emphasis on communities to take responsibility for their own fire safety

2.5.2 Institutional interventions and measures

This section refers to the actions that can be taken by public and governmental bodies and institutions such as local councils and national governments to reduce the threat and impact of fires. The speed and capacity with which emergency services are able to tackle a fire has a significant influence on the outcome of the fire. Ensuring fire fighting resources are appropriately dispersed around cities reduces the amount of time it takes to reach any one location. Once a fire has been noticed and the decision made that the emergency services (primarily the fire service) will be required to attend, time is of the essence.
Surrounding the limited capacity of African governments to undertake risk awareness and reduction work relating to disaster risk, there is a lack of political priority allocated to urban disaster risk (Pelling and Wisner, 2009a, p.5).

It has been acknowledged that there is an increasing need to make disaster risk reduction a higher priority than it currently is, particularly in relation to urban risk. The speed of urbanisation in the developing world is lead by Asia (Shaw *et al.,* 2009, p. i).

A decrease in the number of fires in informal settlements in Cape Town has been attributed to education of fire awareness through the use of pamphlets prior and during the „fire season". This formed part of a campaign by staff from the Disaster Risk Management department (City of Cape Town, 2009). The importance of the capacity of fire services in tackling informal settlements fires has been acknowledged in South Africa. New fire appliances with 4x4 capabilities have been purchased with the specific goal of assisting fire fighters to tackle fires in mountainous and informal settlement areas (City of Cape Town, 2009).

Legislation has been utilised to make it illegal for people to start fires in areas of „extraordinary fire hazards" which includes the burning of rubbish and similar acts (City of

Cape Town, 2009). In doing this, legislation is being adopted as a deterrent and enabling people to be held accountable for negligent and irresponsible acts.

A novel yet potentially very effective way of improving the response time of emergency services may be to use motorbikes specifically modified to carry fire fighting equipment (see figure 7). Reducing the time taken for emergency service to begin extinguishing a fire could significantly reduce the impact of informal dwelling fires. Such motor bikes have been adopted in developed countries such as the UK, Sweden and Denmark and have been introduced into cities such as Delhi already (Indian Express, 2009). Their ability to cut through traffic to reach a fire quickly and also reach hard to access areas which are notoriously difficult for traditional fire appliances to access could be instrumental in extinguishing small fires before they spread too quickly. The bikes which have been brought into service optimise the use of water through „Water Mist Technology" unlike traditional fire extinguishers (Indian Express, 2009). Using multiple bikes for single fires would further enhance their effectiveness.

Figure 7: Motorbike fire appliance in action (Merseyside Fire and Rescue Service, 2010)

2.5.3 Disaster management and preparedness

Disaster Risk Reduction (DRR) is an activity carried out by governments, aid agencies and communities that helps prepare, mitigate, adapt and increase resilience towards the impact of disasters (Save the Children, 2011). DRR activities have been widely used to address the threat posed by disasters such as: flooding, tsunamis, earthquakes, volcano eruptions and cyclones. Many of the DRR activities used for these types of disasters could be adapted to suit urban slum fire incidences.

Pelling and Wisner (2009b, p.46), identified that making change in relation to DRR requires three levels of engagement: institutions, policies and techniques. Pelling and

Wisner (2009b, pp.48-59) identified the following techniques for managing urban disaster risk reduction:

- Development planning
  - Land use planning
  - Transport planning
  - Critical infrastructure
- Development regulation
  - Building control
  - Pollution control
  - Traffic regulation
- Risk management
  - Vulnerability and risk assessment
  - Building local resilience: vulnerability reduction and hazard mitigation
- Risk response
  - Early warning
  - Emergency response and reconstruction planning

Nearly all these techniques are directly relatable to reducing the risk of fires in informal settlements. The ten actions (or themes) are organised into four areas of professional practice. These actions can all be adopted and worked with by municipal government, developmental or humanitarian NGO or community organisation (Pelling and Wisner, 2009b, p.59)

Sharma (2009) argues that the issue of disastrous informal settlement fires in Behrampada were compounded by an absence of a plan on how to deal with displaced victims who have lost their homes. She claims that a month after a fire, people were still had no replacement accommodation.

The vulnerability of those in many developing countries is strongly influenced by the difficulties many face in recovering from large impact fires. The economic impact for businesses may be prolonged as only 1% of businesses and households in low-income countries have catastrophe insurance compared to 30% in high-income countries (IFRC, 2010, p.17).

2.6 Summary

The literature presented in chapter two has identified that whilst many fires appeared to occur in both India and the Philippines, governments are not forthcoming with the statistics from those fires. Where statistical information was available, the data was unclear, difficult to interpret and gave little or no indication of what proportion of fire incidences could be attributed to slums. Many of the direct causes of fires are as a result of faulty electrical wiring, open fires, candles and gas cylinders. The impact and severity of fires are strongly influenced by the response of fire services and their capacity to extinguish fires. Simple steps taken at community levels such as improved fire awareness training and education are likely to reduce the frequency of fires. There appear to be a number of similarities between fires and natural disaster disasters in terms of how stakeholders address disaster risk reduction strategies.

Chapter 3. Methodology

3.1 Introduction

This chapter documents the methodology that was implemented to locate, collect and analyse the data used to inform the subsequent chapters of this study. It explains how the data was collected and justifies the approach that was taken to do this.

Chapter 1 set out the aims and objectives of this study. The aim is to assess the threat of urban slums fires in India and the Philippines. In doing so, to also explore measures at community and institutional levels, which are likely to help reduce the risk of fire to slum residents. The research objectives are:

Research objective A: Quantify the impact of fires within the project area through an assessment of number of deaths, injuries and displaced people slum fires annually. Identify similarities between fires locally, nationally and internationally. Identify the most „at risk" population group and any common factors associated with the circumstances surrounding fires.

Research objective B: Identify those factors which dictate the severity and impact of a given fire and establish if slums are more „at risk" than other parts of cities. Examine common causes of fires and assess how fire severity is influenced by water source security.

Research objective C: Suggest measures to reduce the risk of starting a fire accidentally. Recommend actions that can be taken at community and institutional levels to minimise the overall impact of fire. Establish whether there is scope for cross learning from disaster preparedness events elsewhere such as floods or earthquakes.

The areas on which the focus of this study is concentrated are India and the Philippines due to their high level of slum populations, lack of existing research on fire incidences and high number and frequency of slum fire incidences. This catchment area covers a combined geographical land area of 3,271,363 km^2 and nearly 1.3 billion people (Central Intelligence Agency, 2011)). An in-depth analysis of each country's slum fire demographic is beyond the scope and capacity of this study. However, it is intended that an insight into specific situations which may be representative of other regions or countries with similar circumstances can be gained from the research undertaken and methodology applied.

3.2 Research Design

The concept of the research process was to explore the opinions and experiences of those stakeholders who were directly affected by fires in slums; to collect contextual, contemporary data which accurately depicts the current situation and circumstances surrounding fires in slums.

The primary emphasis of this study is to depict the current, contemporary situation regarding fires in informal settlements. It is anticipated that the nature and circumstances surrounding informal settlements fires changes and progresses on a frequent basis. Such changes may quickly render recommendations based on historical data outdated.

Due to the evolving nature of the research topic, the framework adopted to collect and analyse the data amassed during the course of this research was required to be flexible. A flexible research design process develops during the data collection and is most commonly associated with qualitative approaches, although it may incorporate an amount of quantitative data (Robson, 2002 cited in Walliman, 2006, p.42).

In order to gather information related to the circumstances surrounding slum fire incidences, it was essential to incorporate the opinions and experiences of people who had been in such situations. As it was not possible for the author to visit any slums due to the reasons listed in the limitations, it was necessary to rely upon others who had been directly involved or had experiences of such situations. Primary data was gathered through formal interviews with stakeholders. The format of the initial interviews was unstructured whilst the extent of the research problem was still being explored; however as the need for greater detail developed, a targeted questionnaire approach was adopted.
The primary and secondary data collected as part of the research were a combination of qualitative and quantitative data. Qualitative data are used to examine the meaning of social phenomena through the experiences of the individuals themselves in their natural context (Malterud, 2001). The qualitative data that was collected was used to analyse events which could not be represented or described though numerical and statistical data alone such as the emotional and psychological impacts of fires.
Quantitative data formed the basis of examining the extent of the problem through numerical representation. 20 examples of fires, 10 from India and 10 from the Philippines were taken and data collected on those fires. The purpose of this was to illustrate what were considered to be typical causes, impacts and effects of slum fires. These fires were not intended to be representative of the entire countries they were taken from and

therefore no specific sampling technique was employed or geographical considerations taken into account. The intention was to establish a clearer picture of common themes within the fires not to represent the full extent of the problem as it was considered such a small number of fires would not accurately achieve this.

Information about the fires was collected (where possible) with a view to addressing mainly research objectives A and B: quantifying the threat of fires and identifying their causes and impacts. Secondary data, published by governments and the media, provided the details about slum fire incidences which enabled the circumstances to be documented and then analysed to assess the impact of those fires. Unlike case studies, the depth and detail of information collected was relatively shallow. However, this provided a quick and concise overview of each fire which was sufficient for the purpose of gaining a broader understanding.

3.2.1 Stakeholder identification

A stakeholder identification process was carried out in the early stages of the study to identify all the key parties who may have a vested interest in any informal settlement fire. The purpose of this was to identify organisations or individuals that could be approached in order to provide their perspective and opinions on the research objectives. This helped ensure a balanced and well considered argument was presented. By examining the interests of the different organisations and individuals, it was anticipated that relationships and the behaviour between the different parties could be more easily understood. The intentions of the different stakeholders within the slum may be very dissimilar and could be a critical factor

Stakeholders were identified through two methods. Initially, core stakeholders were identified through the literature review. Simultaneously, media reports from fire incidences regularly mentioned the names of individuals and organisations that were affected or involved in fire events.

Potential stakeholders of a large fire (a fire which destroys more than 10 dwellings) in any given slum are likely to include:

- **Slum residents** – home owners who are living in their property
- **Slum tenants** – people living in rented accommodation
- **Potential residents** – people who want to live in the slum but currently don't
- **Landlords** – people who own properties or the land on which properties are located

- **Property developers, builders, local businesses and industry** – individuals or organisations which may wish to acquire the land on which the slum is located
- **Informal sector businesses** – businesses which operate within and are located in the informal settlement
- **Customers of informal sector businesses** – people (either within or outside the slum) who rely on informal sector businesses to provide them with a service or items
- **Non-Governmental Organisations (NGOs)** – local, regional, national or international organisations who operate in the slum independently of any government
- **Religious organisations** – organisations which may represent the spiritual faith of many slum residents
- **Fire service –** private or state operated organisation which is tasked with extinguishing fires and investigate cause where appropriate.
- **Police –** maintain public order and investigate fire if necessary
- **Healthcare service –** private or state run body which provides hospital treatment and emergency medical response to fire
- **Municipal organisation –** responsible for housing and social welfare of residents, transport infrastructure and service provision
- **Academics and researchers**
- **Politicians –** elected representatives of local government
- **Media –** TV, newspapers, radio etc.

The interest of many of these stakeholders varies dramatically.

3.3 Research Methods

The stakeholder identification was a valuable tool which helped determine which stakeholders should be incorporated into the data collection process. It would have been preferential to include contributions from all stakeholders however this was not possible due to logistical challenges, limited resources and time restrictions. A large number of stakeholders however were contacted to request their cooperation in contributing to this study.

The opinions and perspectives of stakeholders were represented from primary and secondary data collection. The selection of stakeholders for primary data collection was based on two main criteria: that they could be contacted in order to discuss aspects of the

study and that they were to provide a contribution that aligned with satisfying the research objectives. The media was a valuable source of secondary data as they frequently incorporated comments or responses from a variety of stakeholders. These stakeholders included: slum residents, landlords, fire service officials, the police, politicians, municipal organisations and the media themselves.

Primary qualitative data collected from stakeholders was gathered through telephone interviews and a questionnaire. The stakeholders that were selected for primary data collection were: NGOs and academics or researchers. This represented stakeholders who may have the most holistic view of informal settlement fires. This also reflected stakeholders that weren't represented through the secondary data sources and who would most likely to able to answer many of the research objectives.

This data collected from the stakeholder interviews was fundamentally qualitative data as little numerical data was given. The discussion mostly related to the socio-cultural, technical, financial and institutional aspects of the research problems. The secondary data collected, was both qualitative and quantitative in nature as it was predominantly in the form of news articles. Along with interviews with witnesses and stakeholders, there was numerical data which provided a quantitative element. The use of reliable and accurate secondary sources of data has been instrumental in addressing the research objectives set out previously.

