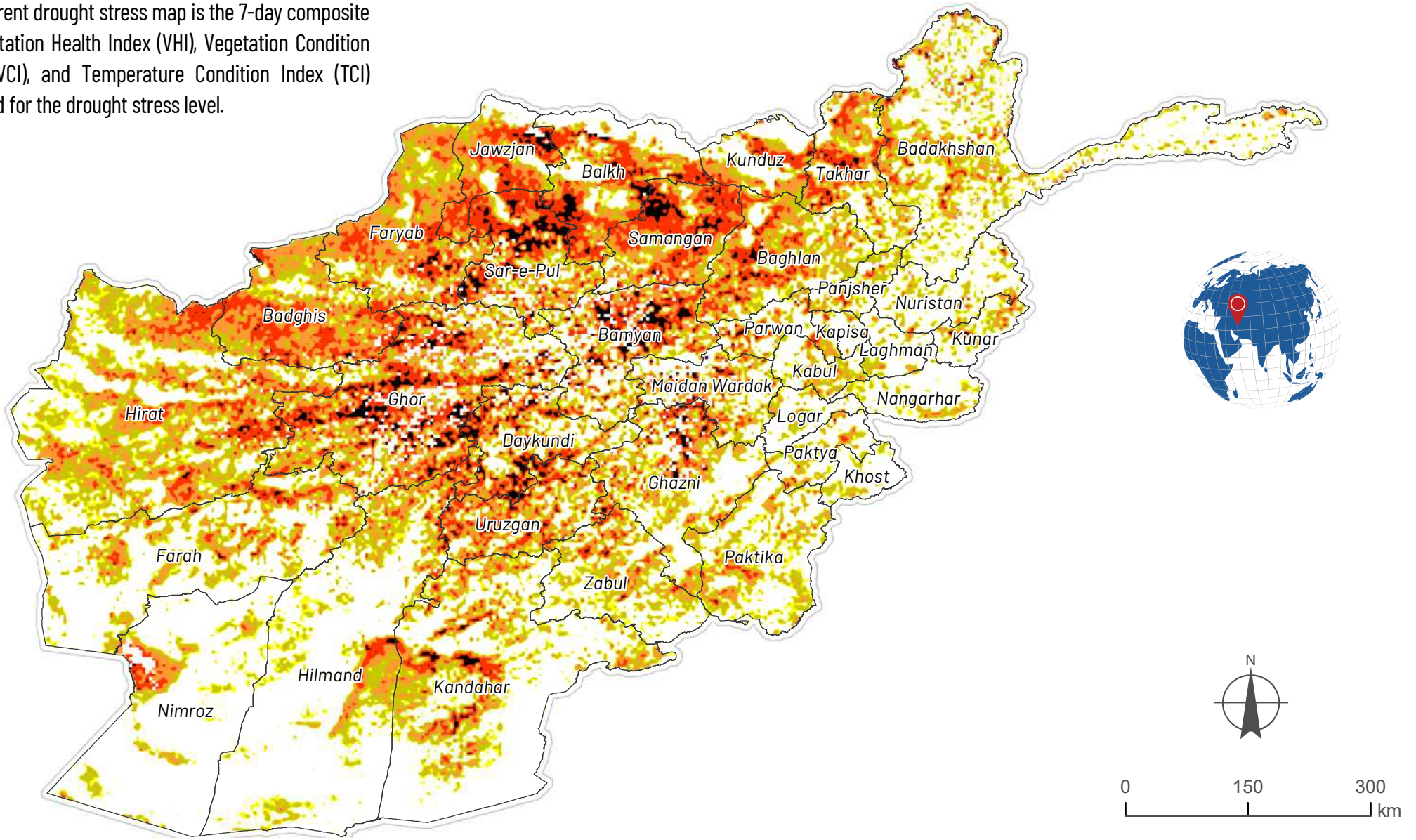
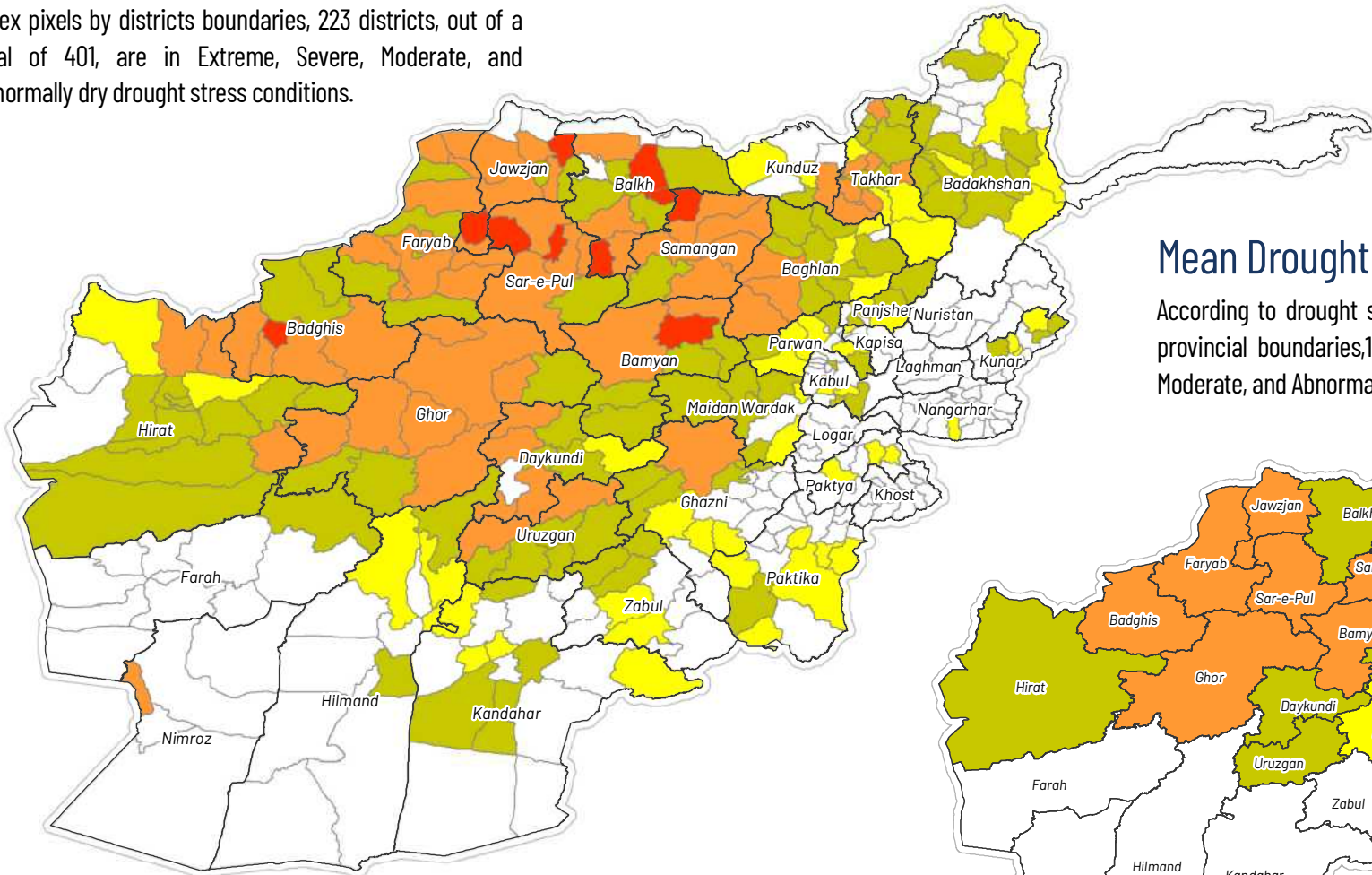


The current drought stress map is the 7-day composite of Vegetation Health Index (VHI), Vegetation Condition Index (VCI), and Temperature Condition Index (TCI) adjusted for the drought stress level.



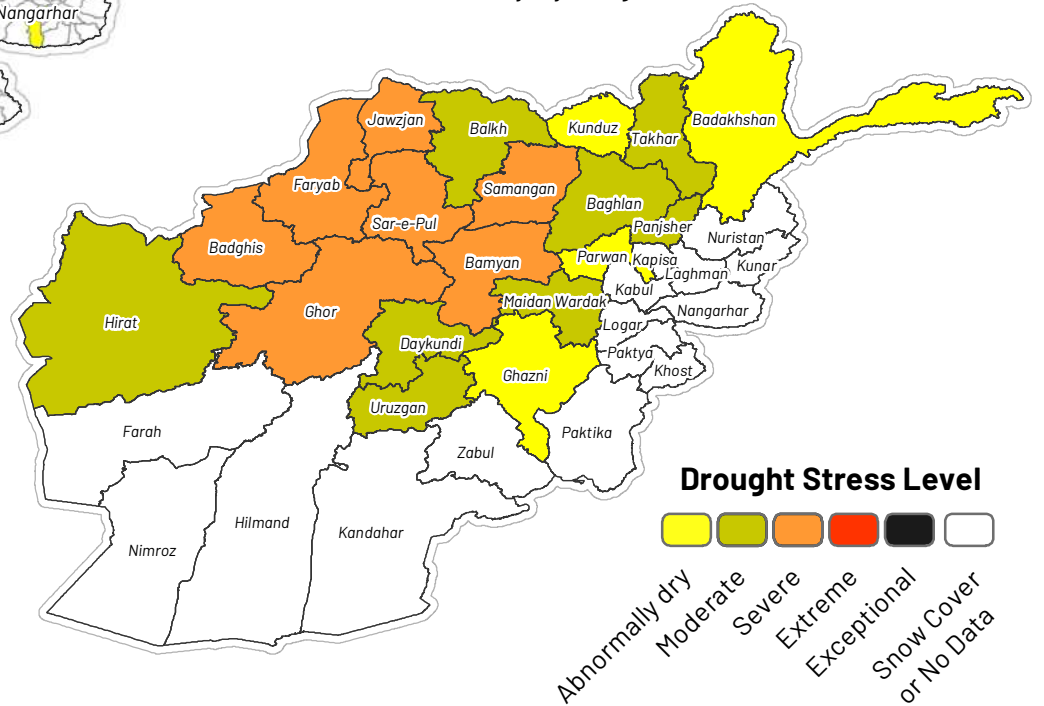
### Mean Drought Stress by District

According to drought stress based on mean vegetation index pixels by districts boundaries, 223 districts, out of a total of 401, are in Extreme, Severe, Moderate, and Abnormally dry drought stress conditions.



### Mean Drought Stress by Province

According to drought stress based on mean vegetation index pixels by provincial boundaries, 19 provinces, out of a total of 34, are in Severe, Moderate, and Abnormally dry drought stress conditions.



#### Drought Stress Level



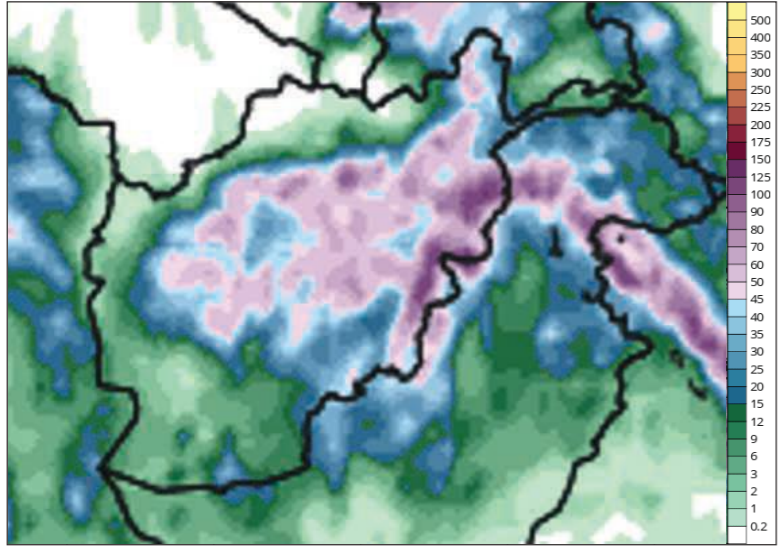
**Datum/projection:** WGS84/Geographic  
**Data Sources:** NOAA STAR, AGCHO  
**Creation Date:** July 20, 2022

**Description:** This map shows drought stress risk based on the vegetation index in Afghanistan. The current drought map is a 4 km resolution, and a 7-day composite of Vegetation Health Index (VHI), Vegetation Condition Index (VCI), and Temperature Condition Index (TCI) adjusted for the drought stress level (if their values are below 40). **Drought stress is 'Exceptional' if the indices are between 0 and 5; 'Extreme' if they are 6-15; 'Severe' 16-25; 'Moderate' 26-35; 'Abnormally dry condition' 35-40.**

**Disclaimer:** This map is made possible by the generous support of the American people through the United States Agency for International Development (USAID) – Bureau for Humanitarian Assistance (BHA). The boundaries, denominations, and designations displayed in this product are defined by the data shared with iMMAP. At iMMAP we visualize data, we do not create it, so these elements and freshness of the data are the responsibility of the data providers and no endorsement nor acceptance of it by iMMAP, USAID-BHA, or the United States Government can be assumed.

**Feedback:** rep-afghanistan@immap.org

# AFGHANISTAN: 10-Day Flood Risk Forecast - Population and Buildings Exposed (17 April 2024)

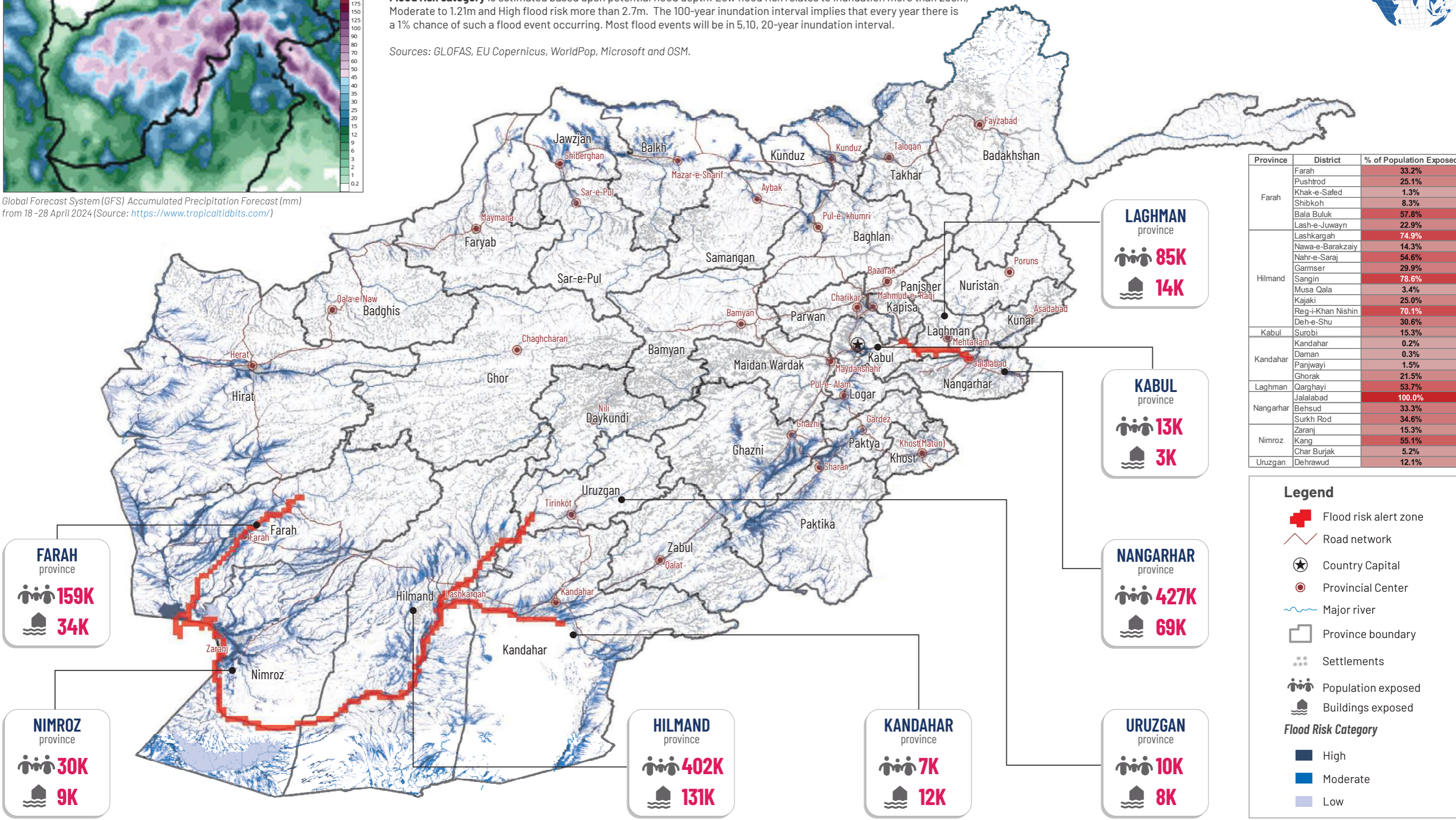


Global Forecast System (GFS) Accumulated Precipitation Forecast (mm) from 18-28 April 2024 (Source: <https://www.tropicaltidbits.com/>)

**Flood risk alert** is based on GLOFAS river discharge and return level data for 4-10 days from today. Specifically, a flood alerted pixel represents a likely river discharge volume exceeding the 2 year return level. It is calculated by iMMAP Inc. (<https://hsdc.immap.org/catalogue/#/dataset/326>) based on discharge forecast and return levels available through Global Flood Awareness System (GLOFAS). Estimated population and buildings exposed were derived using spatial analysis on the most recent available GIS shapefiles and raster datasets.

**Flood risk category** is estimated based upon potential flood depth: Low flood risk relates to inundation more than 29cm, Moderate to 1.21m and High flood risk more than 2.7m. The 100-year inundation interval implies that every year there is a 1% chance of such a flood event occurring. Most flood events will be in 5,10, 20-year inundation interval.

Sources: GLOFAS, EU Copernicus, WorldPop, Microsoft and OSM.



Province	District	% of Population Exposed
Farah	Farah	33.2%
	Pushrod	25.1%
	Khak-e-Safed	1.3%
	Shibkoh	8.3%
	Bala Buluk	57.8%
Hilmand	Lash-e-Juwayn	22.9%
	Lashkargah	74.9%
	Nawa-e-Barakzaiy	14.3%
	Nahr-e-Saraj	54.6%
	Gamser	29.9%
Kabul	Sangin	78.6%
	Musa Qala	3.4%
	Kajaki	25.0%
	Reg-i-Khan Nishin	70.1%
	Deh-e-Shu	30.6%
Kandahar	Surobi	15.3%
	Kandahar	0.2%
	Daman	0.3%
Laghman	Panjwayi	1.5%
	Ghorak	21.5%
	Qarghayi	53.7%
Nangarhar	Jalalabad	100.0%
	Behsud	33.3%
	Surkh Rod	34.6%
Nimroz	Zaranj	15.3%
	Kang	55.1%
	Char Burjak	5.2%
Uruzgan	Dehrawud	12.1%

**Legend**

- Flood risk alert zone
- Road network
- Country Capital
- Provincial Center
- Major river
- Province boundary
- Settlements
- Population exposed
- Buildings exposed

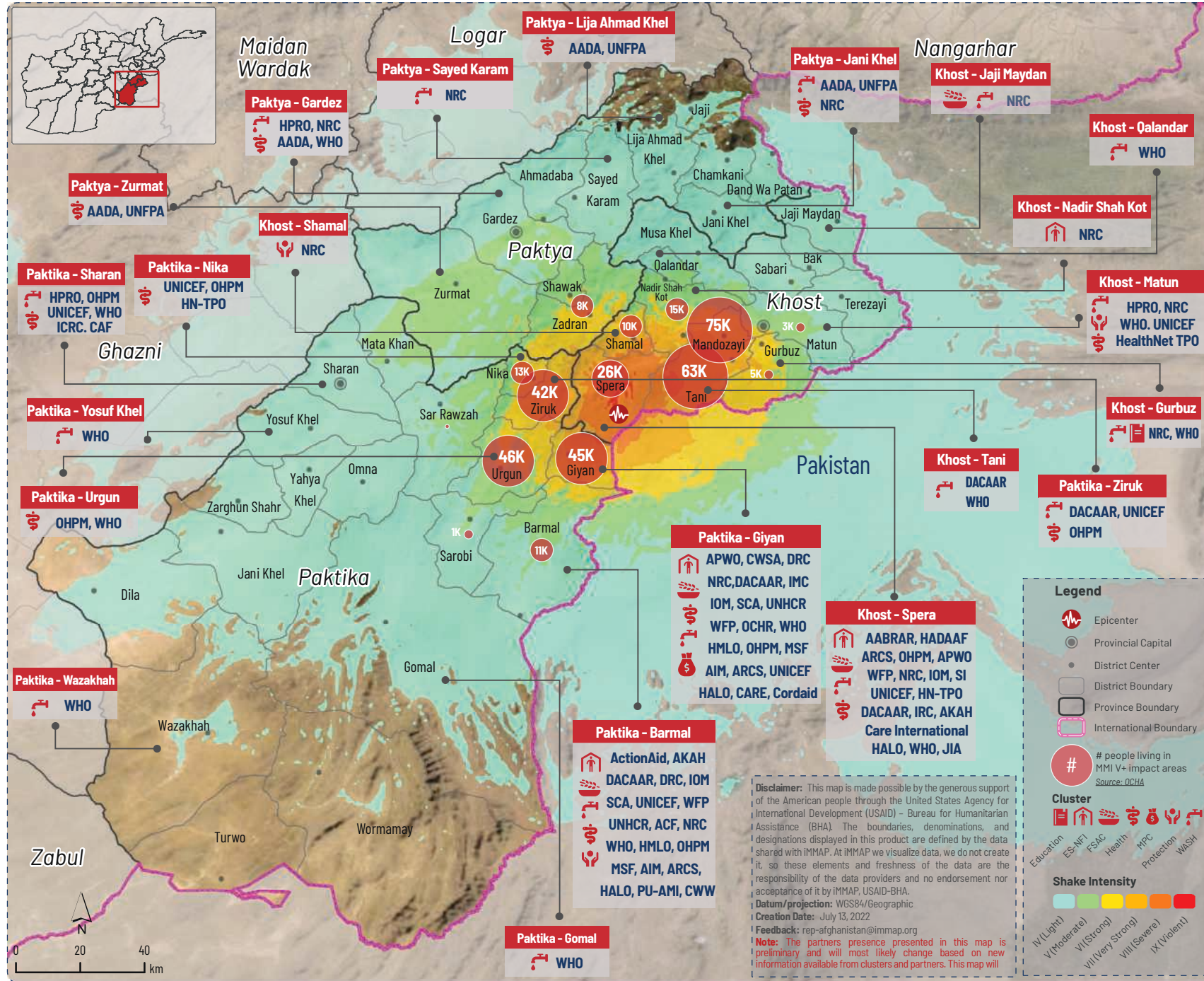
**Flood Risk Category**

- High
- Moderate
- Low

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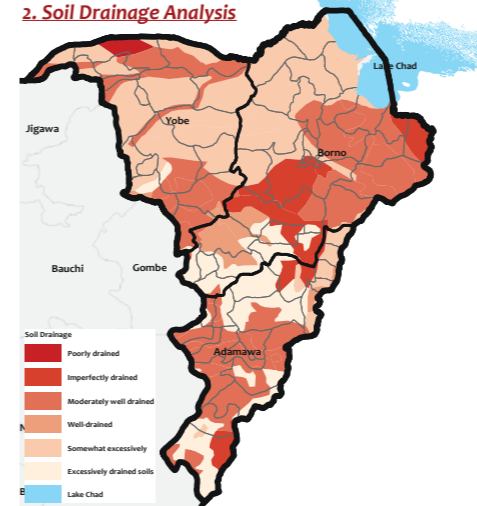
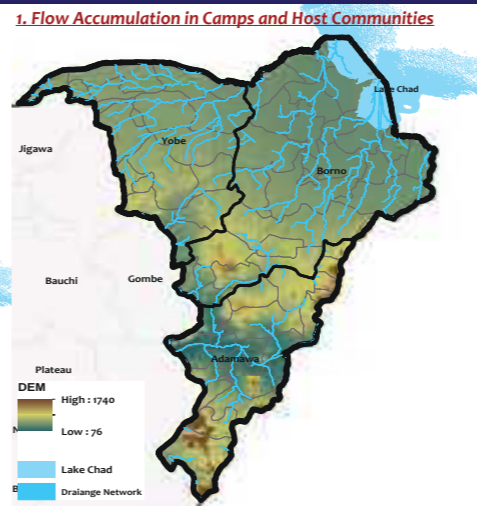
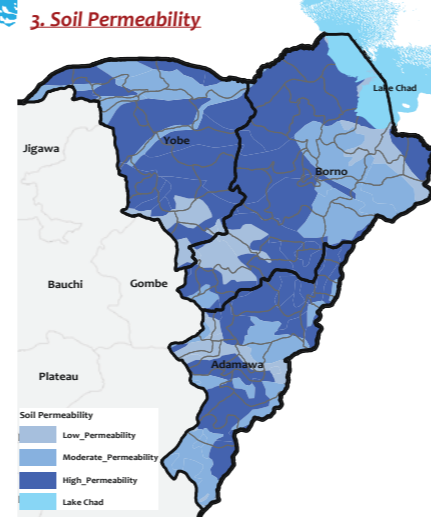
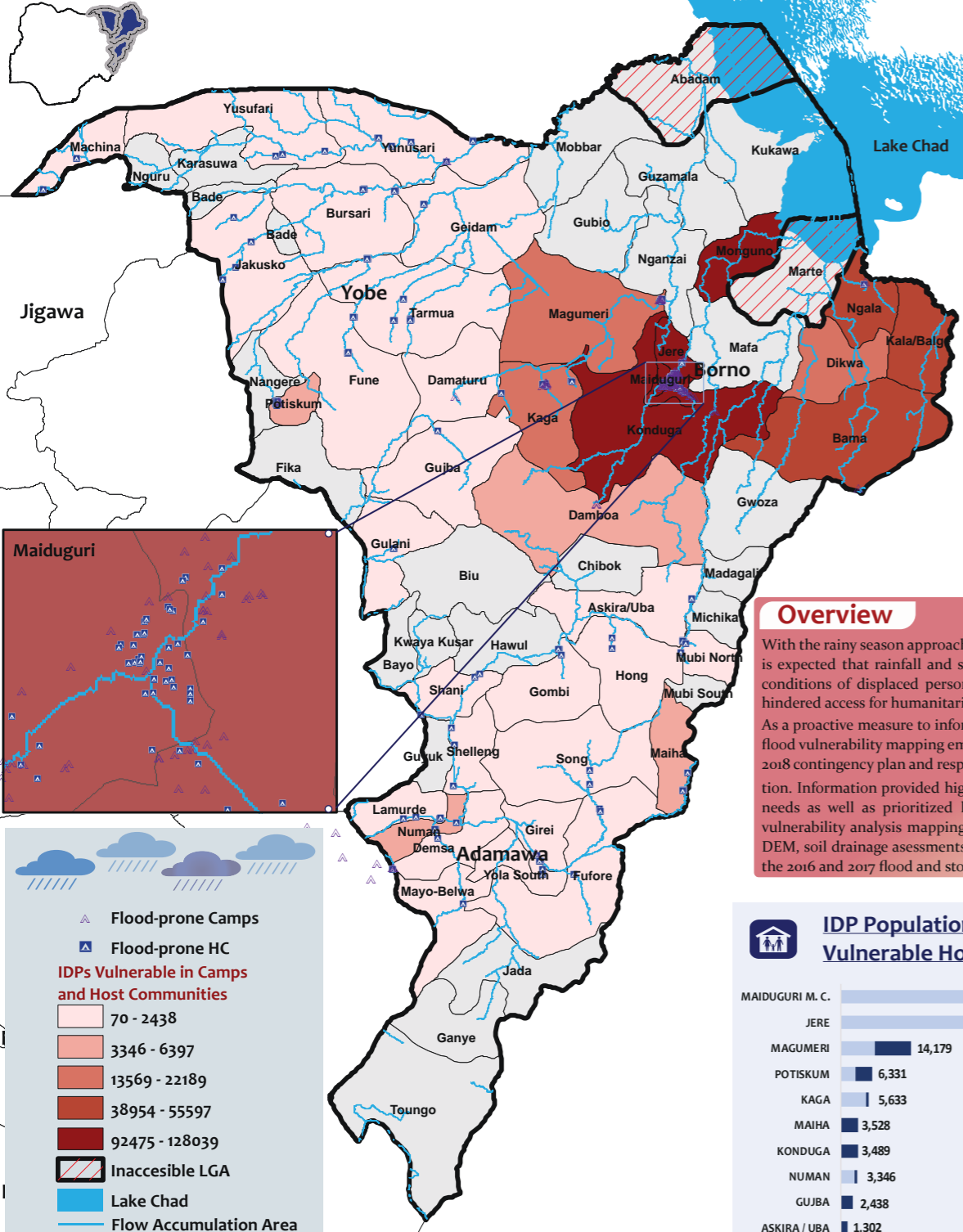
# AFGHANISTAN EARTHQUAKE RESPONSE: PARTNERS PRESENCE

Humanitarian Response to 5.9 Magnitude Earthquake in Spera District of Khost Province on June 22, 2022 | Update 02: as of 13 July 2022



Operational Presence			
Province	District	Cluster	Implementing Agency
Khost	Gurbuz	Education WASH	NRC, WHO
	Jaji Maydan	FSAC, WASH	NRC
	Matun	Health Protection WASH	HPRO, NRC WHO, UNICEF HealthNet- TPO
	Nadir Shah Kot	ES-NFI	NRC
	Shamal	Protection	NRC
	Spera	ES-NFI FSAC WASH Health	AABRAR, HADAAF ARCS, OHPM, APWO WFP, NRC, IOM, SI UNICEF, HN-TPO DACAAR, IRC, AKAH Care International HALO, WHO, JIA
	Qalandar	WASH	WHO
	Tani	WASH	DACAAR, WHO
	Barmal	ES-NFI FSAC WASH Health Protection	ActionAid, AKAH DACAAR, DRC, IOM SCA, UNICEF, WFP UNHCR, ACF, NRC WHO, HMLO, OHPM MSF, AIM, ARCS, HALO, PU-AMI, CWW
	Giyan	ES-NFI FSAC WASH Health MPC	APWO, CWSA, DRC NRC, DACAAR, IMC IOM, SCA, UNHCR WFP, OCHR, WHO HMLO, OHPM, MSF AIM, ARCS, UNICEF HALO, CARE, Cordaid
Paktika	Nika	Health	UNICEF, OHPM HN-TPO
	Yosuf Khel	WASH	WHO
	Sharan	WASH Health	HPRO, OHPM, WHO UNICEF, ICRC, CAF
	Urgun	Health	OHPM, WHO
	Wazakhah	WASH	WHO
Paktya	Lija Ahmad Khel	Health	AADA, UNFPA
	Ziruk	WASH Health	DACAAR, UNICEF OHPM
	Gardez	WASH Health	HPRO, NRC AADA, WHO
	Jani Khel	Health WASH	NRC, UNFPA AADA
	Sayed Karam	WASH	NRC
Zabul	Zurmat	Health	AADA, UNFPA

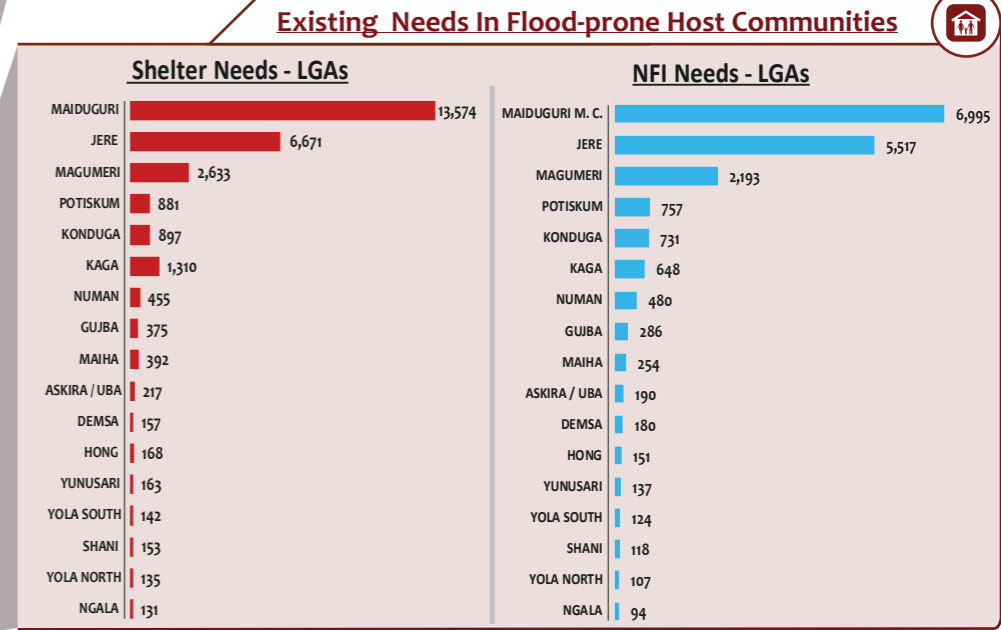
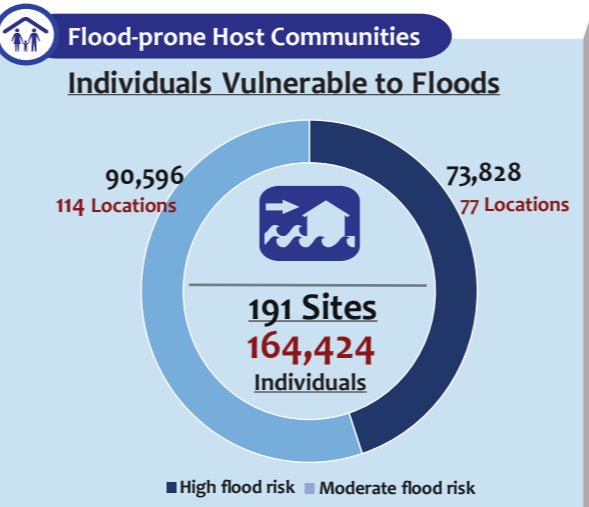
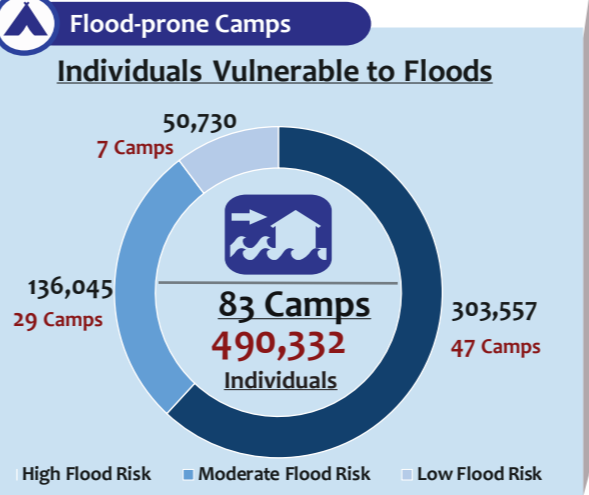
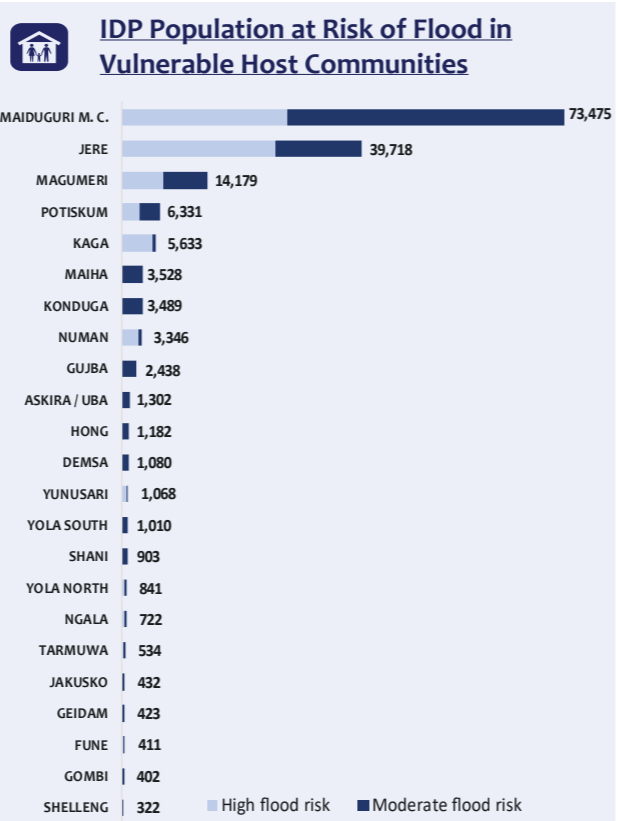
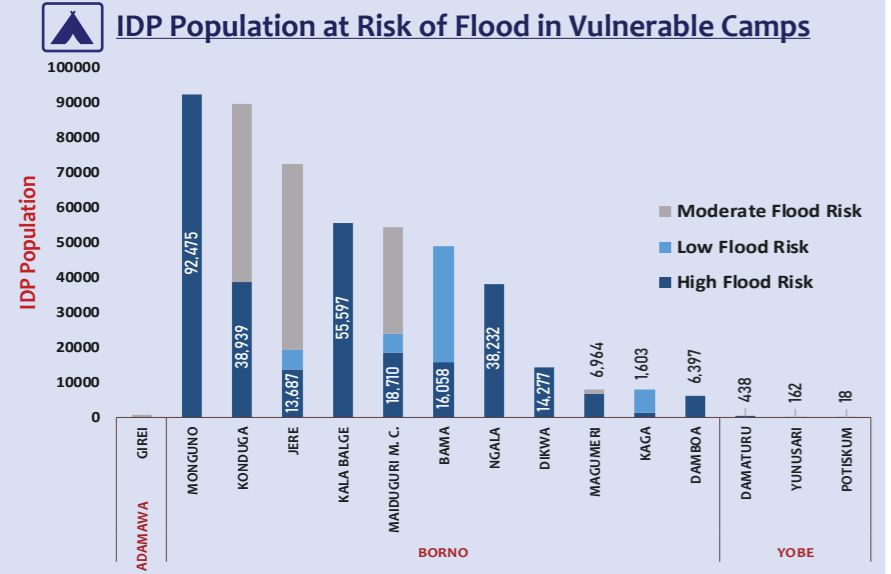
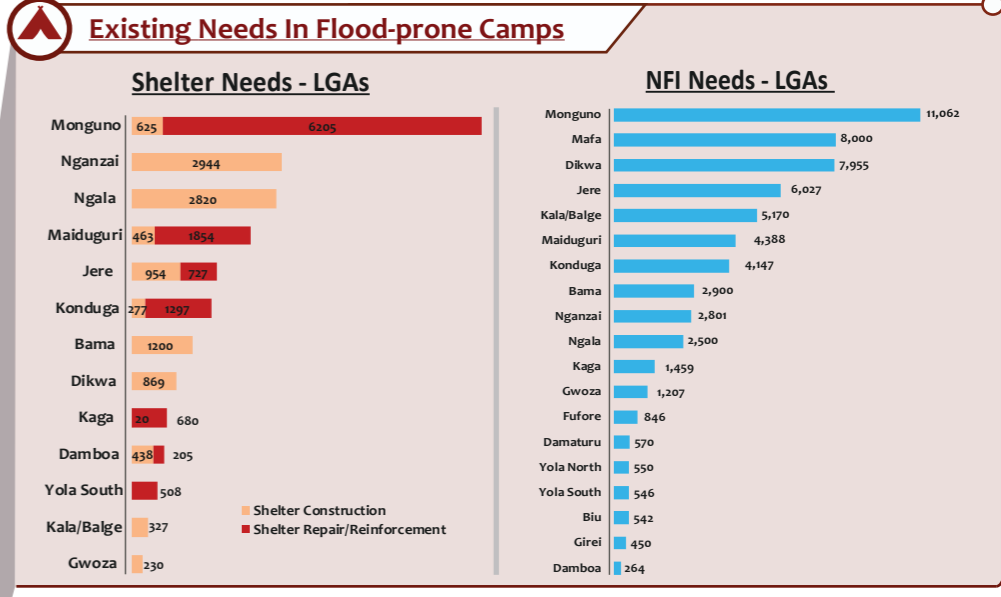
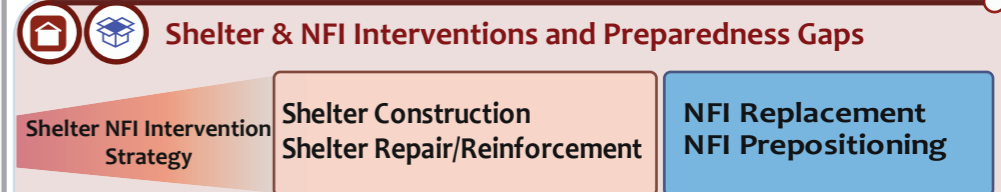
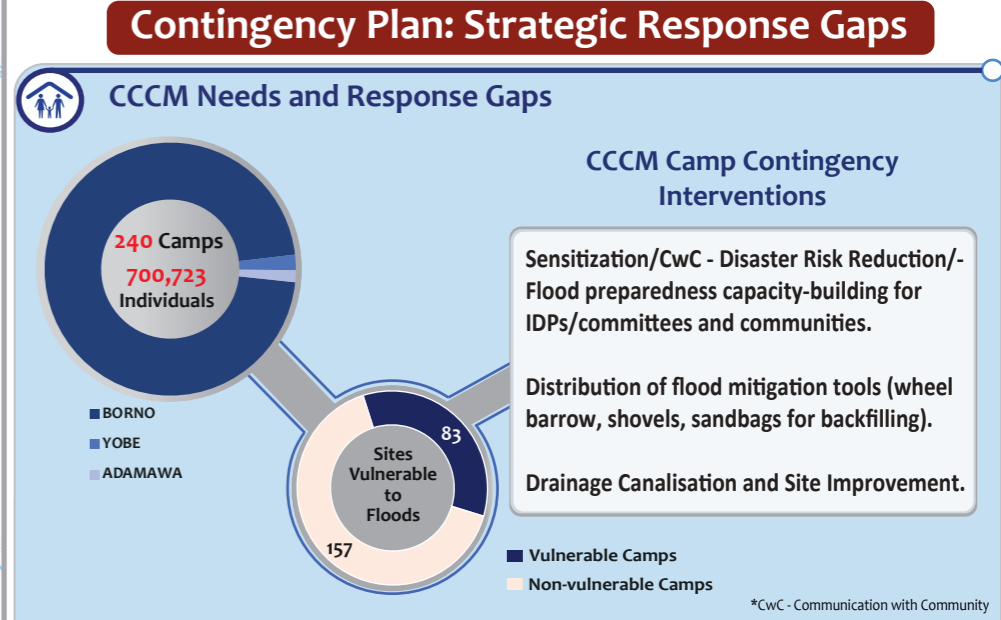
Source: Extracted from OCHA, WASH, ES-NFI, FSA and Health Clusters' reports and emails.



### Overview

With the rainy season approaching in Northeast Nigeria - from May to September 2018, it is expected that rainfall and storm events will have damaging consequences on living conditions of displaced persons both in camp sites and host communities, including hindered access for humanitarian actors in most vulnerable locations.

As a proactive measure to inform preparedness activities, the sector produced a targeted flood vulnerability mapping emphasizing on sector needs and gaps assessed to review the 2018 contingency plan and response strategy for CCCM, Shelter and NFI-related intervention. Information provided highlights the different levels of vulnerability, the severity of needs as well as prioritized locations for preparedness and response activities. The vulnerability analysis mapping and gap assessment were done using field assessments, DEM, soil drainage assessments, a review of arrivals trends as well as data recorded from the 2016 and 2017 flood and storm events.