3.3.1 Data Triangulation

Data triangulation involves viewing information or data from more than one perspective enabling a researcher to develop a greater understanding of the topic they are investigating (Denscombe, 2007, p.134). Much of the information on fire incidences in informal settlements is reported by the media. This is often the only information relating to a fire which is in the public domain. As with any data, its reliability is improved by obtaining multiple sources which concur with each other. Equally, if sources contradict each other it might strongly suggests that further analysis of the situation is required, ideally from a new or additional perspective. Alternately, the source of the data may need further scrutiny. The integrity of a source and its reputation are also important factors. A peer reviewed journal from a professional institute is given more precedence over that of a magazine article as there is greater quality assurance in a journal article. To ensure that the data present in this thesis was valid, multiple sources were used when confirming important details and reporting

3.4 Research Instruments

3.4.1 Unstructured Interviews

Interviews are often presented as the „gold-standard" of qualitative research (Barbour cited in Barbour, 2008, p.113). This type of interview method is based on the researcher having a clear plan that is constantly kept in mind but also characterised by minimum control over the respondent's responses (Bernard, 2000, p.191). Unstructured interviews were carried out in the early stages of the data collection process in order to help understand the extent of the research problem in greater depth and clarity. Structured interviews were considered too restrictive at this early stage and were therefore disregarded. The potential benefits of focus groups were considered but logistical constraints largely ruled the possibility out.

Unstructured interviews are an excellent way of building a rapport with informants (Bernard, 2000, p.193) which is exactly how they were used. One difficulty faced when conducting unstructured interviews is facilitating the interview in such a way that encourages the respondent to share the information that you require with you. Barbour (2008, p.113) suggests interviewing is both a science and an art which is understandable considering this. Due to the flexible nature of the unstructured format, it is also easy for the respondent or even researcher to deviate too far from the topic to still be considered relevant. However, this relies on the skill and experience of the interviewer to bring the subject back to the matter at hand. Denscombe (2007, p.176) surmises that what separates both unstructured and semi-structures from structured interviews, is their ability to allow interviewees to speak their mind and that they are aim is to „discover" rather than „check".

Figure 8 below suggests the possible relationship between the depth of interview structuring selected and the phase in development of a theory (Wengraf, 2001, p.61). As this study is based around building a theory of the impact and response to fires in informal settlements, an unstructured approach was adopted.

Figure 8: Spectrum from unstructured to fully structured interviewing, and possible relationship to phases in the development of a theory (Wengraf, 2001, p.61)

An advantage of unstructured interviews over structured interviews is that they allow the researcher to incorporate questions as they come to light and build on the responses the interviewee is providing. However, it is easy to miss important discussion point in unstructured interviews if it is not well planned.

The interviews were used in the earlier stages of the data collection process. The information obtained from the interviews helped identify a suitable format of the questionnaires to be used later on.

3.4.3 Targeted Questionnaires

Targeted questionnaires were adopted for circumstances and situations when it was not possible to conduct interviews but the respondent was pre-determined. The people who were sent the targeted questionnaires were very specifically selected. The advantages of questionnaires in these instances are: there is a written record of the subjects‟ response, the respondent is free to complete it in their own time, they are very low cost, the respondent has more time to consider their answers and the personal influence of the researcher is eliminated (Walliman, 2006, p.88). The most significant limitation is that there is no way for the researcher to probe in order to ascertain further details. The scope of the questions are also quite restricted as are the answers given by the respondent.
The questionnaire was designed so that the questions are grouped together into topics. This helped the respondents when answering but also made analysis of their responses more systematic and logical. The majority of questions had an open-format to try and avoid leading the respondent into a response as opposed to them thinking instinctively. The questions have been designed to avoid ambiguities although this is not always possible when many factors surrounding the questions are unknown. An example of the questionnaire used can be seen in appendix B.

3.4.4 Case Studies

A case study approach was adopted to provide a detailed and accurate insight into the circumstances surrounding and leading up to specific fire events. Case studies allow the connections and relationships between various elements to be understood analysing the individual components (Denscombe, 2007, p.36). The selection of which cases to study is very important and must be appropriately justified. The nature of the case must be carefully examined to address whether it represents a „typical instance‟, „extreme instance‟, „test-site for theory‟ or a „least likely instance‟ (Denscombe, 2007, p.37).
Case studies can be used to study social groups, communities, systems, institutions, events or even a person or personality (Walliman, 2006, p.44). A thorough analysis of a

specific fire fires using a case study approach facilitated the identification of a number of factors which needed to be addressed to meet the research objectives. Case studies are suited when three other conditions apply:

- The research question poses a „how" or „why"
- The investigator has little control over events and;
- The focus is on a contemporary phenomenon
  (Yin, 2009, p.2)

Barbour (2008, p.60), is quite critical of Yin"s earlier edition book (1994) on case studies claiming he fails to take account of "the flexibility afforded by case studies". However, all three of these criteria are met by the research aim which suggests that case studies are suitable instruments in this situation. Figure 9 graphically evaluates the suitability of various research methods against three conditions.

METHOD	(1) Form of Research Question	(2) Requires Control of Behavioral Events?	(3) Focuses on Contemporary Events?
Experiment	how, why?	yes	yes
Survey	who, what, where, how many, how much?	no	yes
Archival Analysis	who, what, where, how many, how much?	no	yes/no
History	how, why?	no	no
Case Study	how, why?	no	yes

Figure 1.1 Relevant Situations for Different Research Methods

SOURCE: COSMOS Corporation.

Figure 9: A comparison of five different research methods against three conditions (COSMOS Corporation cited in Yin, 2009, p.8)

The choice of which cases (slum fires) to choose was based on a number of critical elements. One of the most important factors was ensuring adequate amounts of data could be collected to accurately represent what had happened in order to determine the „how"s" and „why"s". Secondary factors which acted as criteria for selecting particular fires included:

- In order for the study to be considered as assessing the contemporary situation, the fires which are used for the case study must have occurred within the 2 years, therefore after 19 August 2009. Also, sufficient time must have passed from the

date of the fire to see a measure of the post fire response. In this instance, that amount of time is considered to be 3 months or more before the 19 august 2011.

- The case must be from cities either in India or the Philippines.
- The fire must be of a sufficient magnitude to represent a significant incident. This was considered any fires which destroyed more than 10 homes or dwellings.

A large amount of research was put into identifying suitable slum fires which were appropriate to adopt for the case studies. As the priority was to ensure a vast amount of information was available, it was decided to use fires which had received a significant amount of media attention as that was where a large amount of information would be gathered from. Well publicised fires from India and the Philippines were identified through the use of internet search engines. The two fires selected both affected over 1,000 people. It was therefore considered that these fires represented large-scale fires. Studying fires of a similar size would enabled more credible comparisons to be drawn and provide a more representative picture of slum fires of this magnitude as opposed to studying fires of varying magnitudes.

Both Mumbai and Manila were identified as cities in which many slum fires occurred. Approximately 74% of the total population in Greater Mumbai live in slum or hutment colonies largely due to escalating costs of land and materials along with an increasing population (Government of Maharashtra, no date).

3.5 Data Collection

Candidates who were willing to participate in the data collection stage were identified through the deconstruction of the stakeholder identification process outlined earlier. Specific stakeholders within the NGO and academic or researcher categories were located through internet searches of organisations thought to be potential stakeholders in India and the Philippines. The search for specific organisations which were considered to be stakeholders involved identifying organisations which already worked in India and the Philippines. E-mails were sent to potential stakeholders to attempt to initiate a dialogue with the intention of leading to a formal data collection session at a later date. The NGOs outlined below were identified as already having an involvement in the focus countries. A more general approach was taken to academic and research organisation as it was difficult to establish in what countries they were involved already without speaking to them directly. A number of fire services were also contacted but no responses were received. The potential stakeholders that were contacted were:

NGOs:

- Médecins Sans Frontières (MSF)
- Practical Action
- Save the Children
- Plan International (India, Bangladesh and the Philippines)
- Urban Poor Associates (Manila)
- The Philippine Red Cross
- World Health Organisation
- UNICEF (Manila
- Children International
- Homeless International
- Christian Aid

Academic and Research Organisations

- University of Delhi
- Fire Services College, UK
- Global Fire Monitoring Centre (GFMC), Germany
- Urban Resource Centre, Karachi
- Asian Disaster Preparedness Centre
- Institute of Fire Engineers, UK

Fire Services

- Maharashtra Fire Services, India
- Delhi Fire Service, India
- Bureau of Fire Preventions, Philippines
- London Fire Service, UK

Once a stakeholder had been contacted and had agreed to participate, it was necessary to determine which research tool was most appropriate to adopt for the data collection process. The research tool selection was an important aspect as it is likely to have had a significant influence on the quantity and quality of the data collected. As many of the potential participants were very difficult to get hold of, in most instances there was only one opportunity to collect the data therefore it was important to capitalise on the opportunity.

3.5.1 Example fires

Through the literature search detailed in chapter two, certain cities within India and the Philippines were identified as having high numbers of fire related incidences in slums. In order to be able to refer back to and cross-reference information sources, a table was compiled of all the fire incidences which were found during the course of the entire literature search. This value of displaying the secondary information in this table quickly became apparent and it was subsequently developed further and formed the basis of collating examples of fires that occurred in India and the Philippines.

The table was initially used as a tool for tracking fire incidences from around the world during the literature search. This technique of documenting every fire as the research progressed showed that certain countries within Asia were experiencing high frequency and severity slum fires. India and the Philippines were both identified through this table as countries in which fire events were happening regularly. This process allowed the study focus to be narrowed from the very large (Asia) to specific individual cities within India and the Philippines.

20 examples of individual fires which had occurred in India and the Philippines were collected and displayed in the table. The helped easily identify patterns and relationships in individual fires which were then investigated further. Identification of patterns was carried out by the use of filter functions within Microsoft Excel. The table was able to be filtered according to separate criteria needed to be examined, whether this was: number of people displaced, deaths or county of incident for example.

The specific 20 examples of fires were identified through the use of internet search engines such as Google and Bing where the same search terms as detailed in the literature review were adopted to locate incidences. No specific sampling technique was adopted as the examples weren't considered to constitute a sample. However, selecting which fires to include was dictated by the availability of information and the date of the fire. It was considered that single reference for each fire would be insufficient and that a degree of triangulation was necessary. Turning each fire into a case study by using multiple sources was not considered as the two case studies were determined to be sufficient. Therefore it was decided to verify the information from every fire with two source references which were independent of each other. This avoided excessive levels of details being collected and detracting from the purpose of collecting the individual fire events.

3.5.2 Recording of data

As much of the data collected was verbal, it was felt necessary to make audio recording of the discussions when possible so they could be accurately referred back to for analysis. This presented a possible issue however as the interviewees knew they were being recorded so may have answered differently than if not recorded. All interviewees were asked if they would be happy for conversations to be recorded to be referred back to at a later date. The reliance on electronic voice recorders to capture data was an asset in that it removed the need for copious amounts of notes to be taken during the interviews which often is disruptive. Notes taken in such scenarios are often difficult to do well. The interviews conducted lasted for no longer than 35 minutes.

Brief manuscript notes were also taken by hand during many of the discussions in addition to audio recordings. This was carried out in case of a technical malfunction and to make notes of the most salient points. One disadvantage of audio recordings is that only verbal communication is recorded. Video recordings however may record eye contact, facial expressions and gestures which could provide and additional insight. As most interviews took place via telephone, this was not possible. Video recordings also require and increased level of technical skill to conduct well and may distract the interviewee or intimidate them. The can also be regarded as quite intrusive (Denscombe, 2007, p.195).

3.5.3 Data Collection considerations

For the case studies, it was necessary to combine both primary and secondary data. This was necessary in order to triangulate the information and increase the degree of certainty with which analysis could be drawn. One of the strength of using case studies is that they allow a researcher to be able to do this (Denscombe, 2007, p.37).

3.6 Data Analysis

The analysis of the data collected aims to identify patterns within the data and explain why those patterns have occurred (Bernard, 2000, p.419).

3.6.1 Qualitative data analysis

Chapter five forms the in-depth discussion and analysis of all the data collected. The analysis of the collected data forms a fundamental aspect of any research project. Ensuring that data is presented in a logical and coherent format aids clarity and assists in the analysis. Therefore, data collected from the interviews and the questionnaire is presented together as can be seen in chapter four. To aid the analysis, the data was arranged according to related themes identified in the data and organised in a structure

which matches that of the research objectives. The potential source of confusion in this method is the frequent changes between sources of data. This was considered in how the findings were presented, therefore every effort was taken to ensure the source of each piece of information is clearly acknowledged.

Whilst interviews provide researchers with information they may not have been able to collect through other research instruments, they tend to produce non-standard responses. Unstructured interviews also produce data which isn't pre coded and has a relatively open format (Denscombe, 2007, p.203).

The qualitative and circumstantial data gathered through the example fires was presented as comments in the table of fire examples. It was incorporated anecdotally into the main body of the discussion to illustrate situations and circumstances where patterns and similarities could be seen which either concurred or disagreed with what was being discussed.

Data collected from the questionnaire was coded according to which research objective the question and response corresponded to. This made it very straight forward to abstract the responses from the questionnaire and incorporate them into the findings from the interviews, creating what is considered to be a balanced argument. Designing the questionnaire according to subject groups assisted in this process but the further coding enabled the data to be sorted efficiently.

The two case studies are presented according to a chronological structure. The first section introduces the context and background of the slum to begin with, which is followed by the circumstances leading up to the fire being discussed. The fire itself is presented after this and the studies finish with the short-term and longer-term post fire aftermath. The format of the case studies was not considered to be as effectively incorporated into the other aspects of the findings as the interview and questionnaire data therefore the case studies have be presented individually.