References

- Batjes NH 2015. World soil property estimates for broad-scale modelling (WISE30sec). Report 2015/01, ISRIC - World Soil Information, Wageningen (with data set, available at [www.isric.org](http://www.isric.org)).
- Displacement Tracking Matrix (DTM) Rd XXI

Sector Contact:

Website: <https://www.humanitarianresponse.info/en/operations/nigeria/shelter-and-nfi>

Email: [shelter.cccm.nigeria@gmail.com](mailto:shelter.cccm.nigeria@gmail.com) | Phone: +2349075111558, +2349087360402



**Developing Social Vulnerability Indices for Extreme  
Temperatures Risk in Newcastle:  
An Evidence-based Tool for Emergency Preparedness.**

**Vocational Dissertation  
with  
Newcastle City Council**

**MSc. Risk**

**Department of Geography  
Durham University**

**September 2016.**

## Executive Summary

This vocational dissertation was undertaken in collaboration with Newcastle City Council. This study was aimed at developing a quantitative social vulnerability indices for assessing extreme temperature vulnerability in Newcastle. This report is expected to help in identifying localized community-level social vulnerability determinants for emergency planning and response. The first objective of this study was to determine the social indicators which could contribute to increased losses on well-being. First, drawing theoretical justification from the literature and consultation with experts at Newcastle City Council, an initial set of indicators was collected from census data for 910 Output Areas (OAs) in Newcastle. These datasets were used to quantify to what extent their availability or lack can contribute to an overall increase or decrease in vulnerability in different parts of Newcastle. The summary of social vulnerability proxies developed in this study is presented in Chapter 3.

The second part of the analysis combines statistics and GIS to compare the relationship between sensitivity, adaptive capacity and enhanced exposure sub-indices and their components. The result of this investigation indicates that there is a significant statistical relationship between sensitivity and adaptive capacity, and also between sensitivity and enhanced exposure. The spatial relationship was tested using Getis Ord  $G_i^*$  hotspot analysis and Ripley's K statistic, which found a significant clustering of vulnerability driven by both "sensitivity", "adaptive capacity" and "enhanced exposure". This study has identified the most vulnerable output areas in Newcastle in these wards; Walker, Elswick, Jesmond, Newburn, and Gosforth. From these observations, this report advocates the inclusion of social indicators in vulnerability analysis to reveal the marginalized population otherwise not acknowledged.

Finally, a proximity assessment of health and emergency services was carried out to reveal the southern cluster of emergency facilities and inefficient coverage of ambulance services. The identified accessibility-deprived output areas are located in the wards on the Northern parts including; Woolsington, Parkland, Fawdon, East and West Gosforth, and Castle.

This report summarizes by noting that the new framework is only intended to inform the periodic review of emergency planning and response strategies in Newcastle, suggesting an adoption of spatially detailed data to improve quantitative understanding of the spatial distribution of extreme temperature-related social vulnerability. It finally recommends an improvement in institutional adaptive capacity to handle emergencies in Newcastle.

## **ACKNOWLEDGMENTS**

I will like to thank those that made this thesis successful. Their support, encouragement, and guidance throughout this brief journey were vital in achieving my goals. First, I will like to thank my supervisor Dr. Laura Turnbull for her consistent advice, patience and technical support during my research was very remarkable. I am also indebted to Prof. Louise Bracken, whose support and links with Newcastle city council contributed significantly to my vocational placement. Finally, I extend my heartfelt appreciation to Kate Cochrane and Helen Hinds who provided tremendous technical and expert support during my placement at Newcastle City Council. I am also very grateful to the Commonwealth Scholarship Commission for providing me the necessary funding for my studies.

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## **ACRONYMS AND ABBREVIATIONS**

**CCS** - Civil Contingencies Secretariat

**CWP** - Cold weather plan

**DCLG** - Department for Communities and Local Government

**DECC** - Department of Energy & Climate Change

**EACs** - Emergency Activity Centres

**EWD** - Excess winter deaths

**GP** - General Practitioner

**IPCC** - Intergovernmental Panel on Climate Change

**LTHPD** – Long Term Health Problem and Disability

**NAP** - National Adaptation Programme

**NCC** - Newcastle City Council

**NHS** - National Health Service

**NSWWS** - National Severe Weather Warning Service

**OA** – Output Area

**ONS** - Office for National Statistics

**PAR** - Pressure and Release Model

**SVI** - Social Vulnerability Index



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## **1. Introduction**

Emergency planning and response during extreme temperature events rely considerably on quality information on groups and communities that are most vulnerable especially in a recently changing climate and socially dynamic environment. Developing strategies and policies for prevention of extreme high and low temperatures (heat waves and cold waves) fatalities in communities is now a matter of growing concern for public health practitioners and policy makers (Bedsworth, 2009; Ebi, 2009; Kovats and Hajat, 2008). Extreme hot and cold weather conditions usually have huge impact on health and wellbeing of households, businesses, and social care systems. Heat waves and cold waves can often result to severe direct consequence, such as heat stress and indirect consequences such as restricted access to essential public services and damages to critical infrastructure (Adams, 2001).

### **Justification of Research**

The enormity of threats posed by extreme temperature occurrences became a problem that deserved serious attention after the heat wave fatalities that affected Europe in 2003 and Russia in 2010 (Robine et al., 2008; Kosatsky, 2005). With an estimated death toll exceeding 30,000, the heat wave of 2003 was one of the ten most deadly natural disasters in Europe in the last 50 years (UNSIDR, 2004). The fatalities from heat waves are expected to increase with corresponding population growth and consequent pressure on already congested high-density housing and infrastructures. This development pressure has already led to the emergence of Urban Heat Islands (Oke, 1979, 1981; Souch and Grimmond, 2006) in most UK cities. Moreover, with the projected increase in the population of vulnerable and deprived people in the Northeast (Ebi and Schmier, 2005; Johnson et al., 2005), it is also expected that extreme temperature fatalities will increase in cities like Newcastle where there is lower life expectancy than the national average.

Regarding cold waves, although cold-related deaths and hospitalization do not increase drastically during extreme cold temperature events, as normally seen during heat wave events, yet coldwaves remains a relevant health concern for exposed populations particularly in the North East of England where Newcastle located. Cold weather causes a deterioration in the health of vulnerable aged and infant population, with additionally significant damages to public infrastructure and restricted access to resources and local business in vulnerable communities (Wilkinson et al., 2004; Donaldson and Keatinge, 2002). For instance, during the 2010 winter in England, numerous transport facilities and roads were on close down due to snow with excess emergency hospitalization (Hughes et al., 2014).

General disaster studies have shown that vulnerable groups and places are most times omitted from decision-making and emergency planning (Adger, 2006; Pelling, 2003; Adger, 2003; Stockholm Environment Institute, 2001). Inability to identify where these socially vulnerable groups are located, widens the gap between emergency management policies and its implementation. The policy-implementation gap in extreme temperature contingency planning was revealed during the 2003 heat wave around Europe where there was poor vulnerability quantification of people and areas at highest risk, which resulted to inadequate emergency response (Lagadec, 2004). The emergency response challenges observed during the 2003 heat wave highlights the need to integrate quantitative social vulnerability research into emergency preparedness and response strategies; a process which requires robust quantitative analysis.

Quantitative vulnerability assessments can contribute to evidence-based understanding of community needs with respect to capacity-building and/or the identification of adaptation actions for vulnerability reduction and improving resilience (Dwyer et al., 2004; Adger et al. 2004). As noted by wolf et al., (2015) and Lindley et al., (2011), quantitative assessments, mapping and visualization of localized spatial vulnerability can support evidence-based information to support decision making. In Newcastle City Council, such huge advancement in understanding of localized social vulnerability will be most useful for the Resilience Planning Unit of the public safety department who has the responsibility of assessing risks and developing local emergency response plans as stipulated in the Civil Contingency Act (CCA, 2004).

Despite the risk of extreme temperature-related morbidity and mortality, many local authorities in the United Kingdom are unable to properly implement the National heatwave and cold wave action plans resulting from the lack of localized information on group and communities that are most social vulnerability. This project has been set up to primarily address the challenge of providing an evidence-based for quantifying social vulnerability indicators at localized scale, using concepts and approaches that can be adopted by emergency planners for estimating the people and place that are vulnerable extreme temperature events.

## **Project Aim and Objectives**

The overall goal of this project is to develop an evidence-based quantitative approach for estimating social vulnerability of people and place to extreme temperature risk in Newcastle.

### **Objectives**

1. To assess the data requirement within the city council and partner agency datasets for understanding social vulnerability to cold and heat wave.
2. To assess the interaction between social vulnerability indicators as risk factors for heat and cold mortality and morbidity and map the spatiotemporal pattern of extreme temperature-related health impacts.
3. To conduct a spatial and temporal analyses assessments of social vulnerability and public health outcomes in Newcastle.
4. To assess council adaptation options through proximity spatial assessment of health and emergency response facilities in relation to vulnerable people.

## **2. Background Context**

This section provides a broad literature foundation that informs the understanding of vulnerability and resilience to extreme temperature as well as the practice of emergency planning using the Community Risk Register (CRR). It presents a critical overview of the numerous research approaches that has been used in assessment of vulnerability. The section then further presents a comprehensive account of vulnerability indicators showing their relevance and researchers who have previously used them. It further emphasizes on the relevance of Geographic Information Systems (GIS) in assessing the risk factors and vulnerability proxies which are considered in assessing the social dimensions of temperature vulnerability in Newcastle.

### **2.1 Concept of Risk, Vulnerability and Adaptive Capacity**

Research on disaster risk management has for over two decade been filled with the concepts of vulnerability, resilience, and adaptive capacity. These terms have been very relevant in explaining the relationship and interactions between human and their biophysical and social environment. Literature reviews from Janssen et al., (2006); Adger, (2006); Folke, (2006); Smit and Wandel, (2006) demonstrated how the concept of risk, vulnerability, resilience and adaptive capacity have earned various interpretations in the social sciences, which was mainly shaped by the discipline and scope where it is being used in literature. Gilberto, (2006) observed that there is a strong conceptual linkage between these concepts which stems from the generic systems approach adopted in their application in risk and disaster studies.

#### **Risk**

Risk is from a disaster management perspective is defined as the systematic interaction of hazard and vulnerability conditions and Exposed Elements; a relationship is usually expressed using the notation "Risk = Hazards x Vulnerability x Exposure" (Crichton, 1999). Previous studies have conceptualized disaster events as signifying unmitigated risks which often highlights the materialization of the latent state of vulnerability through its complex social pathways (Renn, 1992; Cardona et al., 2012). Therefore, in the case of extreme temperature, its disaster risk emerges from the interaction between a hazard occurrence (high or low temperature) and the presence of inherent vulnerability conditions that create exposure.



Figure 1. Crichton's Risk triangle developed (Crichton, 1999; Lindley et al., 2006, 2007)

### **Vulnerability**

Vulnerability is a socio-political and ecological concept that links the interaction between people and their environment to the socio-political forces that either strengthen or weaken the interaction (Oliver-Smith, 2004). Cutter (1996) broadly defines vulnerability as “the potential for loss” (p. 529). From a disaster risk perspective, Kelly and Adger, (2000) conceptualized vulnerability as “the ability or inability of individuals and social groupings to respond to, in the sense of cope with, recover from or adapt to, any external stress placed on their livelihoods and well-being” (p. 328). These definitions point out to the pre-hazard existence of vulnerability, as vulnerability theorists maintain that disasters are more a product of society conditions than of natural events (Oliver-Smith, 2004; Wisner, 2004).

While the definition of vulnerability has slightly changed over time, Eakin and Luers, (2006) suggest that there has been a distinction in approaches used in studying vulnerability. Eakin and Luers, (2006) suggested two distinctive approaches are risk-hazard perspective, and political ecology/economy approaches. These two approaches have metamorphosed into what is known in recent times as “physical vulnerability” and “social vulnerability.” According to the risk hazard or physical vulnerability approach uses damages as rough proxies for vulnerability (Eakin and Luers 2006).

According to Aleksandra (2012), “physical vulnerability” approaches focus on biophysical impacts and adaptive capacities, while “social vulnerability” approach focuses on socio-economic and personal characteristics of the persons and groups that determine their ability to respond to stresses. This conceptual differences and contrast between the approaches are liable to be misleading and most times unacknowledged. However, while the conflict of

methodology continues to exist, the conceptual focus of vulnerability remain on both people and elements (i.e. infrastructure, economic assets, services etc.) and their interaction to exposure conditions. Conceptualizing extreme temperature vulnerability under a climate risk management framework, this study adopts the IPCC, (2007) definition of vulnerability as “a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity” (p.883).

### **Adaptive Capacity**

The concept of “adaptive capacity” has long been recognised in disaster-risk literature (IPCC, 2001; Burton et al., 2002; Adger et al., 2003) often also popularly referred to as “coping” capacity. Both terms are considered have been synonymous although Cutter et al. (2008) point out that “adaptive” capacity is more suitable in hazards discourse. Adaptive capacity refers to the “ability of people, organizations, and systems, using available skills and resources, to face and manage adverse conditions, emergencies, or disasters” (UNISDR, 2009, p.30). In a climate and weather context, Cardona et al., (2012) defined adaptive capacity as “the ability of a system or individual to adapt to climate change”.

These definitions show that “Adaptive capacity” is multi-dimensional (Vincent, 2007; Adger and Vincent, 2005). Its interpretation can also vary across different spatial scales, which is at the personal level and the regional level. At the regional scale adaptive capacity it reflects the availability of economic resources as well as the degree of organization and institutional capacity for prioritizing available resources effectively to the areas and groups of people that are most vulnerable. Adaptive capacity is associated with resilience and conversely related to vulnerability and this produces conceptual interaction both at the household and community level. The relationship between adaptive capacity and vulnerability can be demonstrated in Dayton-Johnson, (2004) view of adaptive capacity as being the “vulnerability of a society before disaster strikes and its resilience after the fact”.

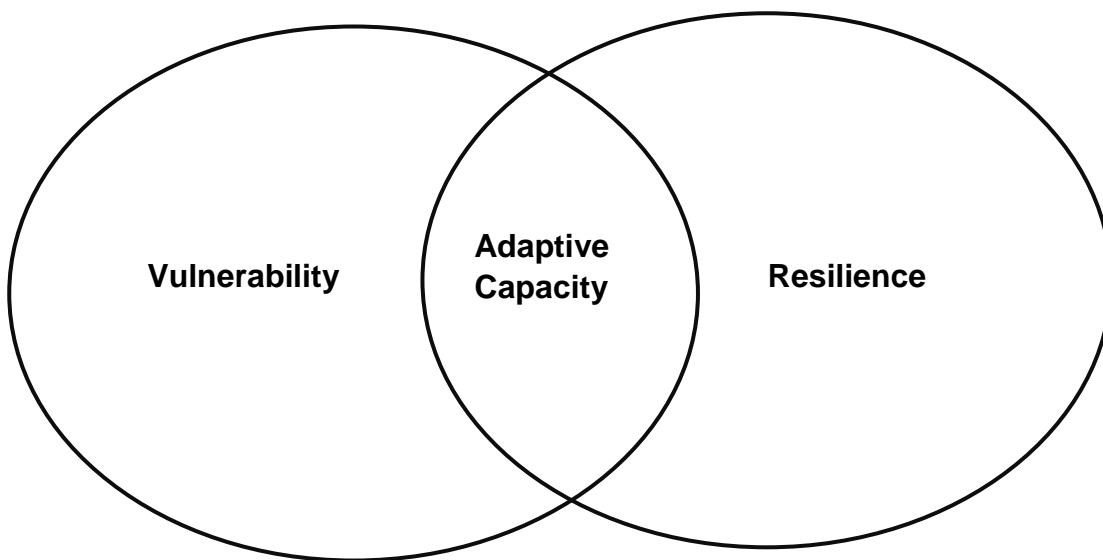


Figure 2. Adaptive capacity conceptual linkage between vulnerability and resilience frameworks (adopted from Cutter et al., 2008).

## 2.2 Heat waves and Cold wave in Newcastle and North East of England

Although there is no generally acceptable definition of what constitutes a cold wave or heat wave event (Perkins and Alexander, 2013). Heatwave is defined as “an extended period of unusually high atmosphere-related heat stress, which causes temporary modifications in lifestyle and which may have adverse health consequences for the affected population.” (Robinson, 2000, p. 763). Heat wave in the North East England is defined as a daytime temperature of 28<sup>0</sup>C and a night temperature of 15<sup>0</sup>C over a period of up to three days (Newcastle City Council, 2015). Cold wave in Newcastle and Northeast is defined as a weather situation where there is mean temperature of 2<sup>0</sup>C or less for a period of at least 48 hours with widespread heavy snow prediction (NHS, 2015).

The threshold maximum day and night temperatures for heat and cold wave vary considerably across regions and is defined by the Met Office National Severe Weather Warning Service (NSWWS). For instance, with regards to heatwave, the threshold temperature set for the North East is day temperature of 28<sup>0</sup>C and Night temperature of (15<sup>0</sup>C), whereas, in London, it is day temperature of 32<sup>0</sup>C, and Night temperature of 18<sup>0</sup>C. The NSWWS established the criteria for defining what constitutes a heat wave or cold wave, by developing the criteria for the issuance of heat watches and warnings. This approach implicitly reflects the spatial dimensions of heat waves and cold waves which are affected by regional “physiological” and the “sociological” sensitivity to extreme temperature (Medina-Ramon and Schwartz, 2007; Hajat and Kosatky, 2010).

## **Heat and Human Physiology**

Excessive heat can cause direct physiological response from a human system which is triggered to create a balance in the body's heat-dissipating and thermo-regulatory mechanisms. The inability of the body to cool excessive body temperature can result to severe health outcomes. Heat exchange in human body happens through cutaneous vasodilatation and vasoconstriction, (Knochel and Reed, 1993; Bouchama and Knochel, 2002). Studies show that an increase of one degree Celsius (1°C) is immediately detected by thermos-receptors disseminated through the skin, deep tissue and organs (Bouchama and Knochel, 2002). These cardiovascular adjustments help to transport heat from the core to the periphery areas of the body for dissipation to the surroundings. Therefore excess heat could constitute a major stress on the cardiovascular system, especially when impaired by terminal conditions and old age which lower body cardiovascular capacity. Excessive heat can cause severe dehydration, acute cerebrovascular accidents. It can further worsen chronic pulmonary conditions, cardiac conditions, kidney disorders and psychiatric illness.

## **Cold Wave and Human Physiology**

Exposure to extreme cold temperatures can have severe health outcomes through physiological responses to cold stress (Conlon et al., 2011). Extreme cold temperatures triggers a systemic body response through vasoconstriction in the skin; a process initiated to preserve body heat by moving oxygenated blood to sustain the vital organs in the body. Usually, a person's capacity to thermos-regulate them from ambient temperatures by maintaining a core body temperature of about 37 °C (98.6 °F) (). Reducing this body thermoregulation requirement can lead to cardiac and cerebrovascular impairment have direct health effects such as hypothermia (core temperature below 35 °C), and indirect effects such as pneumonia, and influenza (McCullough and Aurora, 2004). For instance, studies by Barnett et al., (2005) identified Cardiovascular-related deaths is the most frequently identified health outcome associated with cold weather health stress.

Vulnerability to cold weather risk is dependent on individual and contextual risk factors. The elderly populations are considered particularly vulnerable to cold wave since human ability to thermos-regulate can become weakened by old age. Several studies show that counts of excess winter mortality are higher in individuals over 65 years old particularly during cold waves (Oven et al., 2012; Monacelli et al., 2010; Analitis et al., 2008; Rudge and Gilchrist, 2005). Contextually, geographic location, nature of dwelling infrastructures (Rudge and Gilchrist, 2007; Oven et al., 2012) and access to health care are strong determinants for

cold wave vulnerability since the effects of exposure vary across and within cities. According to Lindley et al., (2011); Conlon et al., (2011) isolated communities may be increasingly vulnerable to extreme temperature risk due to living in remote locations with greater exposure. Usually, remote areas have poorer access to services, health facilities and poor transport links which are all relevant factors in the context of social vulnerability.

## **2.4 Social Vulnerability Indicators for Extreme Temperature Risk**

Social vulnerability provides an understanding of the processes through which society interactions influence our differential experience of hazard events (Cutter et al., 2008). Conceptually, social vulnerability emerges through the interaction of a number of personal, social and environmental factors that determine the manner in which extreme temperature event impacts on the well-being at the individuals and community level. Cutter, (1996) observed that the most vulnerable people may not be living in the most physically vulnerable places. However, socially vulnerable places and people are characterized by poverty and inequality, marginalization and poor access to resources, social networks, and housing quality (Cutter et al., 2003; Turner et al., 2003; Adger, 2006; Blaikie et al., 1994)

The methodological approach in developing social vulnerability indices usually involve three main decisions; the scale of observation of index; the indicators to be included in the index; and suitable method of aggregation (Adger et al 2004; Morath, 2010). The inherent variations in methodology adopted in each study means that different outcomes are being produced the development of the index inevitably. It can also be observed that other studies since then have also taken different approaches to studying social vulnerability. However, irrespective in this different study approaches, OECD, (2008) emphasises that “the quality of a composite indicator, as well as the soundness of the messages it conveys, depend not only on the methodology used in its construction but primarily on the quality of the framework and the data used” (p. 17). Table 1 summarizes a literature review of variables or proxies that have been previously used various researchers in their social vulnerability studies.

Table 1: Literature review of Social Vulnerability Indicators

<b>Indicators</b>	<b>Description</b>	<b>References</b>
<b>Age</b>	Elderly and young people are vulnerable due psychological disposition and dependence on others.	Cutter et al., (2003); Dwyer et al., (2012); Chow et al., (2012), Fekete, (2009)
<b>Education</b>	Education is linked to socioeconomic status, with higher educational attainment resulting in better opportunities. Lower education is related to poverty and ability to understand warning information.	Cutter et al., (2003); Dwyer et al., (2012) ; Fekete, (2009)
<b>Gender</b>	Low-income for women and family responsibilities, make women particularly vulnerable	Cutter et al., (2003); Dwyer et al., (2012); Kuhlicke et al., (2011); Morrow (1999)
<b>Renting</b>	Renting is an indication of a lower socioeconomic status.	Cutter et al., (2003); Dwyer et al., (2012)
<b>Occupancy</b>	Houses of multiple occupancy can increase heat risk.	
<b>Unemployment</b>	High level of unemployment leads to poor health and increases vulnerability to extreme temperature risk.	Cutter et al., (2003); Dwyer et al., (2012); Fekete, (2009) Kuhlicke et al., (2011)
<b>Health</b>	People with generally poor physical and mental health are vulnerable since they highly dependence on others to meet their special needs.	Dwyer et al., (2012); Lemoine et al., (2015)
<b>Vehicles</b>	Vehicle availability in a household is considered an indicator of accessibility to care in extreme temperature event.	Lemoine et al., (2015)
<b>Population Density</b>	High population density is often associated with high housing density which impairs ventilation, thus increasing vulnerability to extreme hot temperature. Moreover, in hazard events, densely populated areas are difficult to evacuation.	Cutter et al., (2003); Fekete, (2009); Lemoine et al., (2015)
<b>Migration Status</b>	Migrant from other countries may face some levels of marginalization in terms of getting health care access during extreme temperature events	Fekete, (2009); Lemoine et al, (2015); Chow et al., (2005).
<b>Socioeconomic status</b>	Lower socioeconomic status increases vulnerability to	Cutter et al., (2003); Dwyer et al., (2012)

	extreme temperature to poor access to quality housing and health care resources.	
<b>Ethnicity and Race</b>	Ethnicity and race can cause language and communication and barriers to early warning information which hinder people ability for extreme temperature events.	Harlan et al., (2013); Cutter et al., (2003); Dwyer et al., (2012) Schmidtlein et al., 2008
<b>Medical Services</b>	Access to health care providers is crucial during and after extreme temperature events. Poor proximity to medical services will hinder emergency relief for the victim of extreme temperature-related health risk.	Cutter et al., (2003); Dwyer et al., (2012)

## 2.6 Structural design of social vulnerability model design

Social vulnerability studies usually adopt one of three commonly used structural designs; deductive; hierarchical; or inductive (Tate, 2012, 2013). The deductive approach usually involves synthesising a small set of indicators using literature derived assumptions. (Vincent, 2007; Balica and Wright, 2010). The hierarchical designs usually synthesizes numerous indicators which are aggregated into sub-indices representing major pathways or dimension of interaction, enabling a clear representation of distinct components of the system of analysis (Maggino and Zumbo, 2012; Tate, 2012). The inductive method for composite index construction is primarily involve factor analysis to reduction a large amount of variables that is usually selected (Cutter et al., 2003; Tate, 2012).

According to Tate, (2012), none of the designs is methodologically better or worse than another, but the index selection and configuration and may affect the suitability of each of the listed techniques as well as robustness of results derived. The methodological choices made from the point of construction a design to the selection of indicators involve an extent of expert assumptions, subjectivity, and uncertainties that should be recognized and communicated throughout the analytic process (OECD, 2008; Balica and Wright, 2010; Permanyer, 2012; Tate, 2012).

## 2.7 Vulnerability Mapping

Since heat wave and cold wave vulnerability and emergencies have strong geographical dimension (Wolf & McGregor, 2013; Cutter et al., 2003; Wolf et al., 2009; Reid et al., 2009; Romero-Lankao et al., 2012), mapping spatial patterns of vulnerability can serve as a reliable indicator in determining how emergency planners can approach managing extreme

temperature risk. Evaluating these various factors and how it is translated into vulnerability and well-being losses can be used to construct an evidence base tool to assist in targeted mitigation programmes and emergency response (Lindley et al., (2011).

GIS can enable emergency managers to identify of demographic aspects of an emergency and allow spatial information from multiple sources and agencies to be integrated across different scale to provide an informed response (Cabinet office, 2008. p.11). Numerous researchers and emergency practitioners have linked the progress in understanding spatial patterns of risk and vulnerability to advancement in Geographical Information Systems (GIS) and remote sensing which provide a valuable tool in planning for, and responding to incidents that may require evacuation and provision of shelter (Joyce et al., 2009; Wilhelmi and Hayden, 201

### **3. Methodology**

#### **3.1 Assessing the Data Requirement (Objective 1)**

This objective was aimed at determining what social indicator information is available within Newcastle City Council and partner agencies which will be required in order to develop a Social Vulnerability Indices (SVIs) of extreme temperature Vulnerability in Newcastle. The aim was achieved by conducting a comprehensive literature and policy review of social vulnerability indicators applied in understanding extreme temperature vulnerability. The two most important data sources that were selected for this study are census data from Office for National Statistics (ONS) and Newcastle infrastructure datasets covering building footprints, roads, green spaces and housing condition data. Additionally, informal meetings with Newcastle City Council emergency planning practitioner were held, in order to obtain additional expert opinions which will explain differential vulnerability conditions that can likely translate to different levels of heat and cold-related emergency and fatality. A list of meetings and discussion topics is provided in the Appendix section.

##### **3.1.1 Census Data Collection**

The first step taken in mapping social vulnerability is to generate a combined list of variables that previous studies have used to identify social vulnerability (Table 1). The table was used as a starting guide in collecting raw demographic data from the 2011 UK Census. This data was obtained from NOMIS website which gives free access to UK labour market statistics for the general public through the Office of National Statistics (ONS). Demographic data collected include information such as age, gender, language skills, population density, occupation, and unemployment numbers, etc.

The UK Census uses a blocking method that starts with output areas that are a minimum of 100 persons and 40 households (Table 2). The output areas (OAs) are joined to produce lower layer super output areas (LSOAs). A common challenge associated with using census data on Output Area scale is that not all information is organized at that scale. However, this scale was still chosen because it provided the most localized detail of vulnerability data which befits the overarching aim and scope of this study. Overall, the census data collected covers 910 Output Areas in Newcastle. Also, Newcastle ward level data was equally collected for this study. Discussion of the overall social vulnerability will be done by examining ward levels trends. This ward level discussion approach was chosen to enable

consistency with the scale of policy discussion and emergency management in Newcastle City Council.

Table 2: Population size of scale two zones used in census data analysis (Office for National Statistics, 2011).

Zone	Min. Population	Ave. Population	Min. Households	Max. Households
OA	100	300	40	125
LSOA	1000	1500	400	1200

### 3.1.2 Newcastle City Council Infrastructure Datasets

In addition to the census data collected for this study, Newcastle city council Housing and GIS datasets were also used to account for localized social vulnerability indicators. The datasets include; building classification, road network data, housing energy efficiency (using the Standard Assessment Procedure). To calculate building density, the building footprints data within the 910 output areas were analyzed with ESRI's ArcMap software and excel. The detailed procedure which was followed to produce the building density is provided in the building density model Figure 3. To calculate road density for each output area, similar process was replicated using the road network dataset. The road density model in Figure 4 outlines the procedure taken in the analysis.

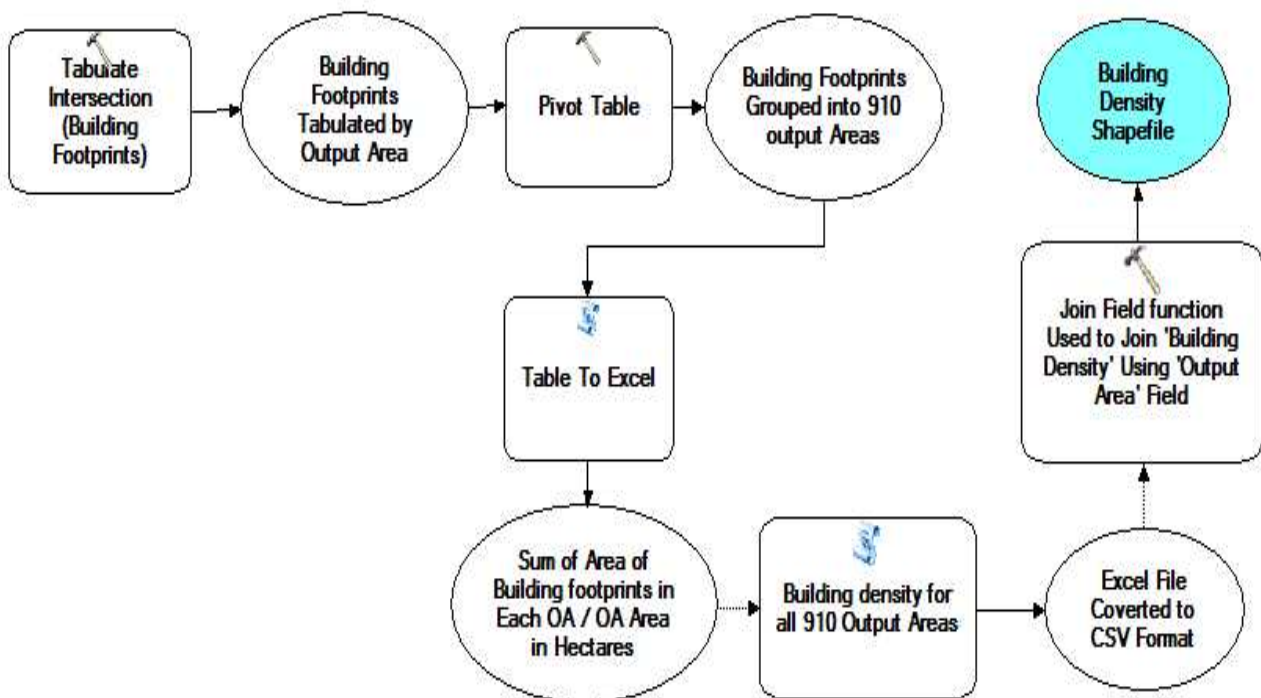


Figure 3. Newcastle building density assessment model using ArcGIS

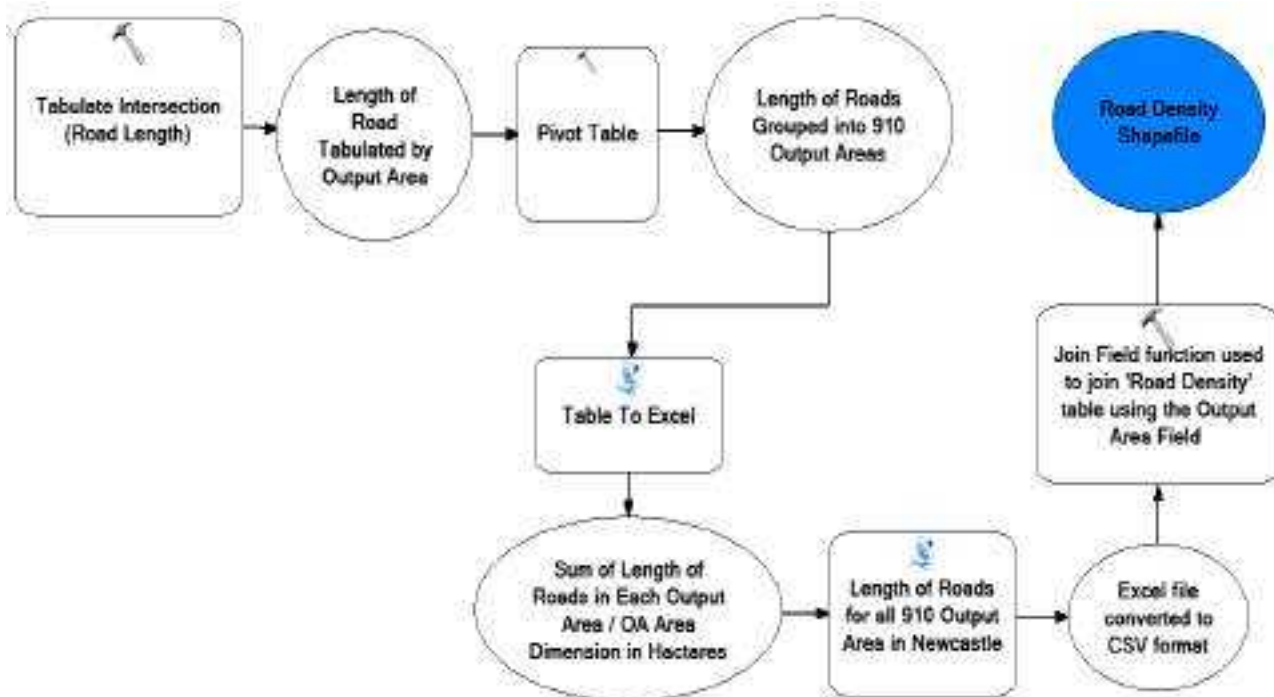


Figure 4. Newcastle road density assessment model using ArcGIS

The SAP rating used in the assessment of housing condition is a building energy efficiency rating system adopted by the UK Government for calculating the energy performance of dwellings (BRE, 2014). The SAP was developed in 1992 for the former Department of the Environment by the Building Research Establishment (BRE). The SAP rating system uses the BRE Domestic Energy Model (BREDEM), to quantify dwelling's performance in terms of energy use per unit floor area (Anderson et al., 1985;2002; Dickson et al., 1996; Shorrocks and Anderson, 1995). The SAP rating system was adopted in this study as a more reliable procedure for assessing housing condition in the absence of evidence for potential alternative methods like the use of housing type and temperature.

### 3.1.3 Social Vulnerability Framework Design

The method of social vulnerability design applied in this research is a hierarchical model which has been used in other vulnerability studies such as Vincent, (2004); Hebb and Mortsch, (2007); Flanagan et al., (2011). This choice of a hierarchical model of social vulnerability framing is informed by the IPCC, (2007) definition of climate change vulnerability as: "The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" (IPCC, 2007, p. 883). Based on this definition, this report has grouped the SVIs into the following sub-indices "Adaptive Capacity",

“Sensitivity” and “Enhanced Exposure” showing their pathways or dimensions of impact as suggested by Polsky et al., (2007) and Lindley et al., (2011). Since the design of the vulnerability assessment model are very crucial to how vulnerability is understood, this hierarchical model has been selected to capture all the components of the indices without underestimating the weight of any indicator to overall vulnerability. In the words of Polsky et al., (2007), “Strictly speaking, to conduct a vulnerability assessment means that no element of the human-environment system may be simplified away or considered a mere boundary condition” (p.1). Polsky et al., (2007) suggested that vulnerability should be conceptualized using the three dimension; three main dimensions: exposure, sensitivity, and adaptive capacity, which he outlined in the Vulnerability Scoping Diagram (VSD).

### **3.1.4 Selection of Social Vulnerability Indicators (SVIs)**

Selection of social vulnerability indicators or indirect proxy indicators is the starting point for ensuring accuracy in the social vulnerability assessment. An indicator is a direct measure while a proxy indicator is an estimation used to represent an attribute of an immeasurable indicator. Table 3 shows the final target indicators list and their sub-index grouping. After the indicator data sets have been collected, the next step involves transforming indicator values into z-scores. The Z-score provides a standardized value for variables with different measurement units (Nardo et al., 2008).

$$\mathbf{Z\ score = (value - mean) / standard deviation} \qquad \text{Equation (1)}$$

To assign cardinality to selected indicators, after the z-score of the output areas is produced, the indicators are reviewed using previous epidemiological evidence to determine the tendency of the component to increase (+) or decrease (–) overall vulnerability. For instance, building and road density can increase heatwave vulnerability due to Urban Heat Island effect (Hajat et al. 2007). However, people living in high building density area also have reduced vulnerability to cold weather, due to lower severity of cold and the normal emergency priority given to ensuring unrestricted road access in city centres and urban areas.

Table 3: Selected target indicators.

Sub-indices	Indicator	Cardinality (Heat wave)	Cardinality (Cold wave)
<b>Adaptive capacity</b>	Unemployment	(+)	(+)
	Occupation	(+)	(+)
	Education	(+)	(+)
	Language	(+)	(+)
	Gender	(+)	(+)
	Vehicles	(+)	(+)
	Tenure	(+)	(+)
	Household deprivation	(+)	(+)
	Low income	(+)	(+)
	Occupancy Rating	(+)	(+)
	<b>Sensitivity</b>	Age	(+)
General Health		(+)	(+)
LTHPD		(+)	(+)
<b>Enhanced Exposure</b>	Building Density	(+)	(-)
	Housing Condition (SAP Rating)	(+)	(+)
	Central Heating	(+)	(+)
	Population Density	(+)	(-)
	Road Density	(+)	(-)

### 3.1.5 Social vulnerability Grouping

To develop a robust measurement of social vulnerability that captures its multidimensionality, this study applied social vulnerability grouping with sub-indices which reflect the hierarchical design model of this social vulnerability assessment (Tate, 2012, 2013). The grouping method was based on Lindley et al., (2011) conceptualization of social vulnerability, where they divided social vulnerability pathways into sensitivity, adaptive capacity and enhanced exposure. ‘Sensitivity’ sub-index refers to the personal physiological characteristics such as age and health condition which influence the severity of negative welfare impacts from heat wave or cold wave. ‘Adaptive Capacity’ refers to the personal and household socioeconomic factors that determine the individual or community ability to prepare, respond and recover from heatwaves or cold wave, such as income and education, language, gender, vehicles ownership, tenure, proximity of hospital and GP services, etc. Finally, ‘Enhanced exposure’ relates to aspects of the physical environment associated with household or individual social position, such as the housing conditions, building density, and availability of green spaces which tends to accentuate or mitigate the severity of heat wave or cold weather event.

When combining scores for each Output Area, care was taken to exclude negative Z-Scores using similar approach adopted by Lemoine et al., (2015) to prevent factors from canceling

each other out. For instance, if an OA had a Z-Score of -0.25 for age vulnerability, -0.42 for LTHPD and a Z-Score of 1.23 for general health, it implies that the area has a greater portion of its non-vulnerable elderly population with poor general health and long term health problem and disability. In the ‘sensitivity’ sub-index, this particular OA would produce an unadjusted score of 0.56 after summing three indicator scores (see Table 4 ). However, as observed by Lemoine et al., (2015), such a score would be misrepresentative of the area output vulnerability because the negative values from the composite would skew the results. A negative vulnerability score from one indicator cannot negate or undermine the presence of another vulnerability in a sub-index. For example, Table 8 shows the unadjusted Z-Scores obtained for vulnerability indicators in the ‘Sensitivity’ sub-index for the output area ‘E00042042.’. The unadjusted vulnerability score was calculated by adding the Z-Score of each of the individual indicators. As seen from the table, low age vulnerability overshadowed the vulnerability emerging from poor general health in the output area to produce an overall Z-score of 0.56. To correct this bias, as seen in Table 5, the vulnerability calculation was adjusted to logically omit the negative scores, generating a Z-score of 1.23 which properly portray the vulnerabilities in the area.

Table 4: Unadjusted ‘Sensitivity’ sub-index Z-Scores for Output Area ‘E00042042.’

**Unadjusted**

NCC_OA_11	Age	General Health	LTHPD	Sensitivity
E00042042	-0.25	1.23	-0.42	0.56

Table 5: Adjusted ‘Sensitivity’ sub-index Z-Scores for Output Area ‘E00042042’

**Adjusted**

NCC_OA_11	Age	General Health	LTHPD	Sensitivity
E00042042	-0.25	1.23	-0.42	1.23

The composite sub-index scores were then exported to ArcMap for mapping and descriptive visual analysis to verify the assumptions made in the assignment of cardinality. Afterward, these sub-indices were computed to know the overall social vulnerability of output areas. High positive values indicate high social vulnerability, while high negative values indicate low social vulnerability. Notably, the indicators that contribute to the overall vulnerability score often vary for each output area, highlighting the complex interactive nature of social vulnerability.

### **3.2. Assessing Relationship between Social Vulnerability Indicators (Objective 2)**

#### **Correlation and Regression Analysis**

The relationship and interaction between social vulnerability indicators, the indices and the grouped sub-indices was statistically tested to address the second objective of this study, which was “to assess the spatiotemporal statistical relationship between social vulnerability indicators for heatwave and cold wave through correlation analysis, and regression analysis. This series of comparisons was carried using correlation, reliability, and regression analyses.

First, the individual components and aggregate sub-index scores for both sensitivity, enhanced exposure, and adaptive capacity were examined using descriptive statistics in Excel. Afterward, Spearman’s Rank correlation analysis (Equation 2) was conducted to investigate the relationship between sensitivity, enhanced exposure and adaptive capacity and their components. The Spearman’s Rank is a nonparametric correlation statistic, meaning that it makes no distributional assumptions. The correlation coefficient rho ( $r_s$ ) was then inspected to determine the statistical strength of the relationship between the variables. The magnitude of rho effectively demonstrates possible correlations between the variables. The correlations were assumed to be significant using a threshold of Sig < 0.050. The values of the correlation coefficients also give insight into the ability of sensitivity and its components to explain adaptive capacity indicators. This analysis was used to calculate the strength and direction of these relationships and their significance.

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)} \quad \text{Equation (2)}$$

### **3.3 Spatial and Temporal Assessment of Extreme Temperature Mortality and Morbidity (Objective 3)**

To bring in a public health context into this study, public health data covering output area scale was sought to show the spatial and temporal distribution of extreme temperature-related clinical outcomes. The public health data used in this study was acquired from the Office for National Statistics. It covers data on output area 13 years’ average mortality rate from 2001 to 2013. Additionally, heat and cold related mortality data for stroke, cardiovascular, chronic heart diseases were collected to identify the most vulnerable population group. These datasets were useful in understanding temporal patterns of all-cause deaths but not cause-specific spatial patterns of mortality which was expected to be more suitable for relational comparison with social vulnerability. After a futile rigorous search

of spatially detailed health data, it was discovered that the availability of poor public health data was a strong limitation in this study.

### **3.4 Proximity Spatial Assessment (Objective 4)**

The final step in this study was to perform a proximity spatial assessment of emergency facilities, to address the third objective of this study. The procedure was carried out to assess if health care and emergency facilities were accessible to vulnerable people and communities. To construct a representative indicator of access to Emergency Activity Centres (EACs) in Newcastle, the document containing the Emergency Activity Plan was reviewed to identify the locations of buildings using the building classification data. The buildings were then converted to a point level shape file in ArcMap. A Euclidean buffer was then applied to each EAC location to represent maximum service area. After an unproductive literature review to find the appropriate service area distance buffer, it was finally determined by using a similar process adopted by Morath, (2010). This involves inductive spatial analysis which calculates the maximum probable Euclidean distance that can be achieved between (A) any point in Newcastle and (B) the nearest EAC facility. The ArcMap spatial analyst distance tool was used to estimate this maximum distance as 4000 metres. Similarly, the same spatial approach was replicated to examine health care access for vulnerable people in Newcastle using a generated maximum distance buffer of 1500 metres.