3.6.2 Quantitative data analysis

The relatively small amount of quantitative data that was collected was presented in a table of the 20 example fires. Analysis of the 20 example fires was done by arranging and sorting the data to identify patterns and similarities. Arranging the data in order of probable causes for example, gave an indication of the most frequent causes. The data

analysis provided an indication to correlations between factors such as the times of fires and the number of casualties for example.

The table in no way gives an indication of the frequency of fires as little control was stipulated over the sample however; a measure of the scale of individual fires can be seen.

The nature of the data prevented in-depth statistical analysis being performed on it as it was felt the such outputs would be misleading as it may be perceived that these fires were representative of either the countries of slum fires in general which they are not. The data presented is purely examples of relationships between variables according to 20 independent fires. Data visualisations were used to display the data in innovative ways which graphically demonstrated relationships between specific variables.

3.7 Ethics

Ethical considerations have formed an integral part of this study. Walliman (2006, p.147) states that “the value of research depends as much on its ethical veracity as it does on the novelty of its discoveries.” This sentiment reflects the importance that was placed on ensuring this research project was conducted in an ethically appropriate manner.
The interviews which formed a large part of the data collection process were carried out in a very ethical manner. Participants were initially contacted by e-mail to ask for their consent to participate with the study. The intention of this step was to avoid putting the interviewee under pressure to respond involuntarily. All interviewees were asked for their consent to record the interviews that were conducted. This ensured that the interviewees were aware of the recording and understood the reasons why they were being recorded. Participants were also informed they could cut short the interviews at any point without the need for explanation and that all the information collected was be being stored and used in accordance with the Data Protection Act 1998.

Consideration was given to minimising disruption and any inconvenience the interview caused for the interviewees. This was done by attempting to be as concise as possible in the questioning, restricting the number of questions that were asked as well as setting an optional time limit on individual interviews of 45 minutes. If more time than this was needed a second interview could be arranged at a mutually exclusive time. The purpose of this was threefold: to encourage the interviewer to remain concise and on topic, to try and prevent the interviewee becoming bored or uninterested and to try and minimise the inconvenience to the interviewee.

The sensitive nature of many aspects related to the impact of fires was considered at all times. As slum fires often result in large numbers of victims who have lost all their worldly possessions, it was necessary to adopt a tactful approach when discussing issues surrounding the impact of slum fires and the damage they can cause. The research approach that was adopted was done so in such a way as to avoid causing any detrimental impact on the participants involved.

3.8 Limitations

Notably, none of the countries featured in this research have been visited by the author. Therefore a large amount of the data that has been used is from secondary sources and subsequently relies upon the experiences and observations of others. Instances of disparities between fire data reported by media and other organisations have demonstrated the variability of some data sources and limit the confidence with which conclusions and analysis can be drawn.

It has only been possible to interview people who speak English. When conducting research based in countries where English isn't people's first language, this may be considered as significant. However, it was found that many people who were able to contribute valuable information, were able to either speak enough English to communicate sufficiently well. There is also room, as with any interview for misinterpretation from either interviewer or interviewee but this is further compounded when language is a barrier. Software such a „Google Translate" enable this disadvantage to be reduced slightly in the search for online information. However it is worth acknowledging that it is possible that some important literature may have been omitted on the basis that it was written in a foreign language.

It may have been beneficial to conduct pilot surveys and trial a number of different data collection tools aimed at targeting different stakeholder groups. The use of focus groups with slum residents would have added an interesting element and clarified a number of aspects.

Sampling limitations may have been encountered with the selection of the fires which are presented as part of the findings. There may be a bias toward countries which report fires better than others but don't necessarily have more fires.

One important aspect to consider about interviews in general, is to establish if what the interviewee is saying is true. There may be a huge number of reasons why the

interviewee may not wish to tell the truth but it is up to the skill of the interviewer to notice if they think they are being misinformed and to cross check claims, accusations and statements. Triangulation helps establish if this is the case or not. It is also quite possible that an interviewee may forget certain things or not mention something which the researcher could find useful.

The questionnaire used had little scope for the respondent to add anything else they thought the researcher may find useful. This limitation was managed by designing into the questionnaire a large proportion of open questions which allowed the respondent to elaborate where they felt was necessary. The selection of participants was more strongly influenced by who was willing to take part rather than the background or experience of the candidates. This was due to a lack of response from willing stakeholders.

As data has been collected from a number of different countries around the globe in relatively short amount of time, it was not possible or economically feasible to meet all interviewees on a face-to-face basis. Telephone interviews were therefore adopted. It would have been slightly beneficial if it had been possible to use video calls at certain stages. However, research has shown that answers to many different types of question asked over the phone are equally as valid as those asked in person or by written correspondence (Dillman cited in Bernard, 2000, p.234). There are a number of advantages associated with conducting telephone interviews. The advantage of face-to-face interviews is that the interviewer may be able to sense if they are being told false information in ways different on not being able to meet the interviewee in person is that researchers may collect.

3.9 Summary

This chapter explained what thought process was followed and justification given for adopting the methodology that has been chosen. The strengths of the tools chosen has been discussed along with reasons for why other tools were rejected. The appropriateness of this methodology in addressing the issues set out in the research aim has been explained with the acknowledgement of the limitations that could not be mitigated.

Chapter 4 - Findings

4. 1 Introduction

This section presents the findings from the research conducted as described in chapter three. The purpose of this section is to accurately describe what information was collected in order to inform the discussion and analysis in subsequent chapter. The primary data presented in these finding was collected through three unstructured interviews and a targeted questionnaire. Secondary data, collected through news reports and government statistics, was used to inform two case studies and collate examples of 20 recent informal settlement fires from India and the Philippines.

4.2 Findings from Primary Data Collection Tools

From the stakeholders contacted as part of the "initiating of dialogue" stage, representatives from Plan International, Médecins Sans Frontièrs (MSF) and the Global Fire Monitoring Centre (GFMC) agreed to participate. Unstructured interviews were conducted with three people, based in three different countries. They were: Professor Johann Goldammer, senior scientist and head of the Fire Ecology Research GFMC based at Freiburg University, Germany; Niklas Bergstrand, Communications Officer with Médecins Sans Frontières (MSF) who was based in India for part of 2011 and Piero Gandini, acting MSF Emergency Coordinator in Mumbai. A single questionnaire was completed by Baltz Tribunalo, a Country Programme Advisor on Child Centred Disaster Risk Management from Plan International in the Philippines. This section presents the data collected from these three interviews and questionnaire and is initially presented according to the topics discussed.

The background and experience of the participants was considered to be very important as it has a direct impact on the validity and gravitas of the data they provide. A point was made of assessing the suitability of candidates either before collecting the data or at the very start of the collection process.

4.2.1 Quantifying the threat of fires in informal settlement

In the interview, Goldammer reasoned that there is a likely to be a lack of research into slum fires. He suggested this may be because fires weren't as high a priority for governments and organisations when compared to disasters like tsunamis for example. However, he explained that many fires come as a result of natural disasters such as floods, earthquakes and tsunamis as was seen in the 2011 Japanese tsunami and after

hurricane Katrina in the USA[2]. In response to the questionnaire, Tribunalo indicated that the Philippines are prone to fires started by earthquakes and other natural disasters [4].
Goldammer explained that the GFMC collates records of wild fires that are reported from around the world but not urban fires. However, the methodology adopted by GFMC for locating fire reports involves the use of internet search engines which are programmed to trawl through news articles in the search for information on wild fires[1]. He acknowledged that collecting and analysing data in this way requires significant resources in terms of man power and that this limits the amount of data that can be collected. This limits the extent of research conducted by the GFMC into fires[1]. The significance of this is that a very similar methodology has been adopted in this study to locate reports of fires. This demonstrates the appropriateness of adopting this method.

Goldammer speculated that a possible reason for a lack of awareness regarding the scale of slum fires in developing countries may be that fewer News organisations and media outlets publish information online. Especially when compared to outlets in more developed countries such as the USA. He recognised that this may mean that much information on fires which occur but aren't reported is missed[1].

When interviewed, Bergstrand recounted a large slum fire in Delhi during 2010. It was significant enough to prompt an emergency response from MSF who intervened to help the fire victims. He explained that similar situation occurred in 2011 when MSF intervened following a large slum fire in Mumbai[3]. The Mumbai fire he referred to was one of the fires that has been used as a case study. Bergstrand recalled that the Mumbai fire destroyed absolutely everything; people lost all their possessions. He went on to say that the slums in Mumbai were being squeezed into all the gaps between buildings[2]. In the interview, Gandini pointed out that slums are often found in the middle of everything, even very affluent neighbourhoods[3].

Gandini claimed that informal settlement fires happened quite frequently in both Mumbai and Delhi although the size of the fires varied dramatically. Whilst he could provide no accurate figures, he speculated that the frequency of large scale slum fires for Mumbai and Delhi combined could be as often as once a month[4]. Tribunalo made a very similar observation regarding the Philippines. He estimated that fires in Manila's slums occurred approximately once a month whilst during the driest month of the year (fire prevention

[2] Interview with Prof. Johann Goldammer, GFMC, [telephone] 27 July 2011
[3] Interview with Niklas Bergstrand, MSF, [telephone] 1 August 2011
[4] Interview with Piero Gandini, MSF, [telephone] 2 August 2011

month) he estimated there to be one slum fire a week[4] although the size of fire he was referring to was difficult to determine. In his questionnaire response, Tribunalo went on to say that slums were always considered to pose a fire risk and were thought to be much more prone to fires that other parts of cities in the Philippines[4].

Few people were injured by the Mumbai, 4 March 2011 fire however, Gandini observed that many residents were so afraid of being evicted once the fire was extinguished that they immediately returned to the charred remains of where their house was before the fire[3]. Tribunalo considered children, the elderly and people with disabilities to be most badly affected by slum fires[4]. He stated that most fire casualties were caused by fires which occur during night time[4].

Tribunalo explained that in terms of magnitude and frequency, slum fires could roughly be equated to the personal, economic and social traumas inflicted by that of other disasters and lost and damaged property. He stated that the number of fatalities from fires was less than that of other disaster[4].

4.2.2 Factors influencing the severity and impact of informal settlement fires

The trend of increasing urbanisation in developing countries is strongly influenced by the search for jobs and paid work Goldammer reasoned in the interview. He expanded by saying that as people migrate from rural areas into cities, the amount of intensive land cultivation is being reduced which makes the land more flammable[1].

Tribunalo explained that in the Philippines, slum residents are seen as a big source of votes for politicians. He said that this was seen as a problem by those who want order and sustainability in the big cities such as Cebu. Furthermore, slums have become places where people have dignity and rights and whom the government promises things but fails to deliver[5].

Goldammer identified that dwellings which were surrounded by dry, combustible materials such as dead vegetation and many materials used to build informal dwellings, are a serious fire hazard in any environment[1]. He observed that such areas become even more hazardous if young children are left to play unsupervised as there have been many cases of children playing with matches[1].

Sparks and embers fanned by strong winds can spread fire very easily and quickly Goldammer argued[1]. Wind speed and direction are therefore a significant factor to take

[5] Target specific questionnaire completed by Baltz Tribunalo, Plan Internation (Philippines)

into account in the spread of fires. He claimed that embers blown by the wind could easily ignite dwellings made from inflammable materials which may be a short distance away, bypassing houses inbetween[1].

Goldammer noted that a lack of formal gas and electricity energy security forced many slum dwellers to rely on illegal connections to power cables for electricity and bottled gas for cooking and heating[1]. Candles and kerosene lamps are used for heat and light in many slums which don't have electricity Goldammer argued, which can easily start fires. He noted that people also illegally connect to their neighbours' electricity which can cause accidental fires[1].

In certain cases, in very densely populated slums, Goldammer reasoned it may be necessary to destroy a proportion of the houses to reduce the threat of fire for those houses that remain by creating fire breaks. However, he stipulated that there needs to be a mechanism or framework in place to ensure people are provided with suitable replacement accommodation. He went on to say that reducing housing density is also important for other issues such as public health and hygiene[1]. It was reported that slum residents know what to do in the event of a fire at a basic level but further training is required[4].

Although very few informal settlements are likely to have air conditioning, Goldammer made the point that glowing embers can be sucked in though air intakes on air conditioning units and ignite buildings in such a way [1].

Transport infrastructure plays an essential role in enabling emergency services to reach fire incidences as quickly as possible. The importance and significance of infrastructure was noted by Goldammer. The capacity of emergency services to extinguish fires quickly can be undermined or diminished if infrastructure is too congested or damaged to cope[1].
Tribunalo suggested that building legislation needs to be applied to old and illegal buildings which don't meet building fire requirements. He recognised that this presents an enormous challenge for fire inspectors in such densely populated cities such as Manila[4].Goldammer made the point that not only does legislation need to exist to prevent people settling in dangerous locations such as those prone to landslides and flood plains but the legislation needs to be enforced. This is in order to provide safe environments to live and work in[1].

According to Tribunalo, fires are commonly used by land owners to destroy slums when negotiations fail between themselves and residents. Fundamentally, he blamed a lack of knowledge, awareness and understanding as the root causes of fires[4]. Following the 2011 Mumbai fire, Bergstrand mentioned that speculation in the local media implied that the local land mafia had been behind the cause of the fire in order to evict residents quickly however this couldn't be verified[2].