## 4. Results and Discussion

### 4.1 Social Vulnerability Assessment Framework

The result of thorough literature reviews and rigorous engagement with expert emergency managers was used to develop this framework using a hierarchical social vulnerability model. The framework has been used to explain the different pathways and levels of social vulnerability (Figure 5). As indicated in the previous section, the sensitivity sub-index group include personal biophysical attributes such as age and health condition which affect the likelihood of being negatively affected by extreme cold or heat wave event. The adaptive capacity sub-index grouping indicates socio-economically related characteristics of the population that determines their choice for preparing, responding and recovering from heat waves and cold waves. Adaptive capacity indicators also affect the way perceive extreme temperature risk.

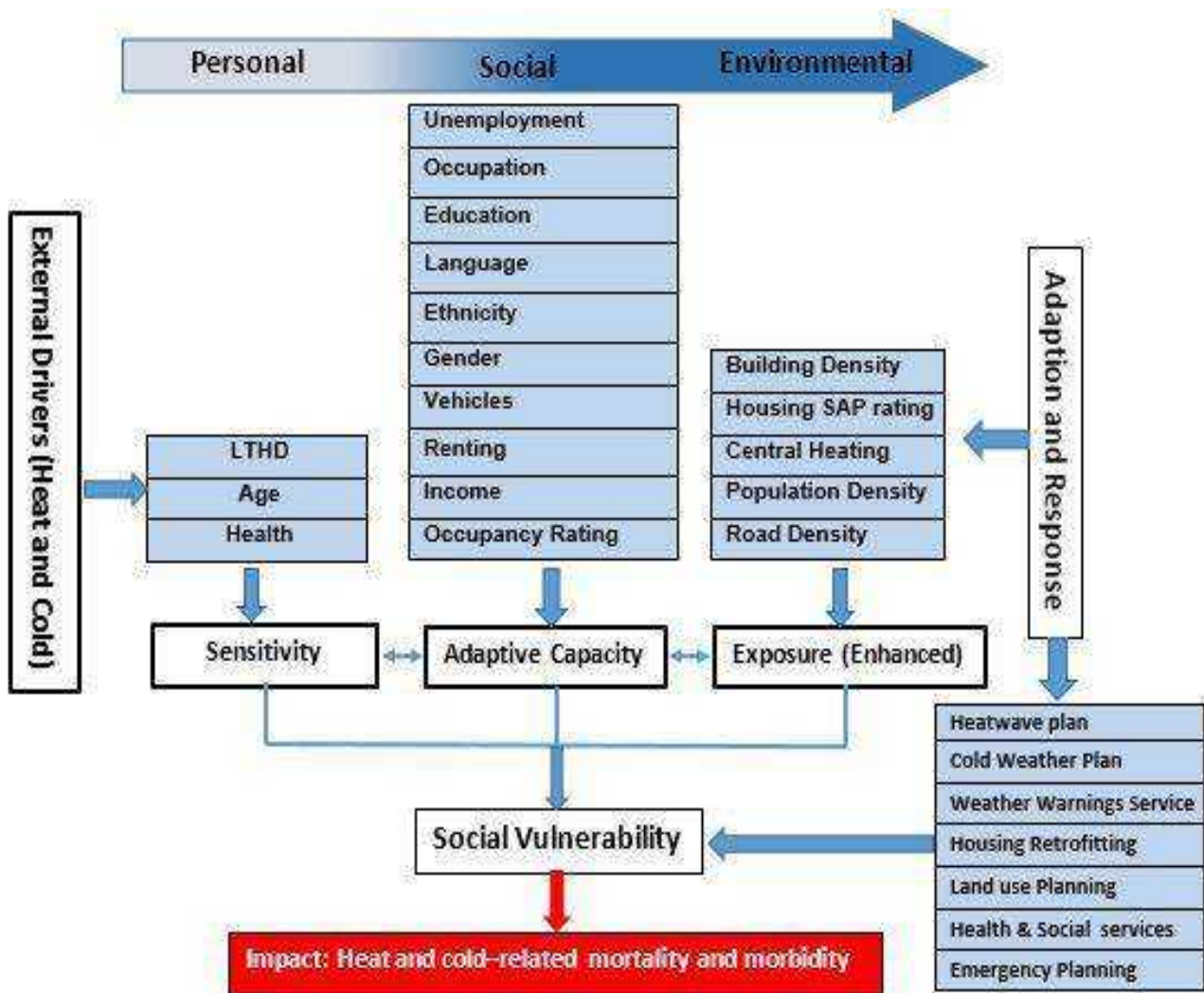


Figure 5: Social vulnerability framework for extreme temperature

Table 6: Selected social vulnerability indicator criteria

<b>Selected Indicators</b>	<b>Criteria</b>
<b>Age</b>	Population of children younger than 5 year and adults older than 65 years old.
<b>Population Density</b>	Number of residents per hectare.
<b>Long Term Health Problem Disability (LTHPD)</b>	Number of households with long term health problem or disability.
<b>Education</b>	Number of working age population residents with 1 or less qualifications.
<b>Gender</b>	Number of population who are women
<b>General Health</b>	Number of population identifying themselves with bad or very bad health.
<b>Unpaid Health care</b>	Number of people who receive unpaid health
<b>Language</b>	Number of population who classified as; “cannot speak” and “cannot speak English well”.
<b>Ethnicity</b>	Number of population who are classified as Black or Minority Ethnic group.
<b>Household occupancy</b>	Number of households with a -1 rating or less.
<b>Occupation</b>	Number of workers with level 1 occupation.
<b>Tenure</b>	Number of households on social and private renting.
<b>Unemployment</b>	Number of working age population unemployed.
<b>Vehicle Ownership</b>	Number of households without access to a vehicle.
<b>Central heating</b>	Number of houses without central heating.
<b>Housing condition SAP rating</b>	Average SAP rating of each output area.
<b>Building Density</b>	Number of building per output area.
<b>Road Density</b>	Total length of road per output area.

#### 4.2 Understanding Social Vulnerability in Newcastle

To understand the pathways of social The grouped indices were used to generate overall vulnerability scores for each sub-index. As noted in the previous section, each component of a sub-index was adjusted based on its tendency to increase or decrease social

vulnerability. Aside from investigating the aggregate sub-index SVI scores, it is imperative to assess the specific components that contributed to the overall social vulnerability. This will reveal the spatial distribution of each indicator and improve the research understanding of the interaction of social vulnerability indicator.

#### 4.2.1 Sensitivity-induced vulnerability

The sensitivity sub-index was produced by calculating an aggregate indicator score for each Output Area. The group indicates those who are dependent on health services, more susceptible to harm and disease and are slower to recover from an event. Persons who certify themselves of poor health in the census and people with disabilities are the most significant in this group. Also, elderly people and young children are equally sensitive due to their fragile health. The additive equation used to compute “sensitivity” was age (component 1) + general health (component 2) + long-term health problem and disability (component 3).

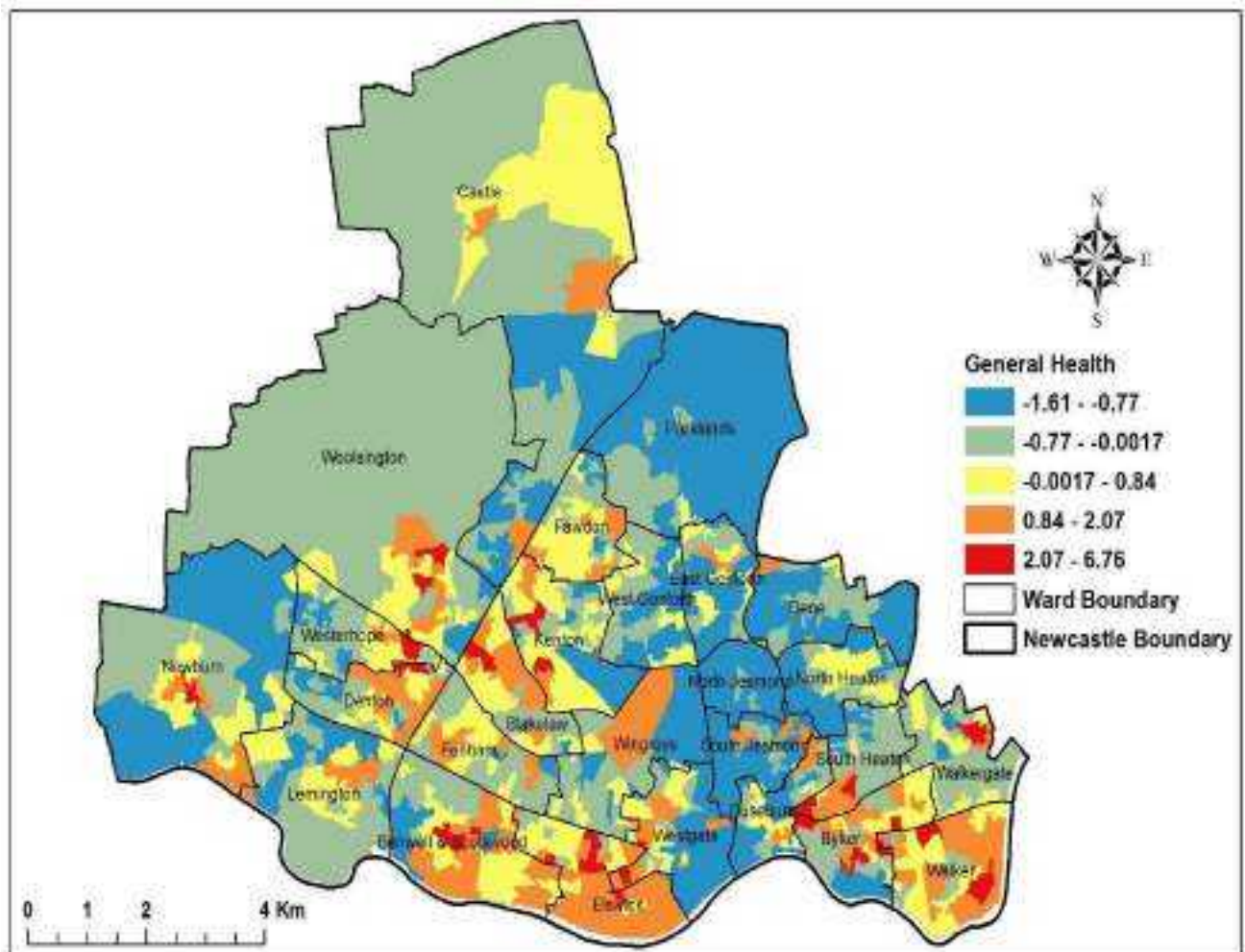


Figure 6: Map of Newcastle showing vulnerability due to poor general health.

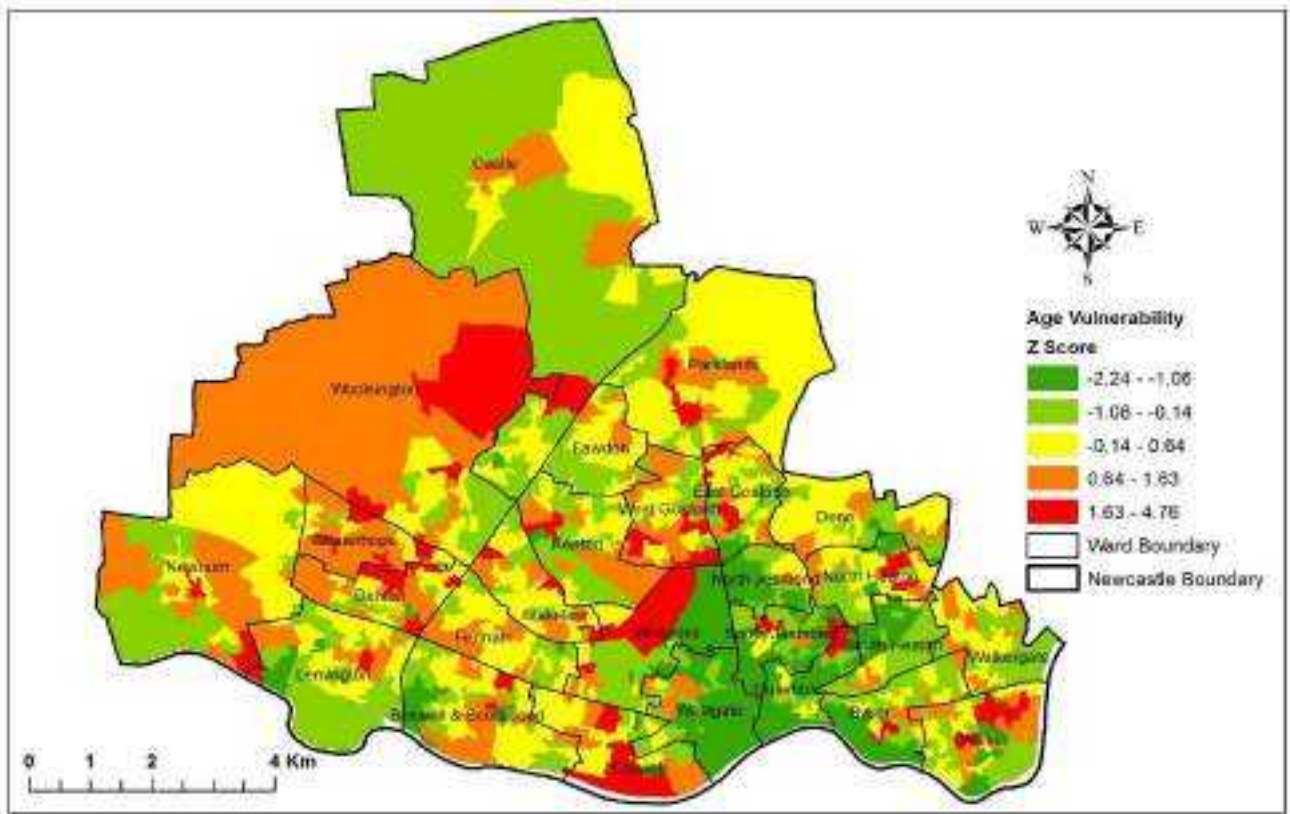


Figure 7: Map of Newcastle showing age vulnerability.

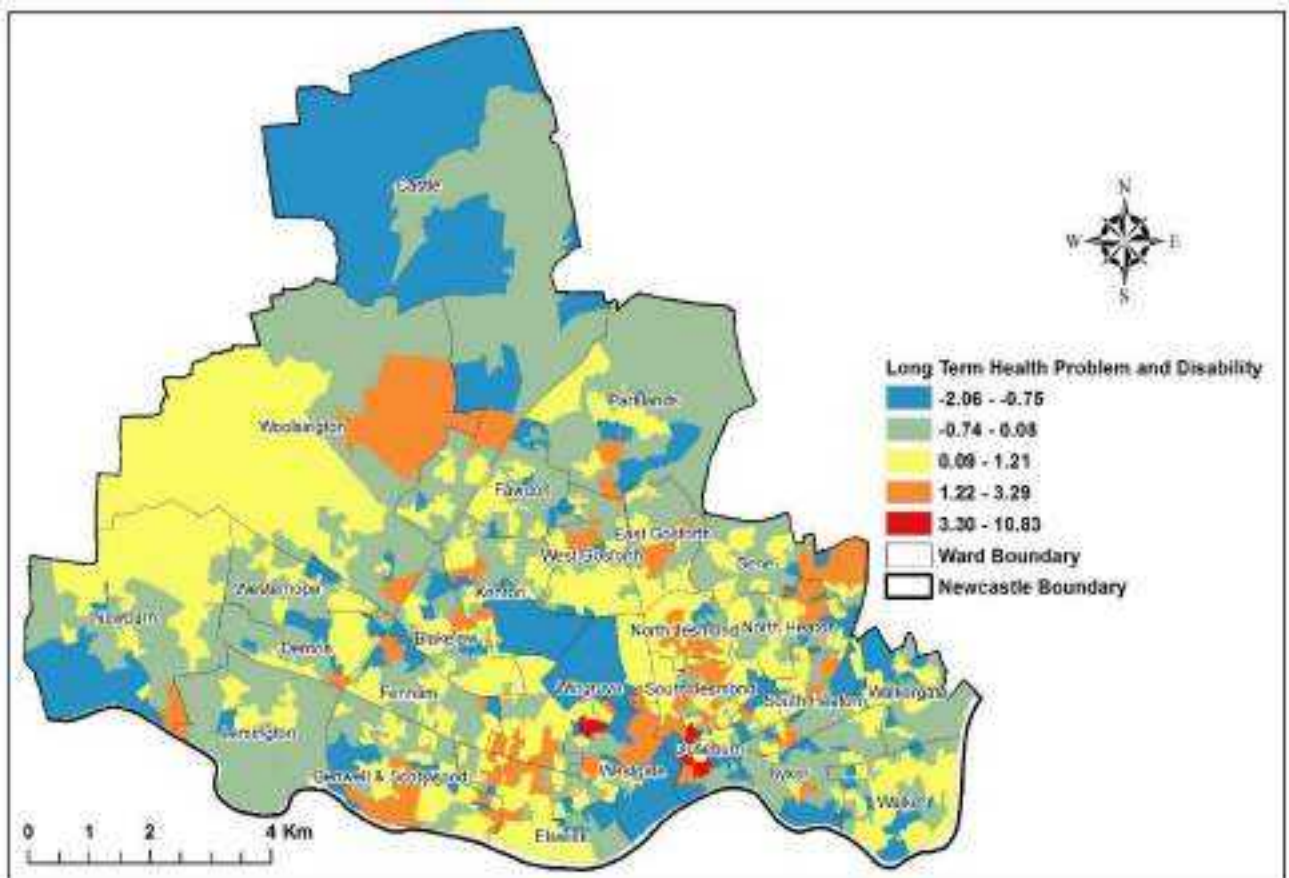


Figure 8: Map of Newcastle showing vulnerability due to LTHPD.



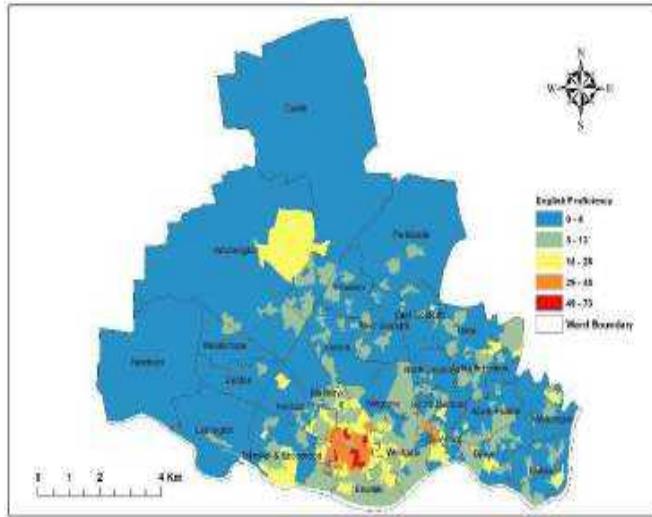


Figure 10: Vulnerability by English Language Proficiency.

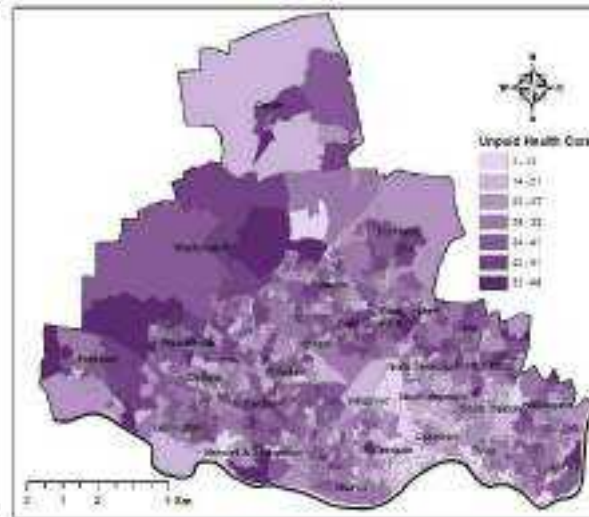


Figure 11: Vulnerability by unpaid health care

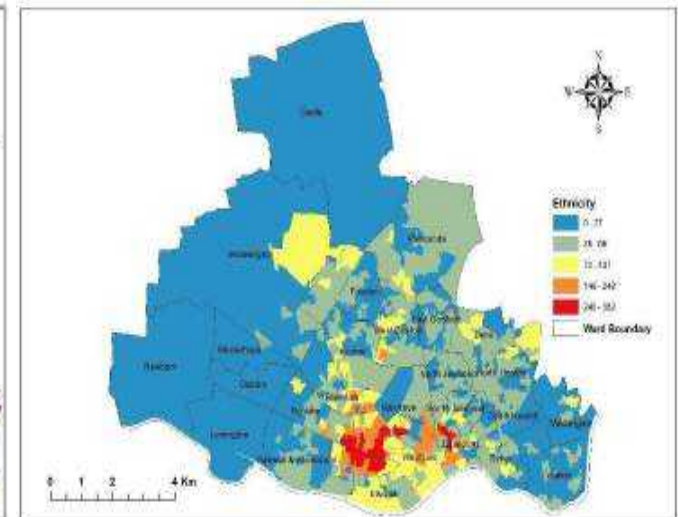


Figure 12: Vulnerability by Ethnicity

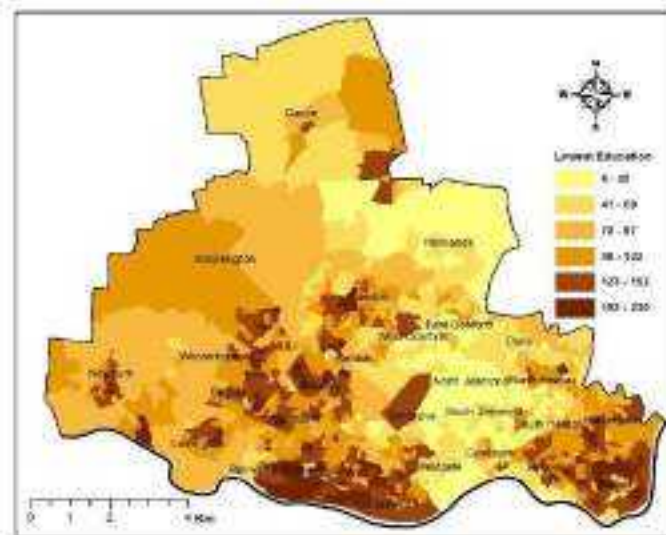


Figure 13: Vulnerability by low education

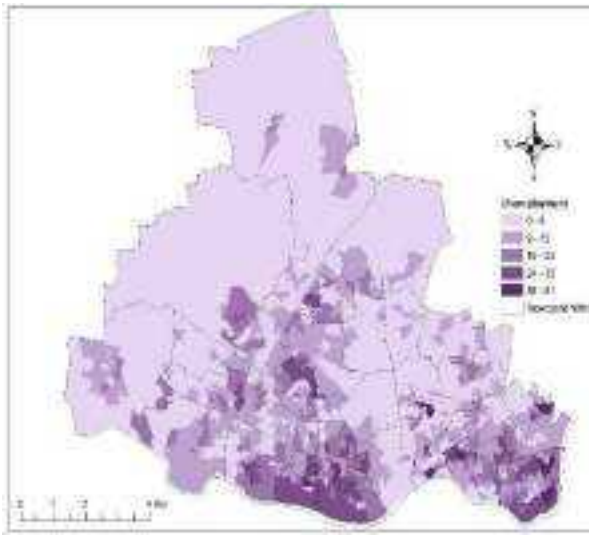


Figure 14: Vulnerability by unemployment

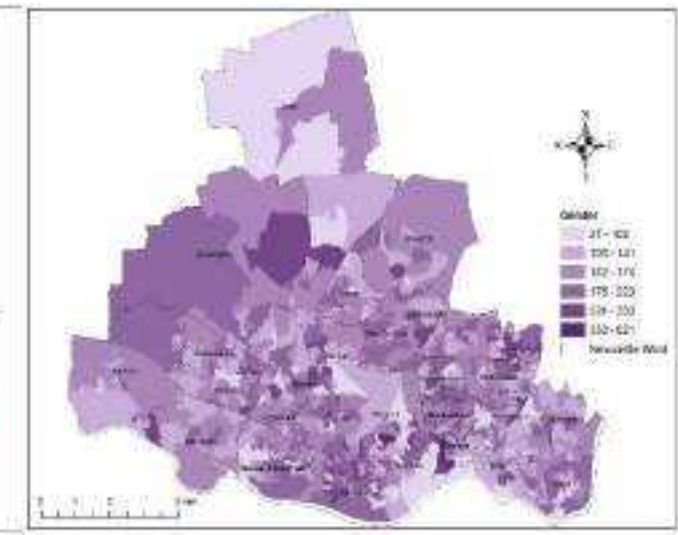


Figure 15: Vulnerability by gender

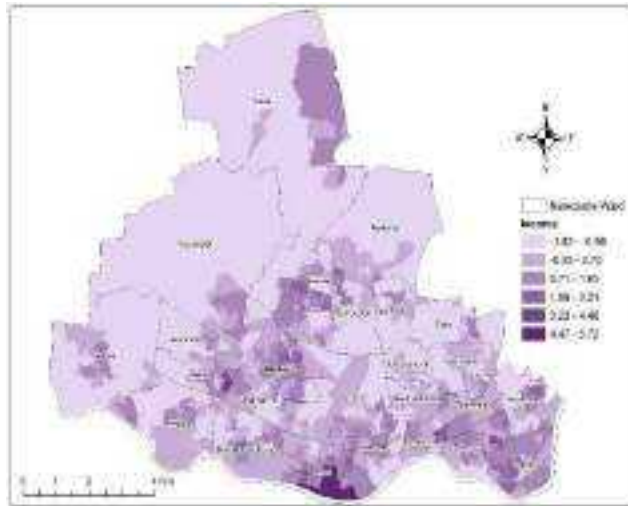


Figure 16: Vulnerability by low income

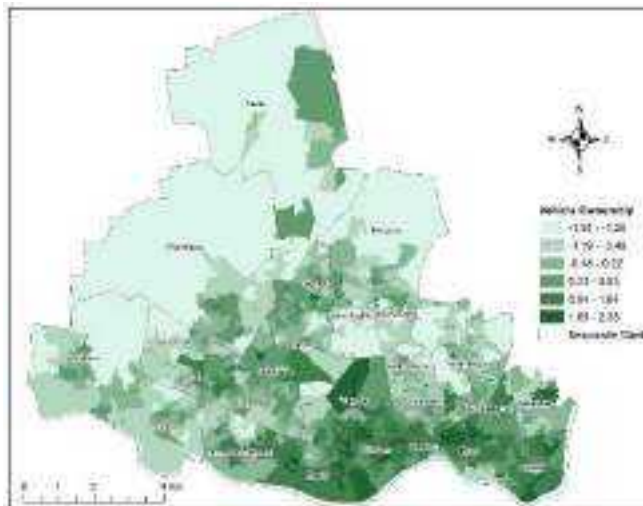


Figure 17: Vulnerability by vehicle ownership

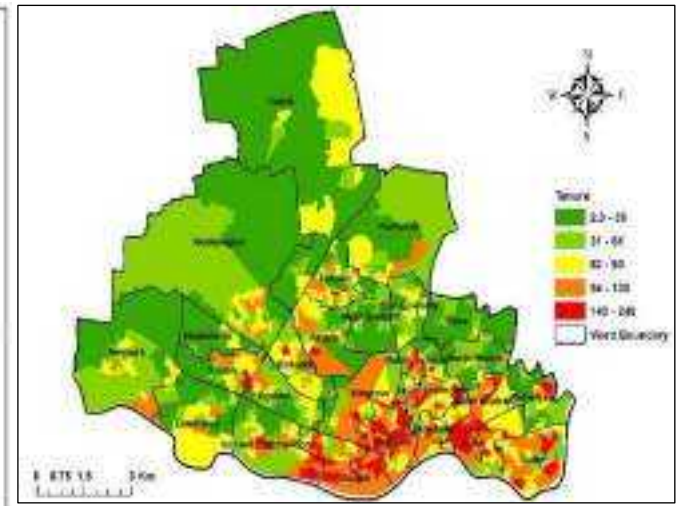


Figure 18: Vulnerability by tenure

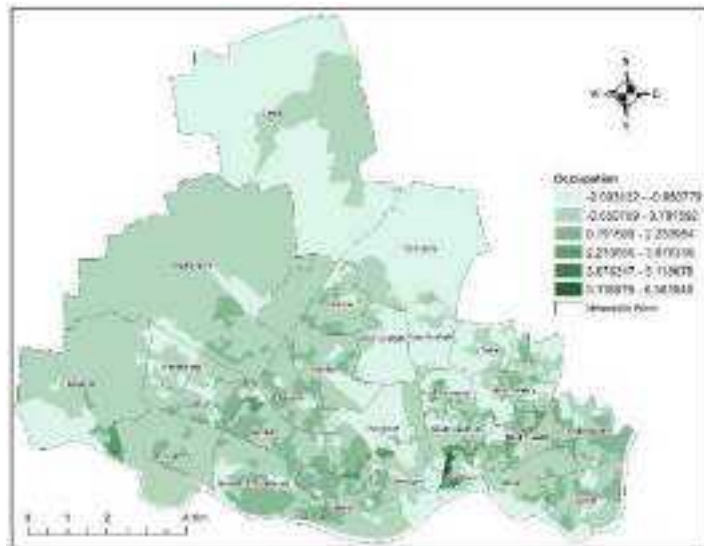


Figure 19: Vulnerability by occupation

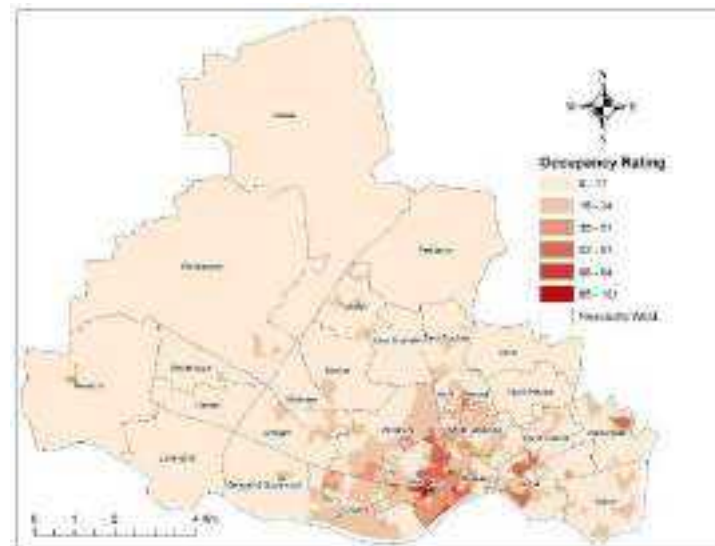


Figure 20: Vulnerability by occupancy rating

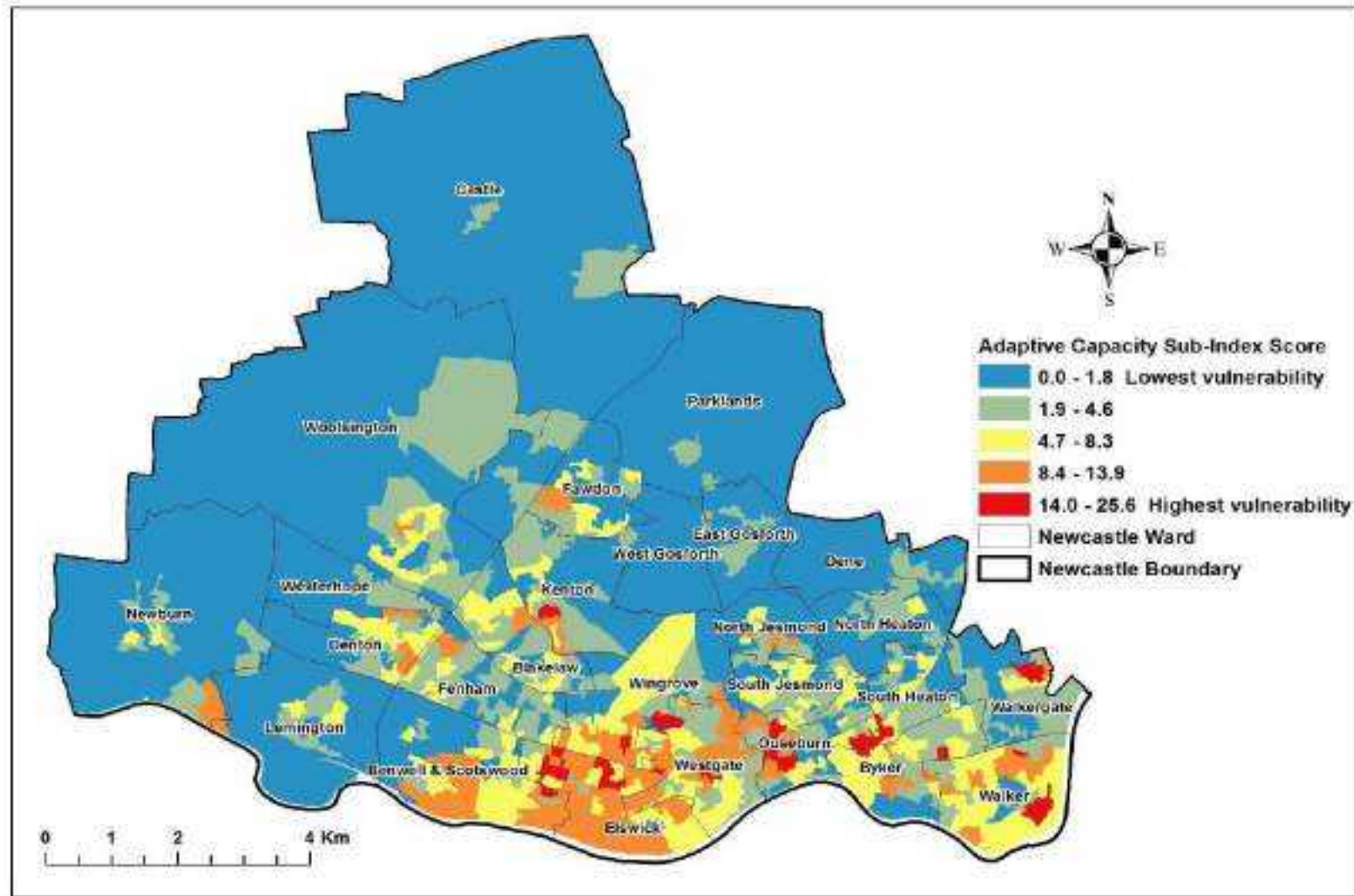


Figure 21. Map of Newcastle showing vulnerability due to low adaptive capacity sub-index score. The score is an aggregated value for; unemployment, occupation, education, language, gender, vehicles ownership, tenure, income and occupancy rating.

### 4.2.3 Enhanced Exposure and Vulnerability in Newcastle

#### Effect of age of housing stock on housing energy efficiency

This research has established a statistical link between building age and its energy efficiency regarding extreme temperature vulnerability of its occupants. The analysis was carried out using the most frequent building age classification per output area of Newcastle and housing average SAP rating for those output area. After aggregating the average SAP score per output area building age classification, the graphical result is shown in Figure 22, and the spatial examination has been presented in Figure 23 and Figure 24. The result of this analysis shows that old aged housing built between the 1837- 1873 have the lowest average SAP rating, while the newest housing units built from 1979 till date produced the highest average SAP rating. Overall, it can be visibly deduced that the newer the housing, the higher the energy efficiency ( i.e. SAP rating) and vice versa. Spatially, the oldest buildings and energy-poor housing were identified in output areas in Westgate, Woolsington, West Gosforth and East Gosforth.

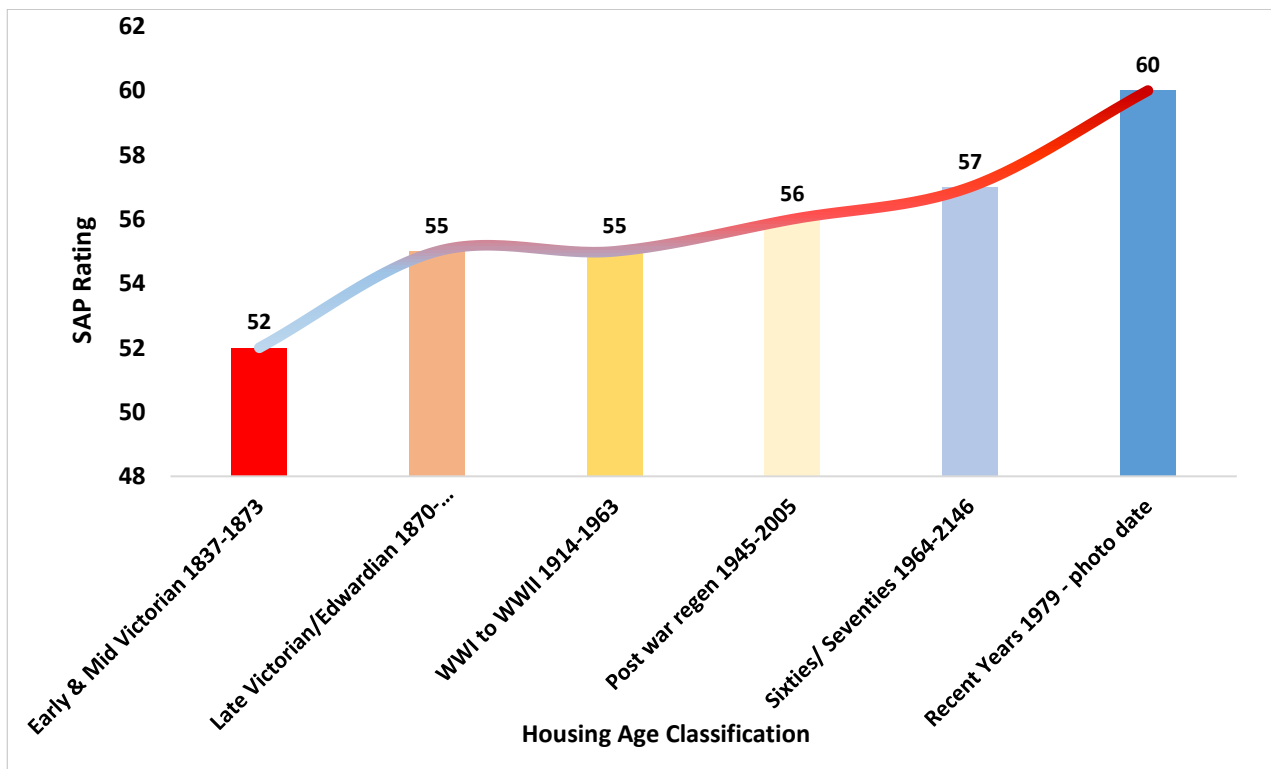


Figure 22: Housing age classification and SAP rating (Housing Energy Efficiency)

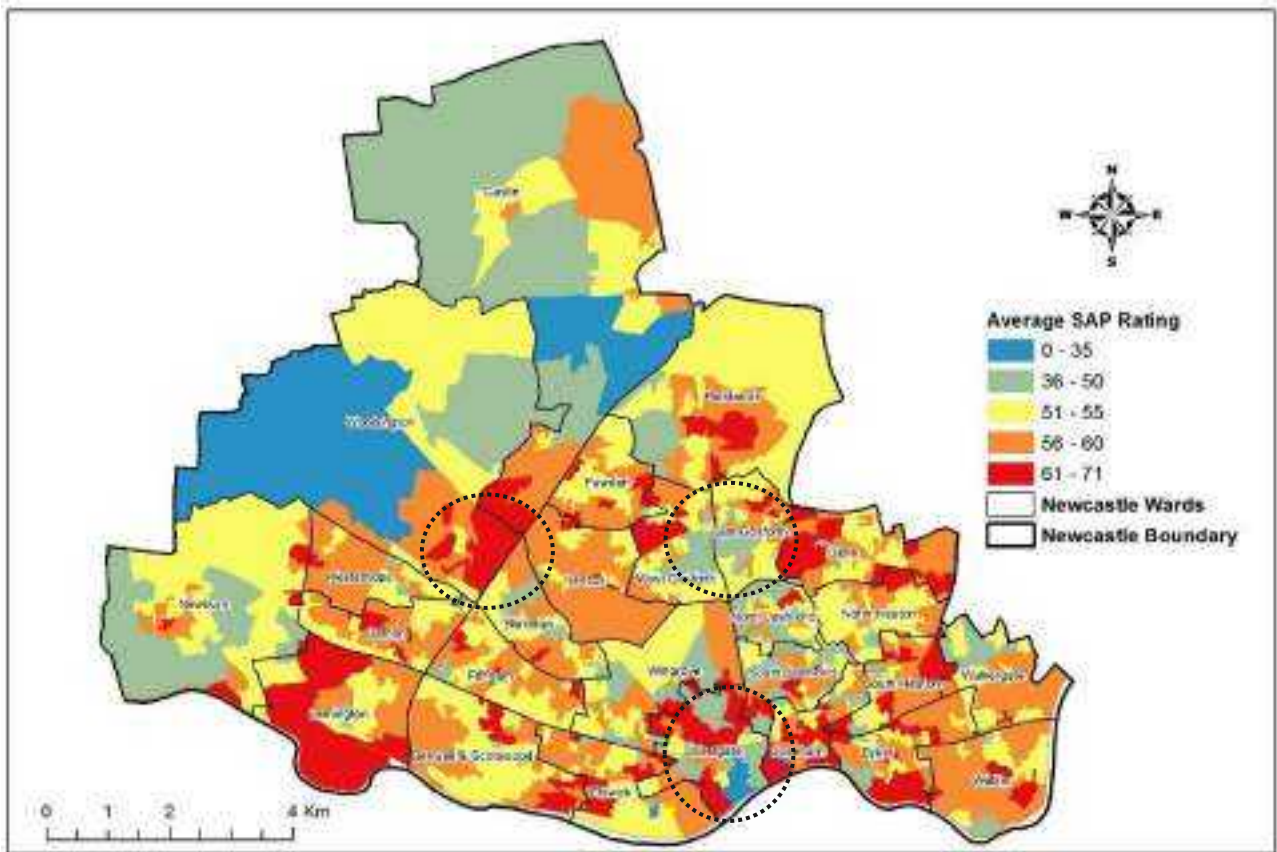


Figure 23: Map of Newcastle showing output area average simple SAP rating

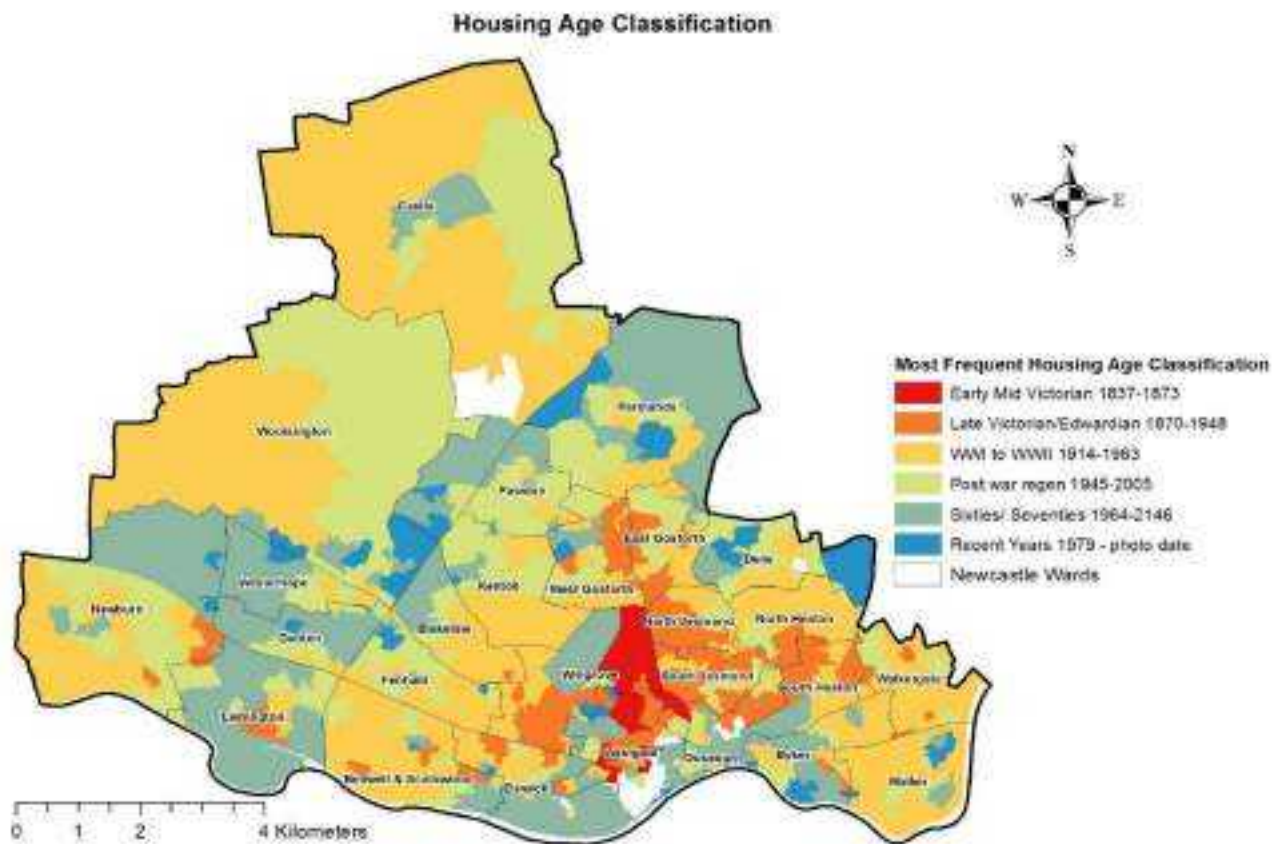


Figure 24: Map of Newcastle showing output area most frequent housing age classification. Output areas with oldest housing are indicated with red while newest housing are indicated with blue.