Gandini explained that slum residents are strongly aware of the threat they face from fires[3].He went on to say that fires are known to happen quite frequently in India's informal settlements however the scale of the fires varies dramatically. According to him, larger fires may benefit from NGO interventions however this may not be feasible for the many smaller scale fires that occur. Many people don't care about the fires that occur in informal settlements[3].

Ensuring victims are supported in the short and long term aftermath following a fire is very important. Bergstrand described the short-term post fire intervention that MSF conducted after a slum fire in Mumbai in 2011. He observed local mosques and NGOs providing support for fire victims in terms of non-food items such as blankets and soap. MSF provided a large number of support kits with items such as cooking utensils to victims[2]. Gandini noted that at the same intervention, there were instances of local residents offering whatever they could to help victims[3]. All these measures help reduce the impact fires have on its victims.

In Delhi, preparation works for the 2010 Commonwealth Games were considered to be the catalyst for mass slum evictions in the city according to Gandini. The land was apparently needed for property developments therefore a number of slums were completely destroyed by government bulldozers. Families and residents who were displaced were relocated 40-50Km outside the city[3].
The age of slums may be proportional to the size of the fire hazard they pose. Gandini estimated that some of Mumbai's slums were thought to be 20-30 years old possibly and very densely populated[3].

4.2.3 Reducing the threat of informal settlement fires

Goldammer claimed that the necessary technical precautions used to reduce the threat of fires are closely link to investment and available money[1]. Creating fire breaks by widening roads improves access for emergency services and reduces the likelihood of spreading

fire by radiant heat. However destroying houses to reduce the population density means fewer houses and therefore fewer places for people to live[1].

Electrical wiring often isn't very safe and requires significant investment Goldammer claimed. He said many people take electricity illegally which is a source of fire[1].
Goldammer questioned whether there was always sufficient water available to extinguish fires in informal settlements. He speculated that if fire extinguishers were introduced into communities it is likely they would be stolen or sold on[1].

Education and fire awareness are very important. Goldammer explained that there are programmes in South Africa called „Firewise" and „Working on Fire" which create awareness of the dangers of wildfires and equip communities with the skills and knowledge to prevent fires. He believed these community based fire management schemes have been very successful in rural areas of South Africa at reducing the number of wild fires. He considered this to be the most important approach that the fire management community (if looking internationally) could take. It is very likely that it could be successfully adapted for urban settings but may be quite challenging as the conditions are very different[1].

Goldammer identified that community based fire management programmes have a number of other benefits besides reducing outbreaks of fire. The schemes in South Africa have empowered community members by placing the emphasis back on residents to take responsibility for their own fire safety. He reasoned that the community fire management schemes also acted as poverty reduction strategies. Young, jobless people can be brought into jobs (which are very much government subsidised), become encouraged and motivated and take pride in what they achieve. This has shown to be very successful[1].
According to Goldammer, education, awareness and building safety are all important in reducing the threat of fires institutionally and voluntary community fire organisations may work, helping to reduce the impact of fires if they could be subsidised by government. He explained that they could quickly rush to fires in their local communities. Such initiatives have worked in South Africa where people and communities are motivated to take responsibility for their own fire safety and preparedness[1].

In the Philippines, Tribunalo explained that fire departments took a leading role in fire education and awareness of communities. His reply to the questionnaire said this is done through schools and at a local level through the use of education campaigns and training children and residents to prevent and analyse the causes of fire and the consequences if

a fire occured[4]. He also claimed that the number of deaths and injuries is being reduced in the Philippines as a results of fire campaigns[4].

According to Gandini, an important aspect of optimising the response of NGOs in the aftermath of a fire was found to be preparation. He commented that well trained staff and equipment which was ready to be deployed at short notice strongly influenced the quality of emergency interventions MSF was able to provide[3]. This in turn allowed the NGO to improve the situation for fire victims thereby potentially reducing the negative impact the fire was able to have on them.

"[Informal settlement fires are] a human induced disaster that needs real and genuine government programming which must focus on social and economic preventions: social justice, care for the citizens is not in the number of fire trucks or firemen but proper social services deliveries, comprehensive land use plan, enough employment, more green zones and enough space for the poor and enough wealth to be shared by the rich, business groups and the government themselves. Specific policies that include fire prevention and educate from one generation to the other generation, the children."[6]

4.2 Case studies

Case studies of fires in densely populated urban informal settlements were conducted to analyse two specific fires, one in Mumbai, India and another in Manila, in the Philippines. The purpose was to identify the specific circumstances and events surrounding the fire before it occurred, determine exactly how the fire broke out and assess the impact that was caused. It was also necessary to assess what had been done in the short and long term aftermath of the fires in terms of victim support initially and then rehabilitation and fire reduction strategies if appropriate.

4.2.1 Case Study 1:

Introduction

On 4 March 2011, a fire broke out in Garib Nagar, one of Mumbai"s informal settlements which adjoins Bandra railway station. This case study investigates the cause of the fire, examines the circumstances surrounding the outbreak and assesses the overall impact caused. Figures 10 and 11 show some of the devastation caused during and after the fire.

[6] Tribuanlo, B., 2011. E-mail correspondence to the author 7 Aug 2011

Figure 10 (left): Garib Nagar slum on fire 4 March 2011 (Bantwal, 2011)

Figure 11 (right): The post fire devastation of Garib Nagar slum fire 4 March 2011 (Shakir, 2011)

Background

Garib Nagar is a slum area which adjoins the East side of Bandra railway station as can be seen from the maps in figure 12 (the point „A" refers to Bandra railway station in all maps). The red ring outlines the approximate boundary of the informal settlement. This was the location of the 4 March 2011 fire which is reported to have injured more than 21 people and left 2,000 people homeless. The age of the settlement is very difficult to establish as few records of it exist.

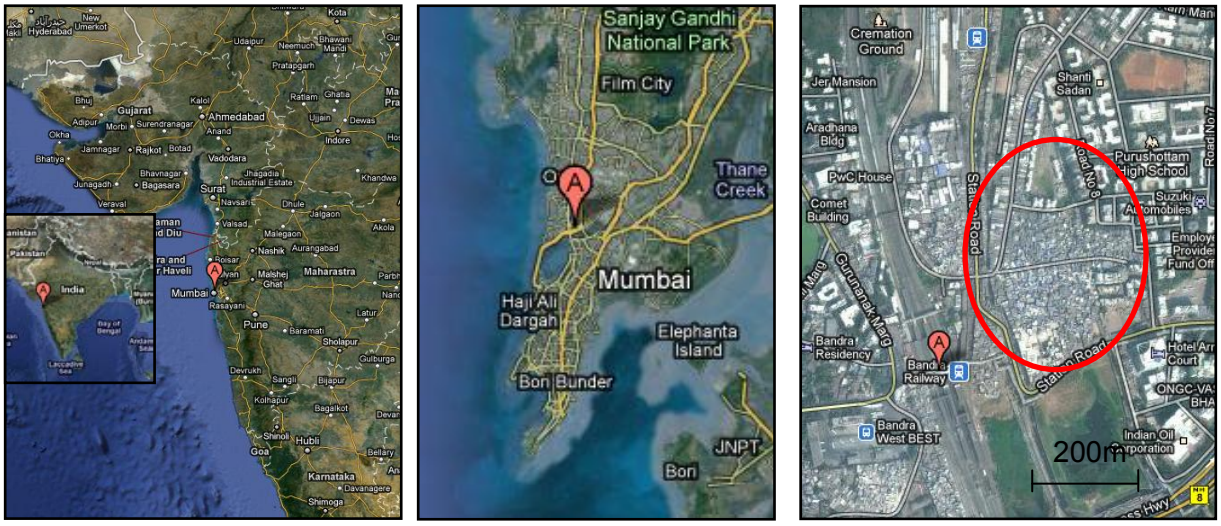


Figure 12: Location of Garib Nagar, Mumbai (Google Maps ©, 2011)

Garib Nagar is reported to have been home to two Oscar winning child actors who starred in the 2008 film *Slumdog Millionaire.* Media attention was first drawn to the Garib Nagar slum in 2009 when authorities demolished a number of houses including one that child actor Azharrudin Ismail lived in with his family (Sky News, 2009). The 4 March 2011 fire received a much higher level of media attention than many other similar fires largely

because the home of the other child actress Rubina Ali was destroyed in the blaze (Sky News, 2011).

This was not the first fire slum residents have had to contend with. In 2009 a fire broke out in the early hours of a June morning in Garib Nagar. The subsequent fire injured 15 people and destroyed 200 shanties. The cause of the fire was not determined (Mid Day, 2009). Three people including two children were reported to have been killed in the fire (GMA News, 2009).

The Fire

A fire broke out in the Garib Nagar slum in Bandra around 7:45pm on Friday 4 March 2011, according to an official report into the fire (The Times of India (TOI), 2011a). Although no loss of life was reported, initial figures reported at least 9 people were injured (IBN, 2011). An fire official was later quoted as saying that as many as 21 people had actually been injured including 4 fire fighters and over 2,000 people were left homeless (BBC, 2011; The India Daily, 2011). The type and severity of injuries sustained by the victims are unclear as are their ages or genders. Approximately 700 shanties were destroyed by the fire (Mid Day, 2011a).

The scale of the fire was extensive with sources reporting an area as large as 100,000m^2 (or 14 average size football pitches) having been destroyed by the blaze (Mid Day, 2011a). Fire officials described the blaze as one of the largest in the past two years (TOI, 2011b). Reports suggest that as many as 34 fire engines and 12 water tankers were used to tackle the fire (TOI, 2011c). It's claimed that 250 fire fighters were involved in tackling the blaze (Mid Day, 2011a) and at one point fire fighters describing the blaze as completely out of control (Rediff, 2011). It took over 4 hours for the fire to be extinguished with the flames finally being considered under control around 12:30am (The India Daily, 2011). As well as hundreds of homes, the fire is reported to have destroyed part of a foot bridge which runs over part of the slum causing it to collapse as can be seen in figure 13(TOI, 2011d; IBN, 2011; Rediff, 2011).

Figure 13: Post fire devastation in Garib Nagar (Xinhua/Reuters, 2011)

Speculation and eyewitness accounts suggest three likely causes of the fire. These are a heated argument, electrical short circuit or arson (Mid Day, 2011a). The official reports state that the cause of the fire is unknown (TOI, 2011b). 20 eyewitnesses were interviewed on the scene by the Assistant Divisional Fire Officer, Abhay Kale who commented that all the reports seemed contradictory making the cause very hard to determine (Mid Day, 2011a; Rediff, 2011). Another senior fire official who wished to remain anonymous was quoted as saying that foul play couldn't be ruled out implying that the cause could be arson as a plight to evict the slum dwellers from the land which has a high potential development value (TOI, 2011e).

The origin of the fire was determined to be in the centre of the slum (TOI, 2011a). Some residents however allege that the fire began near a mosque (Rediff, 2011). The exact location of the mosque is very difficult to ascertain though so it is difficult to say whether these reports contradict each other. An MSF report (2011) into their post fire intervention suggests there is a mosque on the edge of the slum and maps of the surrounding area concur with this. It is very possible that there is a mosque further inside the slum.
Eyewitness claim the fire started after a fight broke out between two drunken brothers on the fourth floor of a slum dwelling (TOI, 2011a). Others strongly believe the fire was engineered by builders to clear the land which is in a prime location for development (Rediff, 2011).

Rail services using the railway line which runs alongside much of the Garib Nagar slum were cancelled or disrupted as the lines were closed as a precaution from 9.45pm until 11:30pm (TOI, 2011a; IBN, 2011).

Local police were reported not to have opened an investigation into the fire initially. Senior Police Inspector Prashant Bagade is quoted as saying “we have questioned a few witnesses from the area, and prima-facie it seems to be a case of a short-circuit,” therefore implying it was an open and shut case. However, upon being told the fire service report into the cause was inconclusive, he said the case would remain open (Mid Day, 2011a). In an interview with Rediff News (2011), Mumbai"s Municipal Commissioner Subodh Kumar, declined to comment on whether the slum settlements near and under the railway footbridge that was destroyed by the fire were illegal.

Factors influencing the severity and impact of the fire

Garib Nagar is a very densely populated urban area. A lack of space hampered the efforts of fire crews not only to reach but to tackle the blaze (TOIa, 2011). Rediff News (2011) interviewed a fire officer who said the fire wasn"t reported until 8:30pm – an hour after the earliest reports claim the fire broke out. Other reports indicate it took the fire service 25 minutes to reach the fire (TOI, 2011f). In a densely populated area, any delay in tackling a fire is going to allow it to spread quickly. In addition, a government minister stated that the two and three storied structures found in the slums were a primary factor in the spreading of the fire (TOI, 2011e). Pictures and reports show multi-storey slum dwellings as high as four-stories (The India Daily, 2011; TOI, 2011f).

It is not clear to what extent fire hydrants were a factor in the fire services" capacity to tackle the fire. As identified in the literature review, (Sharma 2009 and Ashar 2010) a large number of fire hydrants in Mumbai don"t appear to work. Residents claim that fire fighters struggled to find water initially which angered many people who then became violent towards the fire fighters. It is reported that slum residents attacked fire fighters and attempted to steal hose pipes and other fire fighting equipment (Mid Day News, 2011b). As is very probably the case, fire tankers were reported to have run out of water requiring them to seek replenishments. This meant travelling to sites away from the fire to refill potentially leaving fire fighters without the means to fight the fire. This issue was exacerbated by heavily congested roads around the slum which would have increased the turnaround time for the water tankers. The roads were reportedly very narrow in places and clogged by parked cars from spectators wanting to see the fire (Rediff, 2011).