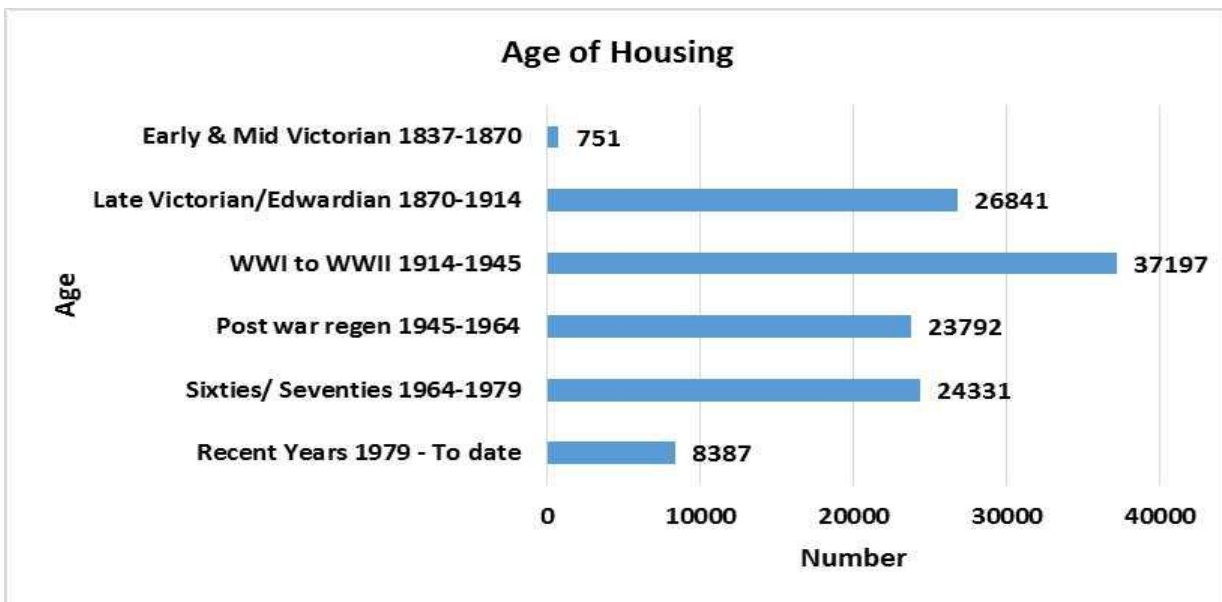


Figure 25: Stock assessment of housing age in Newcastle

### **Housing energy efficiency, heat vulnerability and fuel poverty in Newcastle.**

Housing energy efficiency has been closely associated with the health impacts of both heat waves and cold waves. For heat wave, the architecture and construction materials of housing determine its ability to control temperature fluctuation. This determines its energy efficiency rating. Housing condition can either accentuate or ameliorate the effect of heat and cold. Regarding cold wave, the problem of fuel poverty still presents a threat to climate adaptation in the UK and particularly in Newcastle. Fuel poverty condition is initiated by a combination of high fuel costs, low housing energy efficiency, and low household income. Fuel poverty-drivers are strongly associated with social status and have a strong effect on the risk of poor health outcomes due to households' inability to keep warm. The prevalence of fuel poverty in Newcastle is closely associated with tenure type. In Newcastle, social housing has the highest numbers of fuel poor households (28%) with privately rented properties being also more likely to be fuel poor (25%), followed by owner-occupied homes (20%) (BRE, 2012). In a recent fuel poverty investigation from Marmot team review (2011), their study showed that there is a higher risk of ailment and death from cold homes. Hills review (2012), on measuring of fuel poverty indicated that fuel poverty presents a distinct problem considering its direct contribution to terminal health problems resulting to Excess Winter Deaths (EWDs).

## **Overall Vulnerability in Newcastle**

Map of overall vulnerability in Newcastle was developed by combining the three sub-index score for each of the output areas. The spatial distribution and hotspot analysis carried out for overall vulnerability is shown in Figure 26. From the map, it can be observed that the output areas identified as hotspots are located in the southern ward zones such as Westgate, Elswick, Byker, and Walker. These hotspots are places with clusters of high vulnerability score. While the cold spots output areas are located towards the Northern part of the city council boundary, mainly in wards like Castle, Parklands, and woosington. A list of most socially vulnerable Output areas in Newcastle has been provided in Table 7

Table 7: 20 Most vulnerable output areas in the Newcastle.

<b>Output Area</b>	<b>Overall Vulnerability</b>	<b>Ward</b>
E00042593	35.08428	Westgate
E00042672	32.18788	Ouseburn
E00175578	31.29141	Ouseburn
E00042272	30.84462	Elswick
E00042262	30.04736	Elswick
E00042826	29.83007	Westgate
E00042062	28.91653	Benwell and Scotswood
E00175584	28.13765	Wingrove
E00042266	26.85933	Elswick
E00042280	26.51124	Elswick
E00042118	26.07341	Byker
E00042787	25.99575	Walkergate
E00042284	25.93722	Elswick
E00042547	24.30464	Byker
E00175595	24.05153	Ouseburn
E00042126	23.77318	Byker
E00042679	23.44144	Ouseburn
E00042129	23.30631	South Heaton
E00042507	23.274	Kenton

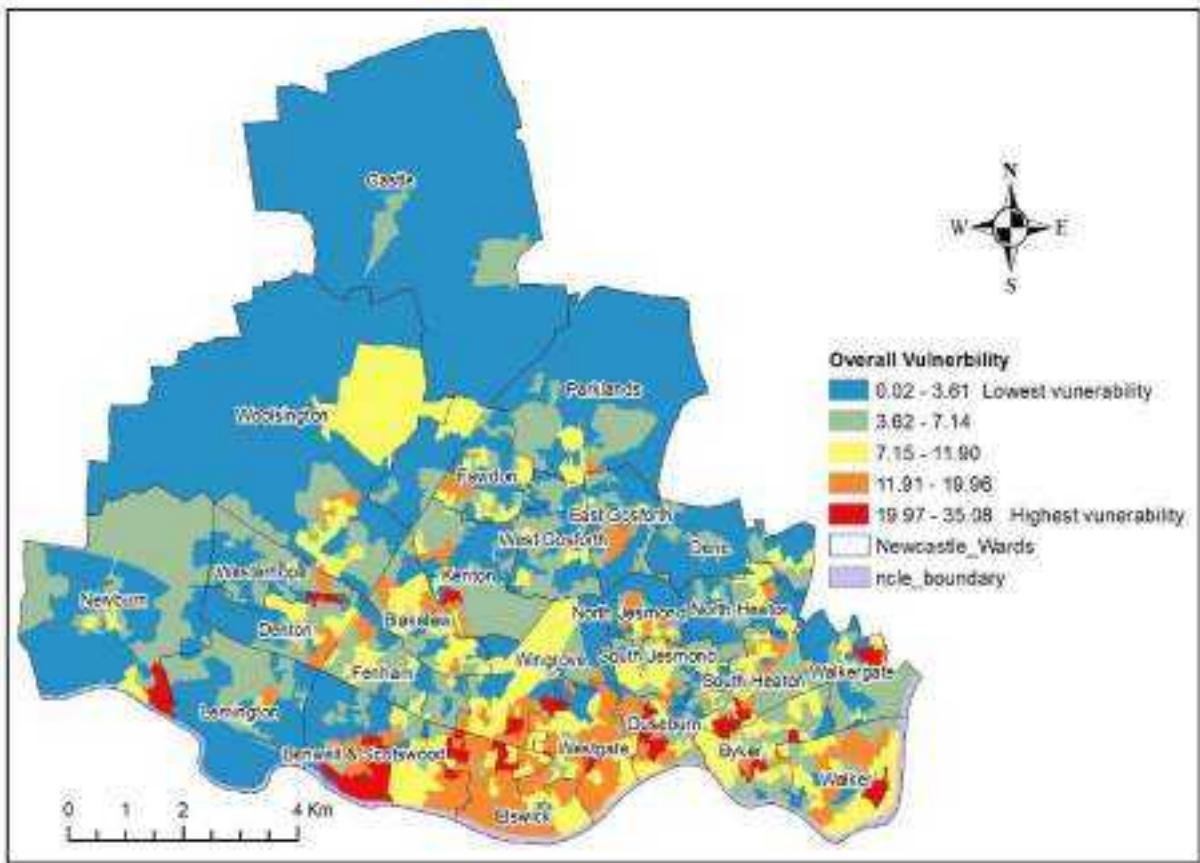


Figure 26: Map of Newcastle showing overall social vulnerability

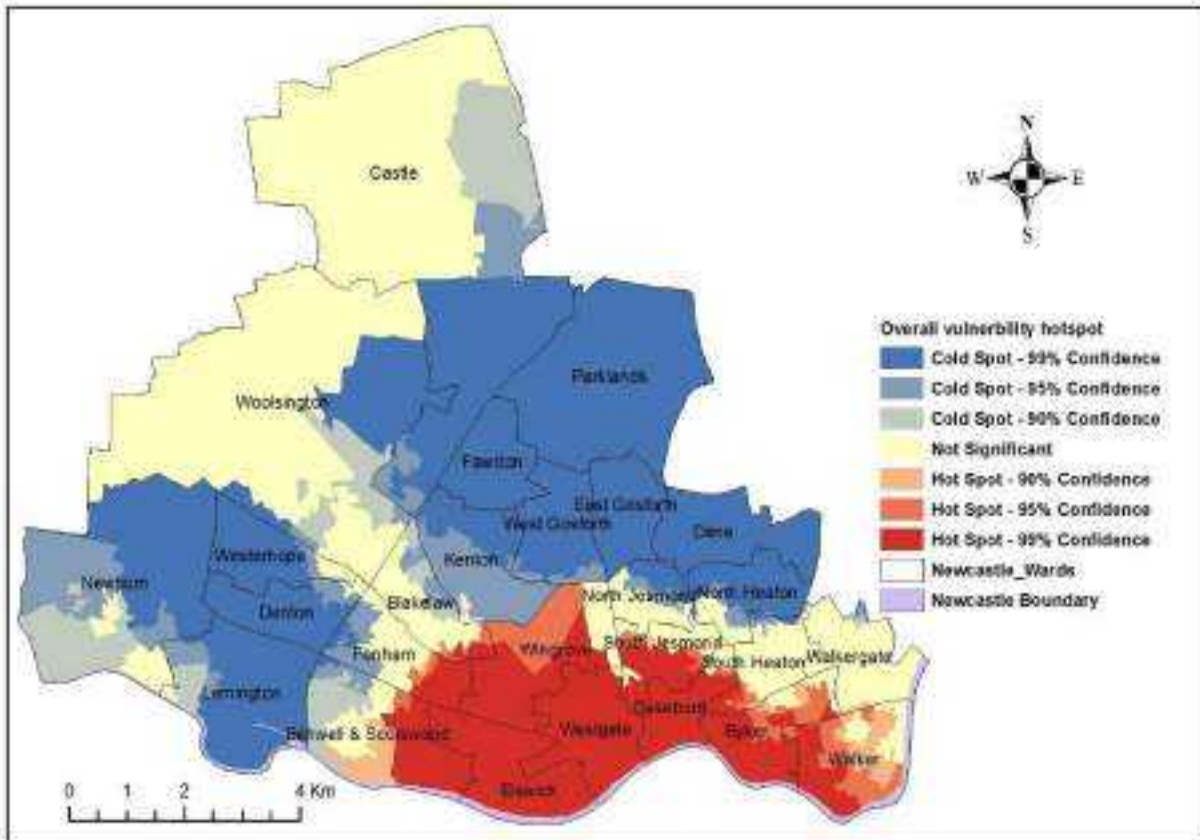


Figure 27: Hotspot map of Newcastle showing significant clustering of social vulnerability on the southern part of Newcastle Upon Tyne.

#### 4.2.4 Correlation, and Regression Analysis

##### Correlation Analysis

Spearman’s rank correlation was applied in assessing the strength and direction of the monotonic relationships between sensitivity and adaptive capacity sub-indices and their individual components. The results are shown in Table 4.1. The association between the aggregate sensitivity and adaptive capacity sub-index scores, though significant at a p-value of <0.01 still have a weak positive relationship at  $r_s = 0.13$ . The correlation coefficient does indicate, however, that as sensitivity-induced vulnerability increases, adaptive capacity increases, and vice versa. Upon further inspection, significant relationships were found to exist among the individual components. For example, the correlation between sensitivity component “general health” and “education” is  $r_s = 0.64$ , which suggests a potential predictive capability between those indicators. Similarly, the correlation between general health and income also showed a strong positive relationship (with a p-value of <0.01 and  $r_s = 0.42$ ). Another remarkable observation was the association between “gender” and “long-term health and disability” with a strong positive association at  $r_s = 0.92$ . This study also shows that to a slightly lesser extent, “occupation”-induced vulnerability is also close related with “long-term health and disability” with  $r_s = 0.36$ .

Table 8: Spearman's Rank correlations for Adaptive capacity and Sensitivity Sub-index

	<b>Sensitivity</b>	<b>Age</b>	<b>General Health</b>	<b>LTHPD</b>
<b>Adaptive Capacity</b>	0.13	0.00	0.22	0.22
<b>Unemployment</b>	0.02	0.00	0.27	0.02
<b>Occupation</b>	0.02	0.01	0.03	0.36
<b>Education</b>	0.18	0.32	0.64	0.01
<b>Language</b>	0.02	0.00	0.01	0.14
<b>Gender</b>	0.18	0.04	0.00	0.92
<b>Vehicles</b>	0.01	0.03	0.29	0.02
<b>Tenure</b>	0.01	0.05	0.21	0.01
<b>Household deprivation</b>	0.11	0.12	0.60	0.00
<b>Ethnicity</b>	0.02	0.01	0.00	0.25
<b>Occupancy Rating</b>	0.01	0.12	0.01	0.03
<b>Income</b>	0.03	0.00	0.42	0.01

##### Regression Analysis

While the correlation analysis above was used to measure the strength of the monotonic relationship between Sensitivity and Adaptive capacity indicators, the regression analysis performed here provided a more detailed predictive relationship between the components of the indices. Results of this analysis is reported in Table 4.2. This was done to provide a

statistical basis for the spatial comparison of social vulnerability indicators mapped in the previous section.

Table 9: Test of Significance of relationship between social vulnerability indicators

<b>Indicator 1</b>	<b>Indicator 2</b>	<b>R<sup>2</sup></b>	<b>95% Confidence Interval</b>	<b>P-Value</b>
<b>Occupancy Rating</b>	<b>Tenure</b>	0.4728	0.64 to 0.735	<0.001
<b>Occupancy Rating</b>	<b>Central Heating</b>	0.1496	0.326 to 0.447	<0.001
<b>Ethnicity</b>	<b>Language</b>	0.787	0.86 to 0.92	<0.001
<b>General health</b>	<b>Pop. Density</b>	0.0087	-0.158 to -0.028	0.00492
<b>Age</b>	<b>Death Rate</b>	0.2131	0.403 to 0.519	<0.001
<b>Age</b>	<b>General health</b>	0.228	0.420 to 0.534	<0.001
<b>Age</b>	<b>LTDH</b>	0.006	-0.142 to -0.013	<0.001

### 4.2.3 Sample spatial comparison of social vulnerability indicators

Sample comparison has been carried out to show how vulnerability maps of specific Social Vulnerability Indicator can be combined to visualize their interaction during emergency planning and response. As illustrated in Figure 28, the central part of the city centre has an extremely high concentration of persons who are of black and minority ethnic groups (BME) and it contains the largest number of people with poor English language speaking ability. Furthermore, in Figure 29, the southern part of the city contains a large number of people high tenure vulnerability due to social or private renting status, which relates also to high occupancy rating in those areas. This presented samples reveal how two or more variables can be combined to reveal useful patterns and trends that can be informative in emergency planning.

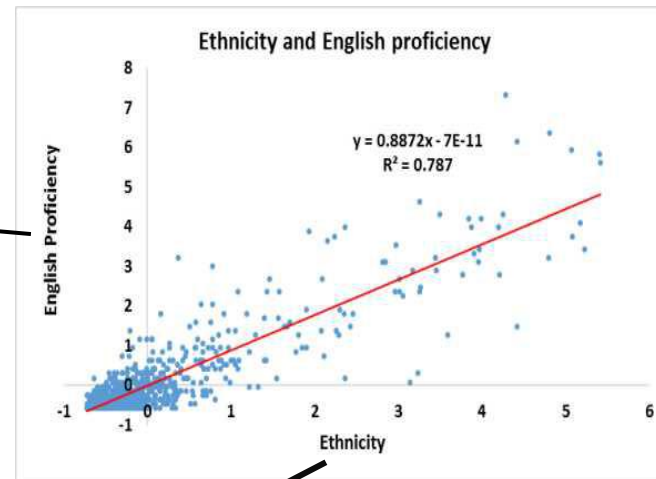
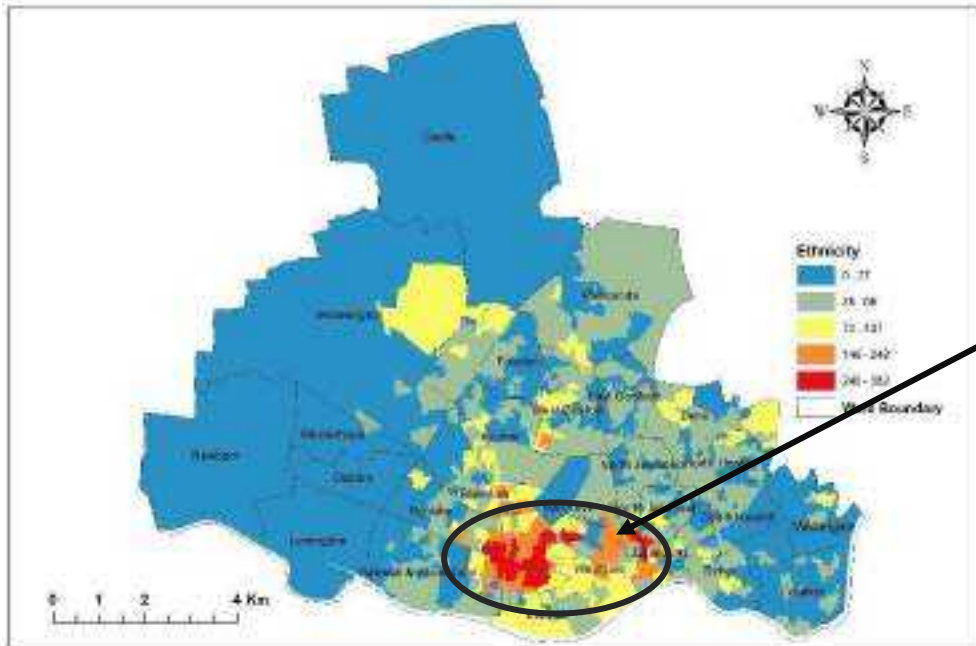
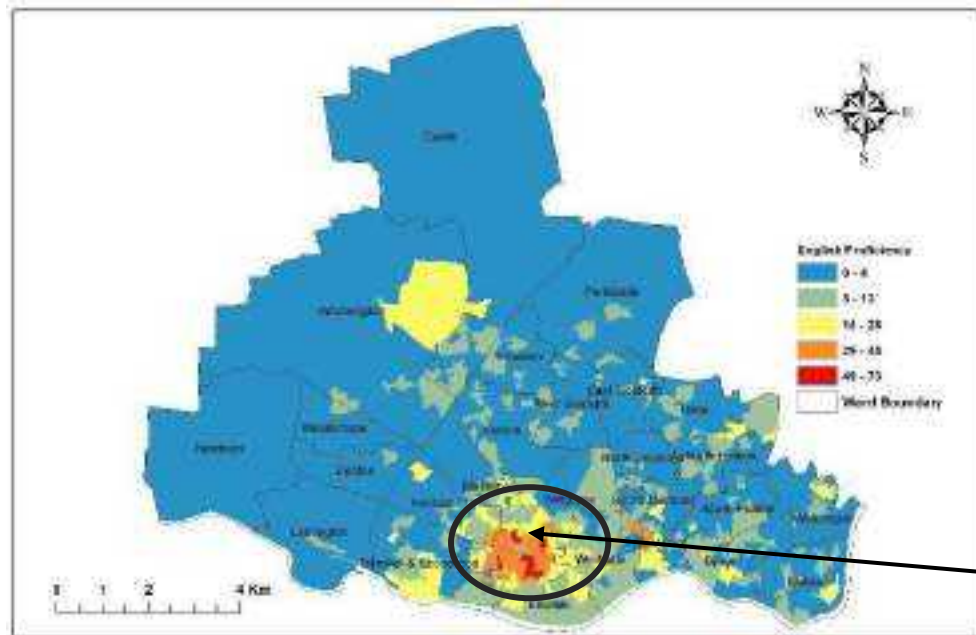


Figure 28: Ethnicity and English Language comparison. The linear regression shows a 78% predicted rate between the two variables with high significance of <math><0.001</math>.