Half an hour after the fire started, gas cylinders were reported to have started exploding (Kale cited in TOI, 2011c). Reports suggest up to 5 cylinders exploded (IBN, 2011; The India Daily, 2011). Whilst they were not reported to be the cause of the fire, it is thought the explosions strongly contributed to the rapid spread of fire. Gas cylinders are commonly used for cooking.

Strong winds were not considered to have caused the rapid spread of the fire the Assistant Divisional Fire officer is reported to have said. Inflammable housing materials that the houses were made from however are reported to have been an important factor in the rapid spread of the fire (TOI, 2011d). Residents claim it took fire fighters over an hour to arrive which fire fighters claim was due to heavy traffic (News X, 2011).

Child actress Rubina Ali who starred in the 2008 film *Slumdog Millionaire* had her family"s home destroyed by the fire. She is quoted as saying that a neighbour alerted her and her family of the fire at which point they rushed to escape without time to save any belongings. She subsequently lost all her possessions to the fire (The India Daily, 2011)

Short-term post fire aftermath

In the immediate aftermath of the fire, (once the flames had been extinguished) the full extent of the damage could be seen. Médecins Sans Frontières (MSF) the international NGO has a project office in Mumbai and so their staff were quickly able to carry out a rapid situation assessment. Although there was no need for medical assistance as all casualties were being attended to at local hospitals, MSF launched an immediate intervention to help residents affected by the fire by distributing 4,800 Hygiene, Kitchen and Shelter non-food item kits (NFIs) (MSF, 2011). The reported cost of this intervention was €76,000 (approximately £66,800) which was made up of staff wages, water/food and snacks, the 4,800 kits, printing materials and transport costs (MSF, 2011).

In the days immediately following the fire, speculation over the cause of the fire was widespread. Fire officials could not establish the original cause of the blaze despite an official investigation (TOI, 2011e).

In the short term, the state government sanctioned compensation payments of Rs 25,000 (£340) for each family affected by the fire a government official is quoted as saying (TOI, 2011f). Other sources quote MP Priya Dutt as stating the government awarded Rs 30,000 (£410). Dutt said many slum residents were offered to be relocated to other places but

many people didn't want to move from where they were originally. She also called on the government and Chief Minister to address long-term rehabilitation solutions for the slum dwellers; the emphasis being on low-cost housing (Mid Day, 2011b). Local residents voiced their opinions appealing to the government to rebuild their houses in addition to providing compensation (Rediff, 2011).

Many local residents who weren't directly affected by the blaze offered aid and assistance. Local relief committees were set up and helped to provide food and clothing to fire victims. Many volunteers had empathy for the victims as they themselves had been affected by the 2009 fire. A religious trust distributed food coupons and blankets to families whilst a team of doctors from Holy Family Hospital, Bandra visit the affected area. They diagnosed many residents with respiratory problems due to smoke inhalation (TOI, 2011g).

Long-term post fire aftermath

It has been suggested that the March 4 fire was a blessing in disguise. While many residents lost all their possessions and a number of people were injured, a number of positives have come in its aftermath. The land on which the slum was located has been relinquished by the railways and BMC which has enabled occupants to gain legitimate occupancy off around 500 homes one resident is quoted as saying (TOI, 2011a). MSF returned to visit victims from the fire one month after their intervention. They found that residents were very happy with the equipment MSF had given them and were still using it (MSF, 2011).

It is argued that the alarming and distressing images broadcast around the world by media organisations evoked an international wave of sympathy. The government is alleged to have put pressure on the railway and BMC to give up the land and money and aid was offered from as far away as the Gulf States and South Africa along with local businesses and mosques (The Times of India, 2011f). Even four months after the fire though, there are still signs of people who haven't yet moved into the improved housing (Mid Day, 2011).

4.2.2 Case Study 2:

Introduction

A devastating fire broke out in the Bahay Toro slum in Manila, Philippines on Monday 14 February 2011. This case study examines the circumstances leading up to the fire, the

probable cause or causes and the impact and devastation caused by the fire. It also identified factors which allowed the fire to spread and what dictated the severity of the fire.

Background

Slums house 2.5 million people, scattered over 526 communities in the municipalities of Metro Manila. Many of the slums are located on vacant or private land, along rivers, near garbage dumps, along rail road tracks, under bridges and alongside industrial establishments (UN-Habitat, 2003). The population density of Manila is extremely high with an estimated 14,300 people per square kilometre. Manila is ranked the fifth largest urban area in the world according to Demographia (2011) and is joint second with Delhi for the highest population density in the top ten countries in the world.

February sees little rain as March is the height of summer in Manila and celebrated as fire prevention month (GMA News, 2010). A report by the Bureau of Fire Protection (BFP) which is responsible for ensuring public safety from fires in the Philippine's, found that 50% of the existing fire hydrants in Metro Manila were not functioning. There are also areas which don't have any hydrants at all. The report also found that there were only 140 fire trucks for the entire metropolis (Antiporda, 2009).

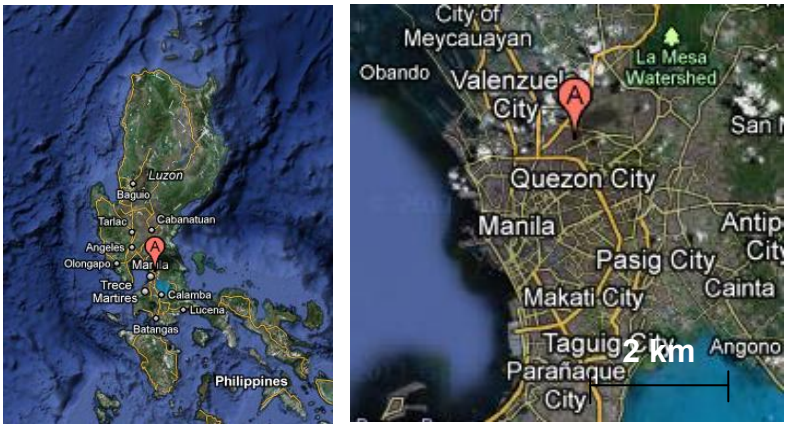


Figure 14: Location of Bahay Toro slum (Google Maps©, 2011)

A number of previous fires have been reported in Bahay Toro (see figure 14 for the location) area with the most recent having happened exactly a week before. Damicog (2011) reports Fire Investigator Renato Delamidi as saying 600 homes were destroyed leaving 4,000 families homeless. 11 people are reported to have been injured. Approximately 100 houses were destroyed by a fire in July 2010 in the same area (Obanil, 2010).

The Fire

A five-year-old boy was burnt to death in a devastating fire which left 1,004 people homeless (Disaster Response Operation and Monitoring and Information Centre (DROMIC), 2011). Initial reports suggested as many as 2,000 families had been displaced (Batallones, 2011).

Padua (2011), named six victims claimed to have been injured as a result of the fire even though a report by the National Disaster Risk Reduction and Management Council only mentioned a 40 year-old female having been injured (Ramos, 2011). As subsequent report by DROMIC (2011) concurred with Padua stating that six people were injured. The injured victims were the 40-year-old woman mentioned previously who it"s claimed sustained a burn injury to her shoulder or back; a 22-year-old with a puncture wound to the left arm; a 39-year-old male who suffered a burn to his right arm; a 48-year-old male who had a laceration to his left back; a 42-year-old male with external abrasions and burnt arms and a six-year-old child who suffered from hypothermia (Padua, 2011). It"s reported that only one ambulance was sent to the scene (Ramos, 2011).

The fire was first reported at approximately 9:13pm on Monday 14 February (Padua, 2011). An official report into the fire concluded that the fire started around 9:09pm (Ramos, 2011). The fire was said to be under control around 12:25am (15 February 2011) and completely extinguished by 2:37am (Ramos, 2011).The financial cost of the fire in terms of the damaged caused is estimated to be PhP10 million (£145,600) (Ramos, 2011).

Early reports could not establish the exact cause of the fire (Ramos, 2011). However, a report dated 8 days after the fire was extinguished identified the cause of the fire as an unattended lit candle (DROMIC, 2011) although it is not stated how this caused the fire.

Factors influencing the severity and impact of the fire

Fire fighters claimed that the fire spread quickly due to the combustible materials the houses were made of (Carcamo, 2011). A video purported to be of the fire, shows huge flames billowing out the top of a very densely populated urban area. Fire fighters are shown to be on the scene (the date stamp on the footage suggests it is 21:45pm) although it appears narrow alleys between buildings are preventing the fire appliances getting very close to the blaze (Papajhung, 2011).

Short-term post fire aftermath

Quezon City Social Service Development Department issued families with cards entitling them to three meals a day and set up a community kitchen. Volunteers were also mobilised to run the kitchen and monitor the needs of the fire victims (DROMIC, 2011).
Along with food, victims were provided with non-food items such as clothes and mats (Dromic, 2011). 23 volunteers from a local Buddhist foundation arrived to provide emotional support to fire victims and donate food and non-food items (Nepomuceno, 2011).

Noemi Diza, a 53-year old fire victim and mother of two, was interviewed following the fire and claimed that the fire was much more devastating than a 2009 Typhoon „Ondoy" which caused flooding to her home up to the second floor. She reasoned that at least she could dry out her furniture and belongings once the water had receded however the fire had destroyed everything (Nepomuceno, 2011).

Long-term post fire aftermath

In the weeks following the Bahay Toro fire, it was discovered that of Metro Manila"s 177 fire trucks, 89 are not fit for purpose and unserviceable. Chief Superintendent Santiago Laguna is quoted as saying "Ideally, we need one fire truck for every 28,000 residents or about 428 fire trucks," (Felipe, 2011). Very little information was available on what happened to the slum following the fire and what if any new fire precautions were taken.

4. 3 Examples of fires in India and Mumbai

Data was collected to document 20 individual examples of informal settlement fires which occurred within the last two years in the Philippines and India. The purpose of collating and presenting these fires was to concisely demonstrate the scale, impact and frequency of what are considered to be „typical" slum fires. These examples included 10 urban fires from India and the Philippines. As the focus of this study is on contemporary events, it was felt that the most recent fires would provide the best representation of the current status of the problem. The data collected from the 20 fires are presented in appendix C. The case studies were not included in the table.

The data visualisations below (see figures 15 and 16) graphically represent the relationship between the time of specific fire outbreaks and the number of deaths that fire caused for the 20 fire examples. The numbers around the circumference represent the time of day, with hour 0 being midnight. Each red line represents one fire and the fires

have been separated into the two representative countries. The shading of the circle is proportional to how light it would be at the time the fire broke out. The length of each red line shows how many people were killed in the fire.

What both visualisations show are firstly, that more fires break out during hours of darkness than during daylight, Secondly, they demonstrate the spread of fires according to time. With more data the results these visualisations would give a very clear illustration of the most hazardous time of day for fire outbreaks. It can be seen that the most severe fire outbreak in the Philippines occurred at approximately 11pm.

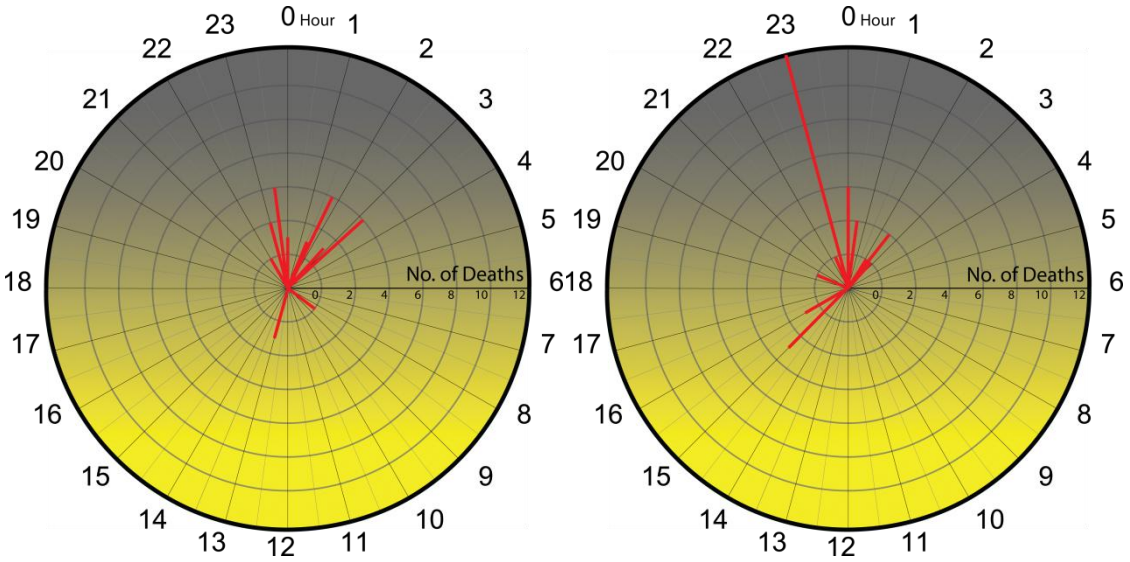


Figure 15: Fire deaths in relation to time of fire outbreak, India (left)

Figure 16: Fire deaths in relation to time of fire outbreak, Philippines (right)

Figure 17 illustrates the relationships between the various causes of fire that were identified in the 20 sample fire events. The causes have been arranged according to the principles of a standard pie chart (segments bounded by the black lines) and are indicative of the proportion of fires attributed as being caused by that factor. Within each of those segments is the distribution of the number of fires between the two countries, orange represents India and blue represents the Philippines.

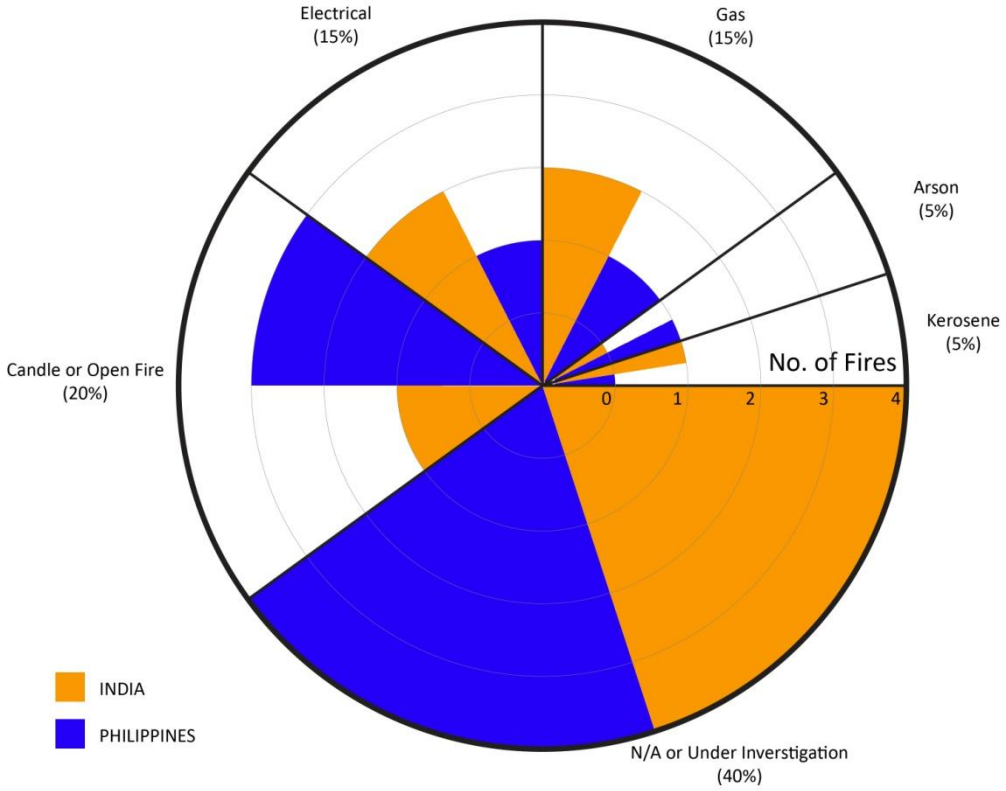


Figure 17: Distribution of fire causes from sample fires

From Figure 17, it can be seen that causes for the largest proportion of the fires could not be determined. It also demonstrates that of the 20 example fires, India had more fires caused by electrical and gas fire.

4.4 Summary

The findings presented in this chapter the data collected from three unstructured interviews which carried out with individuals from the Global Fire Monitoring Centre and Médecins Sans Frontiers. A single questionnaire was completed by one of Plan International"s disaster preparedness programme coordinators. Two case studies were conducted; the first from Garib Nagar in Mumbai India, the second from Bahay Toro in Manila, the Philippines. Finally, 20 examples of fires in India and the Philippines (10 from either country) have been collected and evaluated.

Chapter 5. Discussion and Analysis

5.1 Introduction

This chapter is a critical analysis of the findings that have been presented in chapter four. It also draws on the literature identified and presented in chapter two. This discussion assesses the relevance of the findings and how they relate to SHTEFIE (Socio-cultural, Health/Hygiene, Technical, Economic, Financial, Institutional and Environmental) aspects. It draws on evidence presented previous chapters to identify how successfully the research that has been carried out has met the research aim and objectives set out in chapter one.

5.2 How much of a problem are informal settlements fires?

The literature presented in chapter two and the findings presented in chapter four, both strongly indicate that fires in slums are a serious problem. This is largely due to their frequency and the severity of the detrimental impact that fires have on victims. The evidence gather shows that significant numbers of people in both India and the Philippines have been affected physically, socially, economically and psychologically by devastating fire incidences and the post fire aftermath. It is acknowledge that the current recording, documenting and presenting of fire statistics in India and the Philippines is inadequate and not comprehensive enough. Records are infrequently published in sufficient detail to be able to make well informed comments on exactly how regularly fires in informal settlements occur and identify what the most frequent and prolific causes of fires may be. This has meant that while the nature of fires in slums is becoming more clearly understood, the true scale of the problem has not been fully uncovered.

The literature and findings concur that the fear and threat of fires to informal dwelling residents is severe. It is perceived by some residents as equal to or even greater than the threat posed by natural disasters such as floods, tsunamis and earthquakes. This may be related to people"s ability (or inability) to recover from a particular event. It was argued by one woman in case study two in the Philippines that even after a devastating flood, she could still dry her furniture out and use it again whereas after a fire, there was nothing left. Whilst this is only one person"s opinion, the sentiment can be seen. The significance of victims losing everything was reiterated in the interviews with MSF. Living with a constant and real threat of fire could have a significant detrimental impact on the mental health of

slum dwellers although this has not been proved by this study. What has been demonstrated is the fear informal settlement residents have of fires.

No international database records fires in the same way that EM-DAT is used to record all natural and man-made disasters. The findings indicate that this may be because urban fires do not form a high priority for policy makers and governments. This prevents detailed international analysis of slum fires being carried out and limits the attention that can be drawn to fires of this nature to instigate change and reform. Awareness of the scale of small scale slum fires is limited due to a lack of media attention and lack of reporting by residents.

The 20 fires presented in appendix C demonstrate how many people can be affected by a single fire. From those fires presented in the table in appendix C, the largest number of people displaced by a single fire was 2,700 families. If a conservative UN-Habitat estimate of five persons per room is applied and it is assumed that each family has one room (2003, p.11), this most devastating fire would have affected well over 13,000 people. While much data could not be obtained on the number of people displaced by fires, single examples such as this demonstrate the scale of individual fire events. It was equally eye opening to find that smaller fires can kill as many people or more than larger fires. A fire which destroyed 12 dwellings in Kolkata, took the lives of four children as did a fire in New Delhi which only destroyed two dwellings. The fire referred to previously though, in which 2,700 families were displaced, killed no one and only injured 9 people. Similarly, a fire which displaced over 7,000 people in Quezon City resulted in no deaths and only two injuries. This would suggest that other factors more strongly influence the impact of a fire in terms of casualties than scale of the fire.

According to the data from the 20 example slum fires, a total of 39 people were killed, 22 of whom were children, 66 people were injured and more than 44,600 people lost their homes. This does not include instances where data was unavailable so the actual figures are likely to be much higher. It can be seen that even a relatively small number of fires can affect a large number of people.

Case study two demonstrates one issue that appears to happen quite frequently. Very often a number of fires will occur in the same location over a short period of time. This was shown in the literature by Babaiah *et al.* (2006) in Bangalore but also is identified in the Bahay Toro slum in Manila through the case study. This could simply be

representative of dry seasons or it could be the repeated attempt of arsonist to burn down the slums as was the case in Bangalore.

5.2.1 What patterns exist within between fires?

Much of the data, information and records of fires available to the public is released through media organisations. This presents an issues to the credibility of the data as there is likely to be much less quality control over facts and figures published in the media than that of government organisations.

Informal settlement fires appear to highlight much deeper issues than what simply started the fire. In many instances, fires are the result of the difficulties and challenges slum dwellers face on a daily basis. A serious lack of service delivery in most slums demonstrates the lack of recognition governments have for informal settlements.

In many cases, slums are seen to be a low priority for governments. This was observed in the findings by Tribunalo and Goldammer. If the most fundamental problems within slums such as the lack of clean water and adequate sanitation are barely being addressed, then even less attention is going to be paid to fires as they are unlikely to present a more serious threat than a lack of clean drinking water for example.

Of the fires studied, the threat of fires has been shown to correlates with particular seasons, largely hot and dry. It has been found in both the literature and the findings that certain months of the year are notorious for slum fires such as March in the Philippines. The is also a positive correlation between festive seasons such as Christmas and slum fire outbreaks.

5.2.2 Who is at risk?

The most striking division of population, identified in the data to be most adversely impacted by informal settlement fires was the age groups of victims. A strong theme which ran through much of the secondary data collected was that few details of victims killed in a fire were given unless the victims were children. Children are definitely more vulnerable to fires than adults as they are often reliant on parents or guardians for their safety and wellbeing. The loss of a parent is likely to have more of a detrimental impact on a child than if a parent lost a child. Knowledge is also very important in terms of both fire prevention and what to do in the event of a fire. Not all children may have yet gained this.

It is therefore likely, although it was not possible to prove, that children may be responsible for starting more fires accidentally than adults.

One of the fatalities reported in the table of examples shown in appendix C was a disabled child. Two other victims were elderly individuals (60 and 80-years-old). Details of exactly how they were killed by fires are unclear but when considering the speed with which fires in slums can spread and the lack and difficulty of egress, it becomes apparent that the ability to escape from a fire quickly plays a critical part of surviving it. Delay in exiting a slum which is on fire could be the difference between life and death. The vulnerability of children and their reliance on others for their safety can be tragically illustrated with one of the 20 example fires in table see in appendix C from Kolkata in December 2012: four children were left asleep, unsupervised in a house whilst their parents were working. A fire was left burning to keep the children warm but a plastic item is thought to have caught fire inside the house. The children were locked inside the house and didn"t know how to escape and subsequently all four children died in the fire.

5.3 What makes slum fires such an issue?

5.3.1 Direct and Indirect impacts

Fundamentally, the physical and mental trauma of being affected by a slum fire is severe. Injuries and fatalities compound the issue further, even for the victims that aren"t injured themselves. A parent, sibling or child sustaining a life changing burn injury is likely to adversely impact the entire family for a long period of time demonstrating that the impact of fires is not constrained to the shot-term. The complete loss or partial destruction of property and belongings leaves victims with very little to live with which puts significant pressure on other parties such as NGOs, neighbours, families and the government to provide assistance.

The financial and economic impact of slum fires cannot be underestimated. From a financial perspective, it is clear that many slum residents are poor and have little financial means to improve their standard of living. This in turn means they have little way of recovering after a fire. There is also the financial impact of fires on the emergency services, charities and NGOs and the government if they intervene. MSF reported that the cost of their response to the 4 March 2011 slum fires in Mumbai was approximately £66,800 which is a huge amount of money for the five hours they spent handing out relief materials on a single day. Where financial information was available in the example fires,

it can be seen that the cost of providing food, water, non-food items and compensation quickly mounts up especially when the fire affects a large number of people. Two of the example fires for which data was available showed that £130,000 worth of damage was caused by a fire which displaced 2,700 families and nearly £30,000 of damage was caused by another fire which displaced more than 2200 people. Case study two estimated the cost of the damaged caused by the Bahay Toro slum fire to be over £145,000.

Not only do fire victims often lose their homes, but often their livelihood too. What little slum dwellers do possess can be completely removed in a matter of hours, leaving them with nothing whatsoever. In this way, it could be argued that fires have a worse impact than some natural disasters such as floods.

5.3.2 Direct causes of fires

Many of the same causes of fires were repeated in the findings from the interviews, the questionnaire and when consulting the table of example fires from India and the Philippines. Of the 20 example fires examined, the probable causes were identified as: gas cylinders used for cooking or heating which leaked or exploded, electrical faults largely as a result of haphazard wiring, unattended candles, kerosene lamps falling over, unattended open fires and arson. Interestingly, very few of all the fires found during the course of the study attributed the cause of fire to cigarettes. On the other hand, the Philippines BFP identified cigarettes as a very common cause of dwelling fires as discussed in the literature review. The causes identified from the interviews, questionnaire and case studies were: illegal electrical connections, arson, drunken arguments, unattended lit candles, gas cylinders or stoves, kerosene lamps and one case of fire during refuelling.

It could be argued that many of these fires wouldn't occur if there was sufficient service provision and delivery within informal settlements. As Goldammer pointed out, many of the causes are due to a lack of energy security. In developed countries, legal and secure electrical and gas household connections are very probably taken for granted by most people. This concurred with what Pharoah (2009) stated in the literature which was that the lack of formal electricity supply forced many people to utilise more flammable means of heating and lighting. The literature review identified that solid waste often obstructed the already narrow alleys and paths between houses and presented a fire hazard. Suitable solid waste management policies would remove these two factors.

What is interesting to note is that as stated in the literature review, Pharoah (2009, p.113) suggested there is a link between informal settlement fires in South Africa and alcohol abuse and domestic violence. What was thought to have happened in the Mumbai case study is that a drunken brawl broke out between two brothers and somehow resulted in a fire. Pharoah explicitly identified that this type of behaviour in Cape Town was most common amongst young males which is what is suggested in the case study.

Many of the causes stated, appear to agree with Tribunalo"s assessment that most fires are caused by a lack of knowledge and understanding about the dangers and risk of fire. The most frequent causes of fires identified from the example fires shown in the table in appendix C, can be seen from the data visualisation at the end of chapter four, Figure 17. The causes of fire for the largest proportion of examples couldn"t be determined. However, of the 12 fires where a cause was identified, open fires and candles were most prevent with gas related and electrical fires being second most prevalent. Arson was only reports for one fire as was a kerosene lamp.

It was noted that the cause of many fires were undetermined. This may be due to a lack of interest or commitment by the fire service or police, a lack of evidence if all the dwellings are completely destroyed or conflicting witness statements as was seen following the Garib Nagar fire in case study one.

5.3.3 Factors dictating the severity and impact

Increasing urbanisation is placing increasing demands on cities which already experience some of the highest levels of population density in the world. The net effect of this is that land becomes even more valuable. Politicians seek to reach or maintain power and, it might sometimes be suggested, sometimes resort to unsavoury tactics to do so. Slums, which can be located in prosperous and exclusive areas, are seen as potential money making opportunities for property developers and slum lords alike. Slum dwellers are seen for their vulnerability, lack of voice and lower standards of living as easy targets. An example is given in the literature review where an organised gang set fire to a slum then raised the alarm so that everyone evacuated their houses. As soon as people had left their houses they then robbed many of the residents" belongings before the fire could reach them.

Slum dwellings are seldom built to any sort of building standard or code. They are mostly constructed from whatever materials are available which is why residents or homeowners

can"t afford to be selective in the materials they use. There is a little or no choice which is representative of many aspects of slum life such as where people collect water from or go to the toilet. As many slums are not officially recognised by local governments, it appears they have little interest in making sure slums are built to any suitable specification which might address the threat of fire in the design. It would appear that building legislation is seldom enforced without an ulterior motif which allows slum settlements to be constructed and become such a structural fire hazard. It is acknowledged that the logistical challenge of enforcing building legislation retrospectively in a city as large as Manila for example is a huge undertaking. It therefore, may be more effective to proactively implement and enforce legislation in such ways as providing affordable, suitable, alternate accommodation to people who currently live in slums.

One of the most serious hazards faced by slums is their extreme housing densities and substandard quality of construction compounded by nonexistent building standards. This separates them from many types of formalised buildings which may appear to have a similar density yet gaps and roads between buildings act as fire breaks. The same cannot be said for the majority of slums. Building standards are designed to safeguard buildings and their occupants from fire and structural failure. A complete lack of enforced building standards had enabled huge settlements to appear which have no formal consideration for structural integrity and fire safety. It has also been identified that electrical wires strung between houses (which are often a cause of fires), allow fire to spread by burning along the wire from building to building. Goldammer also noted that the spread of fire could be dramatically increased if the wind was able to blow burning embers and materials towards flammable houses. In this way the fire can „leap-frog" houses.

The LPG (liquid petroleum gas) cylinders used by many slum dwellers for heating and cooking have been identified as a significant factor in the spread of fire. If exposed to high enough temperatures, they often explode sending flaming debris in all direction. It is very easy for a piece of this debris to set other things alight in much the same way as flaming embers.

To address the issue of overcrowding, Goldammer suggested that, although controversial, it may be necessary in certain instances to destroy a number of houses to create a fire break for those houses which remained. He stressed the importance of providing suitable alternate accommodation but this is a significant issue by itself. It also raises the point that if this were to happen, what is there to stop people returning and building houses in the

fire breaks that have just been created? The answer is likely to be enforcing legislation and educating people about the reasons why the fire break had been created.

The cases of arson discussed, used some of the most unsavoury tactics. Arson was possibly the most harrowing topic of this study. The underhanded attitude of those who carried out these acts with the thought of financial gain from it and complete disregard for life was abhorrent. It demonstrated how slum residents were viewed by some people as that of an inconvenience and eyesore and not as human beings. The core issue behind this regarded the ownership and rights to the land on which the slum dwellers were settled. Constant fear of evictions plagues many slum residents.

The location and arrangement of dwellings is shown to be a factor in the level of fire risk. The four storey shanty “skyscrapers” in Mumbai‟s slums are a huge fire hazard. Firstly, more storeys increase the population density of the slum which means more people could potentially start a fire and be affected by it. Secondly, little or no consideration is given to how residents would escape if the ground floor caught fire, meaning they would be trapped. Dwellings on the peripheries of a slum may be less at risk from fires as it may be easier for occupants to escape and they are potentially the furthest away from a fire as opposed to a centrally located house which is closer to many more houses.

From the example fires collected, it would appear that the most severe fires in terms of fatalities occur at night. The main danger posed by fires during the night is that most people are asleep and at home, so therefore unaware of a fire until the alarm is raised. During the day however, many residents are likely to be at work or out of the house at least for some period of time. They are therefore likely to notice a fire much sooner than when they are asleep.

The role of water

The primary method of extinguishing fires in India and the Philippines is through the use of water by local municipal fire services. This presents a number of issues for both slum residents and the fire service. It has been identified that due to a lack of service provision, there is rarely adequate water security in slums for drinking let alone fighting fires.

As can be seen from the case studies, the water infrastructure (water treatment works and distribution network) in both Manila and Mumbai is very poorly equipped to deal with fires, especially large ones. Large numbers of broken or lost fire hydrants are reported, as are

areas which are completely underserviced. As such, water tankers are heavily relied upon. This presents logistical challenges and is a high risk strategy. If tankers are unable to supply other fire appliances with water, the effective capability of the fire service is largely undermined which is likely to increase the damage the fire is able to cause. This puts significant pressure on the fire service to ensure appliances are kept supplied with water.

The chain of events leading up to the fire service arriving at the scene of a fire dictates how much a fire can develop and spread. Raising the alarm quickly is important for at least two main reasons. Firstly, it provides people with as much time as possible to try and escape which will help minimise the number of casualties. Secondly, the sooner the fire service is contacted the quicker they arrive at the scene. Heavy traffic, poor transport infrastructure and people relying on others to contact the fire service instead reporting in themselves have all been shown to delay the arrival of the fire service. Case study two identifies that there were only four minutes between the fire starting and the alarm being raised, however the fire still managed to kill a child and render over 1000 people homeless. While there is room for discrepancies in the time of the fire outbreak, it still illustrates how quickly fire spreads in a slum environment and how difficult to contain it is.

It has also been argued that fire services are poorly trained and equipped to deal with fires in informal settlements. Equipping fire services with enough water tankers is essential to begin with if water infrastructure is not sufficiently in place but the use of specialist aerial platforms is likely to enable a much more effective fire extinguishing capacity to informal settlements which can't be accessed by standard water tenders.

The use of motorbikes equipped with fire fighting apparatus should be strongly considered as a possible way to prevent slum fires spreading so quickly. The advantages in terms of speed and access of fire motorbikes over traditional water tenders is likely to have a significant impact on how quickly a fire can be extinguished and therefore its impact. It may be most effective if the bikes worked in pairs as their fire fighting capacity would be increased but both bikes would still be able to ride into the slum.

5.4 How can the threat and impact of fires be reduced?

In the short term aftermath of fires, well equipped and prepared organisations, NGOs or local government departments have been seen to make a positive difference to reducing the impact of fires on slum residents. This can only be achieved when a well planned and coordinated support mechanism is in place which can be implemented immediately.

Both case studies identified a number of actions which were aimed at reducing the impact of the fire on victims in the immediate and longer term aftermath. These included social services establishing temporary kitchens to supply meals to those displaced, charities providing relief materials but most importantly, in Garib Nagar the rights to the land were acquired and the slum formally recognised. This led to the construction of new, socially, technically, financially and institutionally appropriate housing.

Fundamentally, the direct causes of fires need to be addressed. The fire examples collected show that a number of fires started as a result of faulty or leaking gas cylinders which were also observed during the literature review. The reason why the gas cylinders caused the fires needs to be determined as insufficient information was available in this study to do so. Measures need to be taken to ensure appropriate precautions are taken when using flammable liquids such as kerosene and petrol. Examples of this are refuelling well away from any sources of ignition and storing flammable liquids in containers with secure lids which are kept away from children.

The dangers of illegal and haphazard electrical connections are all too real and apparent. Action needs to be taken at a community and institutional levels to stop illegal and unsafe connections being made. The only way of doing this may be to provide a bona fide electricity supply to the settlement. The implications of this need to be discussed between slum communities, their elected representatives, electricity providers and the local governments or councils.

5.4.1 Community level fire reduction interventions

Education about the causes of fires, hazards, and what to do in the event of a fire need to be well publicised and clear to everyone. Residents and children should be shown the importance of knowing how to get out of a slum in the event of a fire by more than one escape route which may help to keep these routes clear from debris. Campaigns such as „fire awareness month" are carried out in the driest month in the Philippines which is often when most fires occur according to the BFP. "Fire weeks" are carried out elsewhere and raise awareness of the dangers of fires and what can be done to reduce those dangers. Leaflet campaigns have also be utilised to promote good fire hazard awareness although the amount of success this achieved could not be determined. All these measures should be considered when attempting to address fire hazard reduction measures at a community level.

Trialling community based fire organisations and management committees in urban settings would be a worthy investment of time and money. The effectiveness of such strategies in South Africa has been well discussed but little appears to have been tried in urban settings. Encouraging slum dwellers to take responsibility for their own fire safety may help raise awareness. It could act as a poverty reduction strategy if the government were willing to help subsidise the setup, equipment and operational costs of the schemes although this may not be easy to secure. There is the additional benefit of an amount of independence that is gained by a slum community if they take responsibility for a certain proportion of their fire safety. Similar may be said if more community members were first aid trained which would benefit the community greatly. Goldammer identified the possibility for women to take a more active role in community fire fighting capacities.

Increased implementation of child fire hazard awareness programmes such as fire walks, where children walk around their home and local area identifying potential hazards should be encouraged. It may be possible to use a similar strategy to that of community lead total sanitation whereby children act as campaigners for fire awareness. In a similar way, junior fire marshals could be appointed.

Education and awareness is started at an early age in the Philippines and is done through schools and communities. The role of the fire service may help to illustrate the importance of fire awareness and add a sense of excitement for children.

The appropriateness and potential benefits of promoting or introducing fire extinguishers into slums was questioned. While it might seem a sensible thing to do, there is a possibility that many slum residents would try to sell them on if they were provided free or at a subsidised cost if it was seen that money could be made off them. There"s also the question of who would subsidise them in the first place as it is very unlikely that slum dwellers would want to pay the full price out of their own pockets. Low cost fire extinguishers are available though.

No research or data was found to suggest that anyone has considered what affect smoke alarms would have if introduced to slums. Therefore, little is known about the effect they would have in terms of reducing the impact of fires. Nevertheless, fire awareness campaigns in developed countries such as the UK continually promote the benefits which would suggest it is at least worth considering.

5.4.2 Institutional reform

The documenting and recording of fires needs to be carried out rigorously. Recording information from all slum fires will give an infinitely clearer picture of the true scale and cause of the problem. Not only does the data need to be collected, but it needs to be analysed and assessed with action taken to address the issues it identifies. If for instance, electrical fires are identified as the cause of the largest proportion of fires then mitigating and preventative action can be focussed accordingly.

The most significant issue is to address the root causes of slums in the first place and provide much more suitable low-cost accommodation. Case study 1 demonstrated that the rehabilitation of fire victims could be done successfully if appropriate low cost housing was made available. The technical precautions necessary to reduce the threat of fires however require money, which is in very short supply for many slum residents. It is necessary therefore for governments and councils to fund campaigns to raise awareness and educate communities as this has been shown in the Philippines to have worked. Local governments need to be held accountable for not addressing the safety of the public.

Enforce legislation to prevent arson by demonstrating to the public that those who do such acts will be caught and held accountable. In Bangalore, a person who tried to voice his opinion was beaten up by supporters of a local councillor directly in front of police officers. This attitude is completely unacceptable and needs to be reversed. This can only be done through acknowledging that fire safety in slums needs to be addressed.

Governments should invest in their water supply and distribution networks that service both the drinking and fire fighting requirements of cities. The long term inspection and maintenance programmes of distribution networks should be considered to ensure they remain working effectively. Extending networks to service slums should be done as a human right to ensure adequate quantities of drinking water are available. The inspection, testing, location mapping and repairing of fire hydrants should be done on a continual basis. This will reduce the reliance on cumbersome and logistically inappropriate water tankers and should reflect the longer term perspective adopted by the fire service and local authority.

5.4.3 Disaster preparedness

The impact of fires compared to natural and man-made disasters was illustrated by the fear many slum dwellers live in, of fire. The similarities between the actions needed to be taken by residents in the event of a fire are very similar to those of a flood or earthquake. The institutional mechanism if also adopts a very similar approach. This can be seen in the intervention MSF carried out after the Garib Nagar slum fire. The exercise was justified as a practice for the staff so that they we well trained in how to implement an effective intervention when the Monsoon season came and the floods with it (MSF, 2011)

The literature search identified a very appropriate disaster management plan which could easily be adopted by slum communities and local governments. The approach presented, could be used to plan how to avoid starting fires in the first place but also what to do in the event of one. The essential aspects that Pelling and Wisner (2009a) describe are synonymous to most disasters. The scope for cross learning to reduce the impact of fires through lessons learnt from natural and man-made disasters is apparent. Earthquake drills used in Philippine schools only differ slightly to that of a fire drill in that children are educated in what to do, how to do it and how to stay safe in the same way – by practicing it.

5.5 Limitations of study

All the information and data presented in this study has been carried out to the best of the authors‟ ability and knowledge. It is acknowledged that there are certain limitations to the study which may have influenced the outcome of the research. The focus of the study is on two countries which were unable to be visited by the author; therefore no firsthand experience of the true nature of the problem was obtained. The study was restricted to two countries when in reality; fires in informal settlements are not limited to geographical boundaries unlike this study. Much of what has been discussed has treated India and the Philippines as one gigantic country. In reality, they are approximately 3,000 miles apart. What may help to reduce the risk of fire in one city, may not even work in another city in the same country let alone thousands of miles away. Greater consideration needs to be given to specific the specific context.

While every effort has been taken to find and read all available literature on the topics and issues discussed, it is possible that some information may have been omitted. There has been a lack of information found regarding the fire statistics and data in both India, and the Philippines which if available, may have strongly influenced the outcome of this study.

It was identified that much fire data may have been available online, however access was restricted and required official login details.

It was not possible to obtain any primary data from the fire services in India, the Philippines or even the UK. It is likely that this would have strongly benefitted the findings of the study. Great effort was put into attempting to involve those parties but it was not possible with the time or resources available. The contribution to the study of slum residents has only been achieved through secondary sources. Much of the data from the secondary sources contained discrepancies. Similar problems were acknowledged by Pharoah (2009) when conducting research of a similar nature.

The data visualisations used in chapter four are an alternate way of presenting and interpreting the collected data. The full potential of these tools was limited by the sample size of the fires studied. Similarly, it would have been desirable to conduct a much larger sample of informal settlement fires which would be representative of certain areas however the data required to do so was simply unavailable.

The methods adopted are suited to the relatively short timescale of the study. With more time it may have been possible to incorporate the perspectives of more stakeholders and develop a larger professional network of contacts to draw on. Greater attention and in depth analysis may have been possible if more time was allocated to the study also.

A large number of stakeholders were contacted to request their input but many didn't respond. The most significant stakeholders not to have been directly involved are informal settlement residents. It would have been greatly beneficial to discuss the nature of the research problem first hand however this was not possible.

The use of unstructured interviews was necessary to help understand the context of the problem more clearly. However, the data gathered from the interviews suggested they were not as appropriate or effective as initially thought. The main issues were identified as: the interviewee not having a great enough understanding of the subject, the interviewer (the author) asking irrelevant or over complicated questions and a lack of clarity in objective and purpose of specific interviews in terms of what exactly wanted to be established. Part of this was attributed to lack of experience on the part of the interviewer such as detracting from the main purpose of the interview. Another factor was the selection of participants or that only a small number of participants were involved. A

greater number of interviewees with similar and different stakeholders would have provided a more holistic representation. In hindsight, it may have been appropriate to focus on a more specific aspect of the research problem and adopt a more targeted approach using semi-structured interviews to greater effect.

The interpretation of the data collected from the interviews left room for ambiguities. It is possible that the author interpreted information in a slightly different way than the interviewee intended. The nature of the data that is collected from a single individual was seen to be very subjective. A number of the interviewees didn"t speak English as a first language so there is potential for discrepancies in the data due to misunderstandings as a result.

The authors" original intention was to conduct a semi-structured interview with Baltz Tribunalo over Skype. However, this was not possible due to difficulties in arranging a mutually convenient time when both the author and interviewee were free. The time difference between the Philippines and the UK being seven hours and work commitments from the interviewee prevented this from happening. Therefore a questionnaire was sent via e-mail which was duly completed and returned. The main limitation of this compromise was the lack of opportunity to probe and ask the interviewee to expand on certain points or clarify things. The eventual outcome is considered to be similar to what would have been collected from a semi-structured interview though.

Chapter 6. Conclusion and Recommendations

6.1 Introduction

This section concludes and consolidates much of what has been discussed in the preceding chapters. The primary purpose of this is to assess how successfully the research aim set out in chapter one has been addressed and discuss what the research which has been carried out has and has not been able to indentify.

Fires present a constant and severe threat to the millions of people who live in India‟s and the Philippines‟ informal settlements. Many of the circumstances which have lead to an elevated level of risk for slum residents are directly as a result of the substandard quality of housing, overcrowding and extreme population density, lack of service provision and delivery and high levels of poverty.

6.2 Conclusion

This study forms a qualitative assessment of the frequency, severity and impacts of informal settlements fires within the project area. What has not been conclusively determined is the quantitative scale of informal settlement fires on an annual basis for the project countries as initially intended. What could be established was that single, individual fire events can negatively impact large numbers of people in direct and indirect ways. The frequency with which such events occur could not be accurately determined although it was strongly indicated that the frequent and recurrent nature of these fires is significant enough to warrant further detailed investigation.

The profile of fire victims is not restricted to one particular age group, gender or religion. Fires impact all slum residents in much the same way by destroying belongings, homes and livelihoods. However, certain people have been identified as being more susceptible and vulnerable to the threat and impact of slum fires. The most vulnerable groups are young children who are yet unable to take responsibility for their own safety and individuals who are immobile and unable to escape in the event of a fire outbreak such examples are elderly, infirm or disabled individuals.

Informal settlement fires impose a significant detrimental impact on the direct victims of such fires on a number of levels. These include physical, emotional, financial and social

levels. What has also been demonstrated are the indirect impacts informal settlement fires have economical and financial to governments, NGOs and other stakeholders. The most damaging effects of fires may not be the most obvious. An example might be the loss of personal possession if a house burnt down. This might be upsetting for certain individuals however the destruction of a latrine block from a fire and losing a sense of dignity may far outweigh this.

Common and recurrent causes of informal settlement fires have been identified. Amongst them are: leaking gas cylinders, knocked over kerosene lamps, unattended candles, electrical wiring and arson. What is equally important are the indirect causes such as negligence, lack of awareness of fire hazards and ignorance where arson is concerned. Without acknowledging and addressing the indirect causes first, it may not be possible to make a difference to the direct causes.

The slum environment has been described as the perfect recipe for a spontaneous combustion (Davis, 2006, p.127). With extreme population densities, cramped and overcrowded living conditions, houses made from inflammable materials and lack of provision for the management of solid waste, it"s not difficult to see why. This study has shown that this accumulation of factors and prolific fire hazards has led to the elevated threat of fire many slums now face.

The fire service, and the provision of water for fire fighting along with them, have been identified as one of the most significant determining factors in influencing how much damage a fire is able to cause before it is extinguished. Even a fire that was swiftly responded to was shown to have caused significant damage before being extinguished; the capacity and capability of the fire service to tackle these fires is all too often limited by access to the fire. As many slums don"t have adequate access to drinking water, it"s not altogether surprising to find that fire fighters regularly struggle to secure sufficient sources of water to effectively tackle large slum fires.

The impact of fires can be quickly reduced through a number of straight forward steps at a community level. However, the fundament root causes of the problem cannot be solved without the backing and support from high level government officials and politicians. The priority of informal settlements, and particularly fire in informal settlements, is strongly suspected of being low on governments" agendas of issues to address. Especially in areas which it could be argued have more pressing issues such as a lack of access to adequate drinking water and suitable sanitation. The Philippines and India are both

strongly impacted by many natural and man-made disasters in a negative way which absorbs much of governments‟ money and resources.

At community levels, residents lack awareness of the dangers and risks of fire. Little responsibility appears to be taken for people‟s individual fire safety and blame is quickly distributed to other stakeholders such as governments and fire services following a fire. Fire education and awareness campaigns have been shown to reduce the number of fire incidences in other countries and within India and the Philippines themselves. Investment is required from external parties to subsidies any reduction measures as it will be very difficult for slum communities to meet the cost and many may see it at the responsibility of the government.

Governments need to address both the immediate and underlying causes of fire. Fire services need to be equipped with appropriate equipment, resources and training to be able to extinguish fires effectively. This may require investment or allocation of resources such as aerial ladder platforms which overcome many of the issues faced b y restricted access in slums by going over the top of buildings in order to reach fires. Social welfare and low-cost urban housing are essential if people are to move out of slums.

The number of people killed by informal settlement fires is considered to be less than of floods and earthquakes but the impact has been described as equal to that of such disasters. There are many similarities between what can be done to plan how to reduce the impact of fires and what is already done to plan reducing the risk posed by natural disasters. The equipment, resources, techniques and knowledge needed to effectively minimise post-fire impact on victims has been demonstrated by interventions from NGOs such as MSF.

6.3 Recommendations

A number of steps and actions can be taken to immediately reduce the threat of fire to slum residents. More complex and underlying issues will take longer to address and even longer to recognise the difference that has been made. However, in the longer term, a reduction in the number, severity or frequency of slum fires will be seen.

There are different levels that changes can be made at so the recommendations have been adjusted and targeted accordingly. As a number of options are being recommended, they have been listed in order of priority with the most important or easily implemented recommendations first.

Short term measures are considered to be those which can be implemented within one month of deciding action is going to be taken and are more likely to show quick results. Longer-term actions refer to interventions and measures which require greater planning and commitment from stakeholders but in the long term, will demonstrate that the root cause of the issue has been or is being addressed. The recommendations outlined below focus on reducing the likelihood of causing a fire and minimise the impact and severity in the event of a fire.

Short-term, community based fire risk reduction measures

1. Educate communities about the danger of fire hazards such as: faulty wiring, leaking gas cylinders, kerosene lamps, candles and demonstrate how they can easily reduce the threat by steps such as not leaving candles or fires unattended, not connecting to power cables illegally and ensuring gas stoves are maintained and not leaking
2. Encourage residents to plan their escape route in the event of a fire and ensure that it is kept clear of debris. In the event of a fire, residents should assume nobody has raise the alarm or reported the fire and take responsibility for reporting the fire.

Long- term community based fire risk reduction measures

1. Individuals to take greater accountability for fire safety in the community by adopting good fire hazard reduction practices such as storing flammable materials and liquids safely and promoting fire awareness and education to children and other community members.
2. Introduce frequent fire awareness campaigns, possibly linked to the most common season for fires.

Short-term, institutionally based fire risk reduction measures

1. Begin to address how fires in informal settlements are investigated and recorded. Increase the level of detail recorded and analyse the data at regional levels. The information should be placed in the public domain to provide public confidence and reassurance to the public that the causes of fires are being investigated. This will increase accountability.
2. Investigate the feasibility of community based fire organisations and attempt a pilot scheme in most “at risk” area.

Long-term, institutional based fire risk reduction measures

1. Address low cost housing solutions and provide far more affordable housing aimed at accommodating the needs of the urban poor.
2. Address water infrastructure issues with the aspiration of achieving 100% drinking water coverage and water availability for fire fighting purposes. Increase reliability and hours of service coverage.

6.4 Scope for future work

This study has identified a number of areas that would benefit from further investigation and research. Much of the topic discussed has been done so in broad and holistic manner as it has been an exploratory assessment of the current situation covering a vast area. What is required following this, is an in-depth and very specific analysis of the effects that adjusting one or two variables might have on how the impact and severity of fires can be influenced.

It would be greatly beneficial to trial some of the recommendations and measure which of them is most successful in reducing the threat and impact of fires. What is needed is to identify the most “at risk” areas in order to trial urban fire reduction strategies. One such example would be to trial urban community based fire management programmes as a tool for increasing fire awareness, reducing poverty and moving the responsibility and sense of ownership for fire safety from local governments to specific communities. Alternately, an assessment of how fire fighting capacity is influenced by water distribution and supply systems would be very enlightening. Evaluating how a fire service which doesn't have a fully integrated water supply and distribution network compares to that of one that does may indicate the importance and significance of water distribution networks for fire fighting capacities. This may lead to investigating how effective and financially or economically feasible it would be to have a non-potable water distribution network for the sole purpose of providing water coverage for fire fighting purposes. It may also have the added benefit of providing water for irrigation purposes for example.

Examining how low cost, easily implementable fire hazard reduction measures impact the number and severity of fire outbreaks would be interesting. Examples of such measure could be: ensuring gas cylinders and stoves that slum residents use for cooking meet certain safety standards, or subsidising smoke alarms or low cost fire extinguishers. If it was identified that such measure had a tangible link to reducing the impact of fire it would be very worthwhile to conduct.

The scope of the research problem has been very broad which enables many aspects of what has been found to be investigated further. Chapter one set out that this study aimed to form the basis of continued research and developmen

A possible correlation was identified between the time of fire outbreaks and the number of deaths but it would have a significant impact if the correlation between such variables could be more accurately and specifically measured. This may lead to influencing how fire stations manage their staff number around to accommodate times when there is most likelihood of a fire breaking out.

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Appendix A

Appendix B

Appendix C