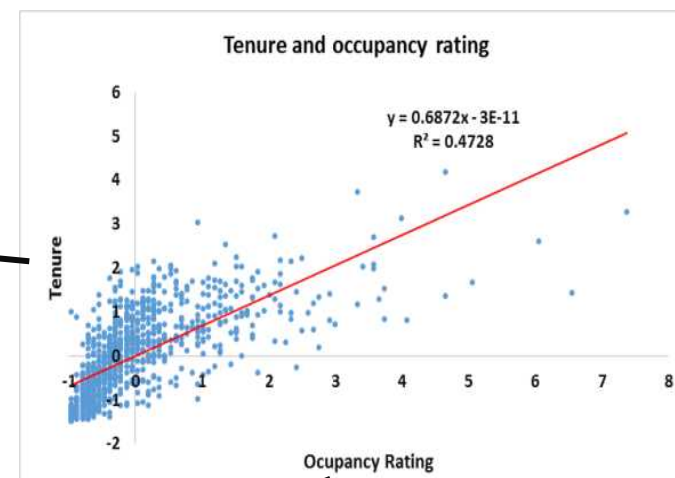
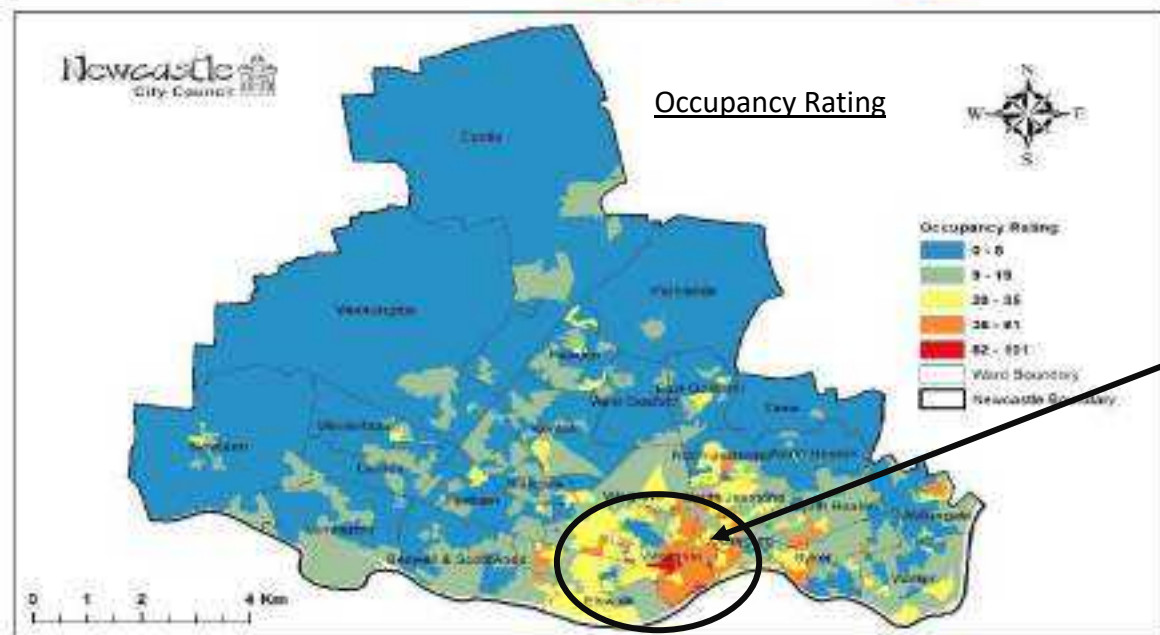
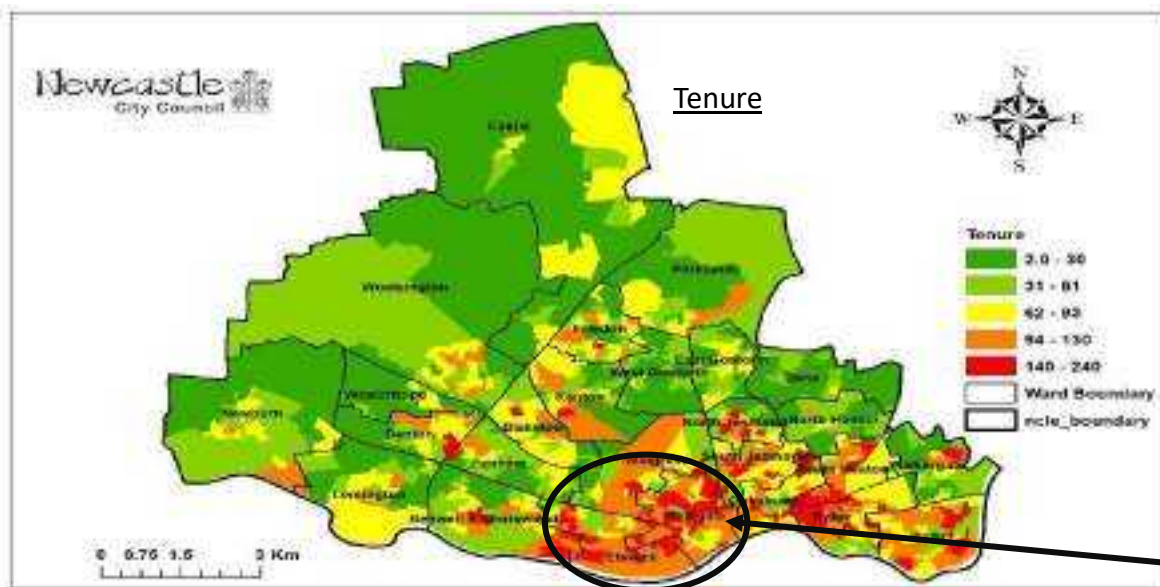


Figure 29: Tenure and Occupancy rating comparison. The linear regression shows a 47% predicted rate between the two variables with high significance of <math><0.001</math>.

### 4.3 Spatial and Temporal Assessment of Extreme temperature and Public Health in Newcastle

The crucial part of this study involved finding for health evidence that can help improve the robustness of the assessment. Much of this ambitious goal was limited by the absence of well detailed spatial and temporal data on extreme temperature-related public health outcomes. As extreme cold and hot temperature is closely associated with direct sensitive responses from human physiology (discussed in chapter two), it is expected that such sharp thermoregulatory stress will have severe morbidity and mortality response on highly vulnerable people. This has been epidemiologically proven through observational evidence in previous cold wave and heat wave health impact studies such as Hajat et al., (2007), Conlon et al., (2011); Wang et al., (2012) and D'Ippoliti et al., (2010).

In this study, public health data were collected for monthly mortality rate, extreme temperature-related cause-specific mortality and overall output area scale distribution of death rate in Newcastle. This result of the graphical analysis is presented in Figure 30, 31 and 32. Regarding the temporal pattern of deaths, the results in Figure 30 shows that there is an occurrence of Excess Winter Deaths (EWDs) in Newcastle. The observation implies that in Newcastle, more people die from exposure to cold temperature than from heat. However, this may be a simplistic assumption as the health data is not well detailed in time scale (e.g weekly or daily mortality) and therefore does not permit examination of downscaled temperature – mortality and morbidity response.

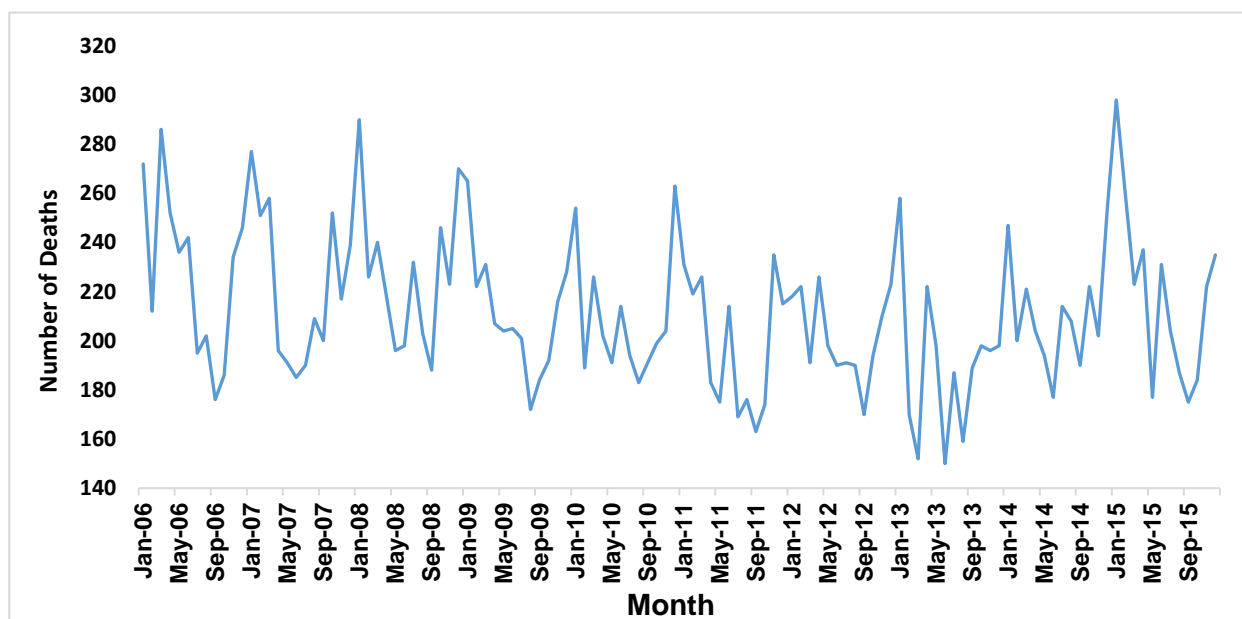


Figure 30: Monthly deaths in Newcastle (2006 - 2015) showing a consistent increase in monthly mortality rates during winter months and lower mortality rate in summer months.

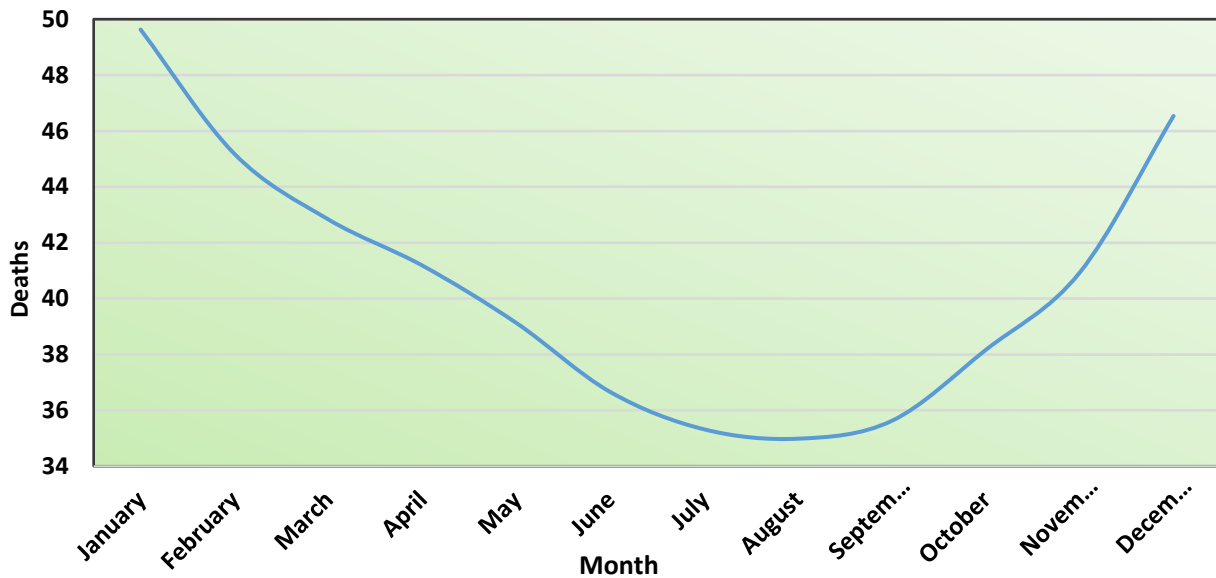


Figure 31: Average monthly number of deaths from CVD, cancer, and liver diseases of the liver.

To further this analysis, causes-specific extreme temperature-related mortality from stroke, coronary heart disease, and cardiovascular disease were examined as shown in Figure 26. The graphical results reveal that elderly people with these long-term conditions terminal diseases are more vulnerable and therefore deserve prioritized attention during cold and heat temperature events. The map presented in Figure 33 shows that vulnerability to a long-term health problem and disability were prevalent throughout output areas in Ouseburn, North and South Jesmond and Elswick.

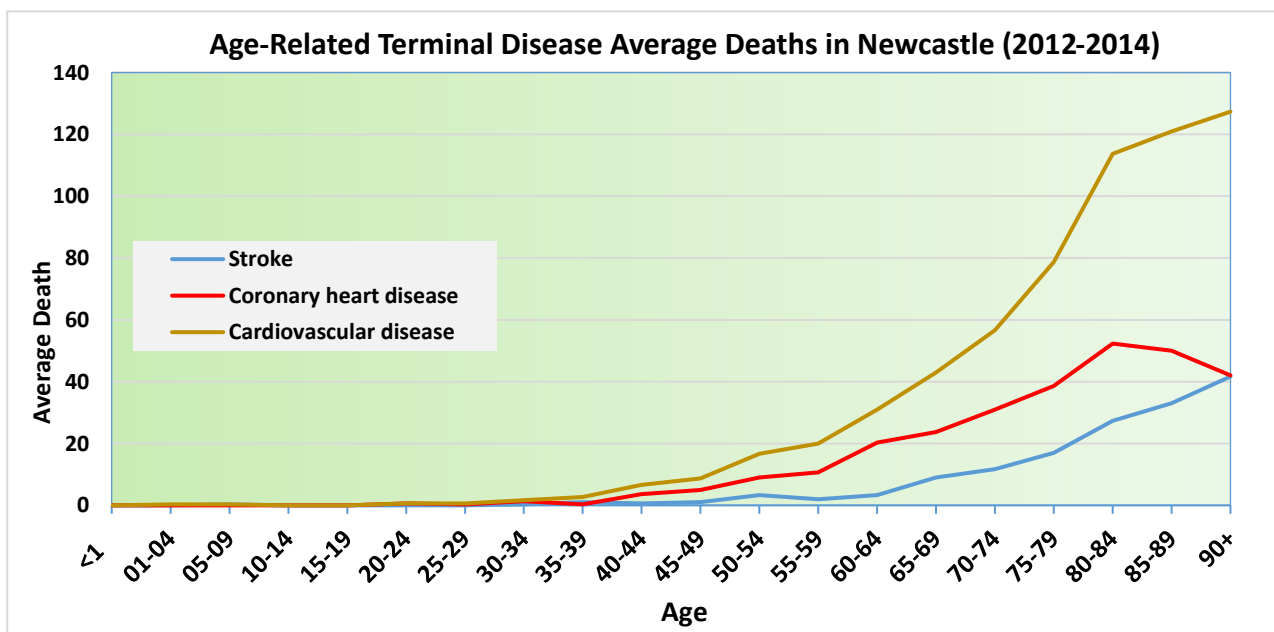


Figure 32: Extreme temperature-related average deaths from stroke, coronary heart disease and cardiovascular diseases in Newcastle (2012-2014).

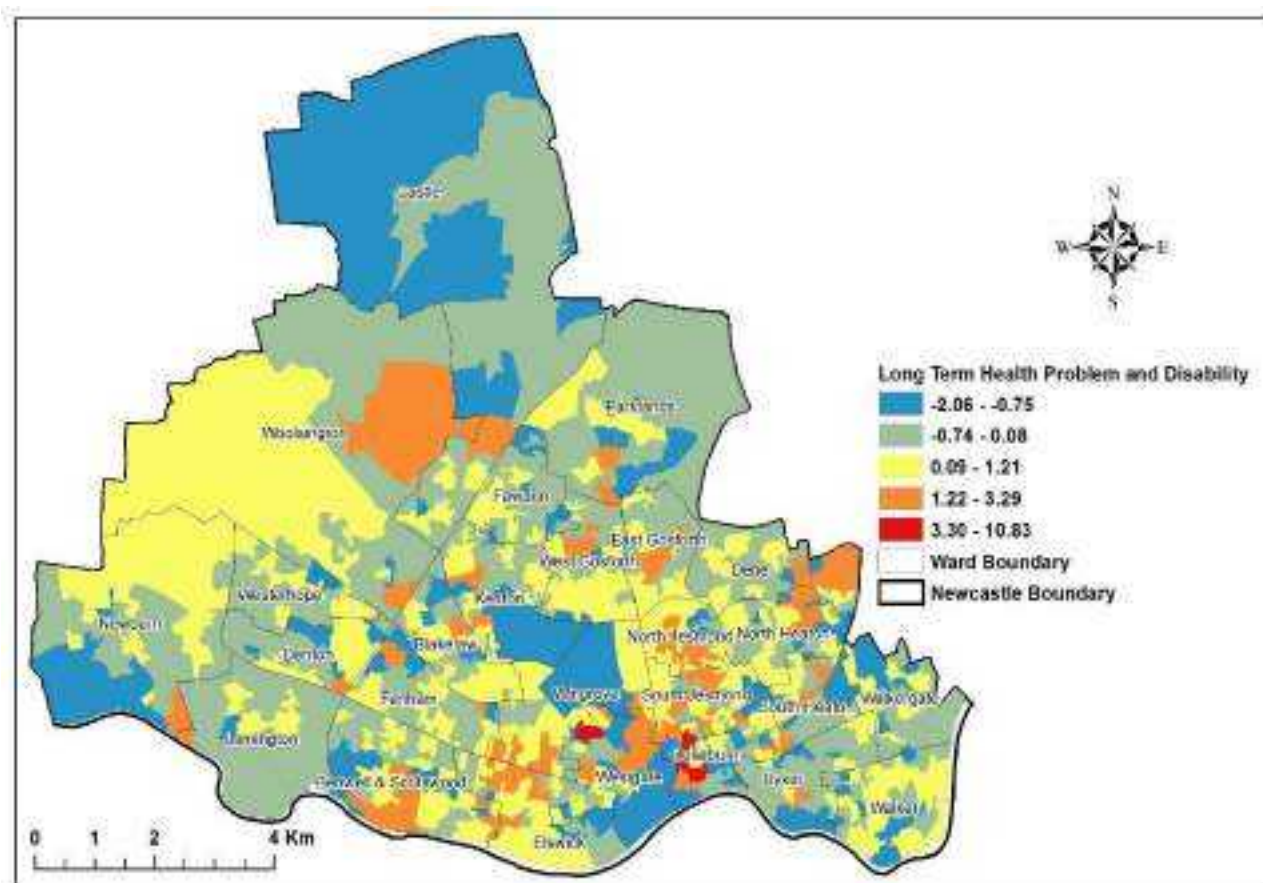


Figure 33: Map of Newcastle showing vulnerability to Long term health problem and disability for each output area.

#### 4.4 Proximity Assessment of Health and Emergency Activity Centres

The final objectives of this study this study involved mapping the proximity of health and emergency facilities to vulnerable locations in Newcastle. The procedure involved conduct a proximity assessment of General Practitioner (GP) services and Emergency Activity Centres in Newcastle. This technique were carried out using buffer analysis procedure outlined in section 3.4. By superimposing the buffer zones on composite vulnerability sub-index layers, it is possible to compare the locations of vulnerable Output Areas to the proximity of facilities that could provide assistance

The map in Figure 34a and 34b shows adequate coverage of GP services in Newcastle particularly in health-sensitive and vulnerable areas such as Benwell and Scotswood, Elswick and Byker. Output Areas in these wards may not require much attention after an emergency given their close proximity to available medical services. In contrast, the Output areas located in the northern end of Newcastle have disproportionate poor access to medical services which mean that residents of the area could have difficulty reaching GP during medical emergencies. Emergency planners should take into account for the response

and recovery process. Moreover, with the low road density in these northern OAs, it also means that during cold waves and heat waves, if the roads are obstructed the area will be isolated with no alternative access to a close by medical facility nor any external help from emergency responders.

In term of EAC facilities, their distrution is clustered in the southern parts of the Newcastle as shown in Figures 35a,35b, and 35c where it has been compared on different dimensions of vulnerability. The basic question that come to mind is how will the vulnerable, low income north located communities deals with extreme cold and heat in times of emergency when they are both marginalized through poor accessibility to GP services and EAC facilities? The observation emerging from this study call for two specific action plans; firstly, the adoption of a spatially inclusive planning method that enables properly visualization of different dimensions of vulnerability within the city. Secondly, an increase city council expenditure on increasing EACs in the city. This will ensure a city-wide efficient coverage of emergency facilities particularly in the northern neglected zone of the city.

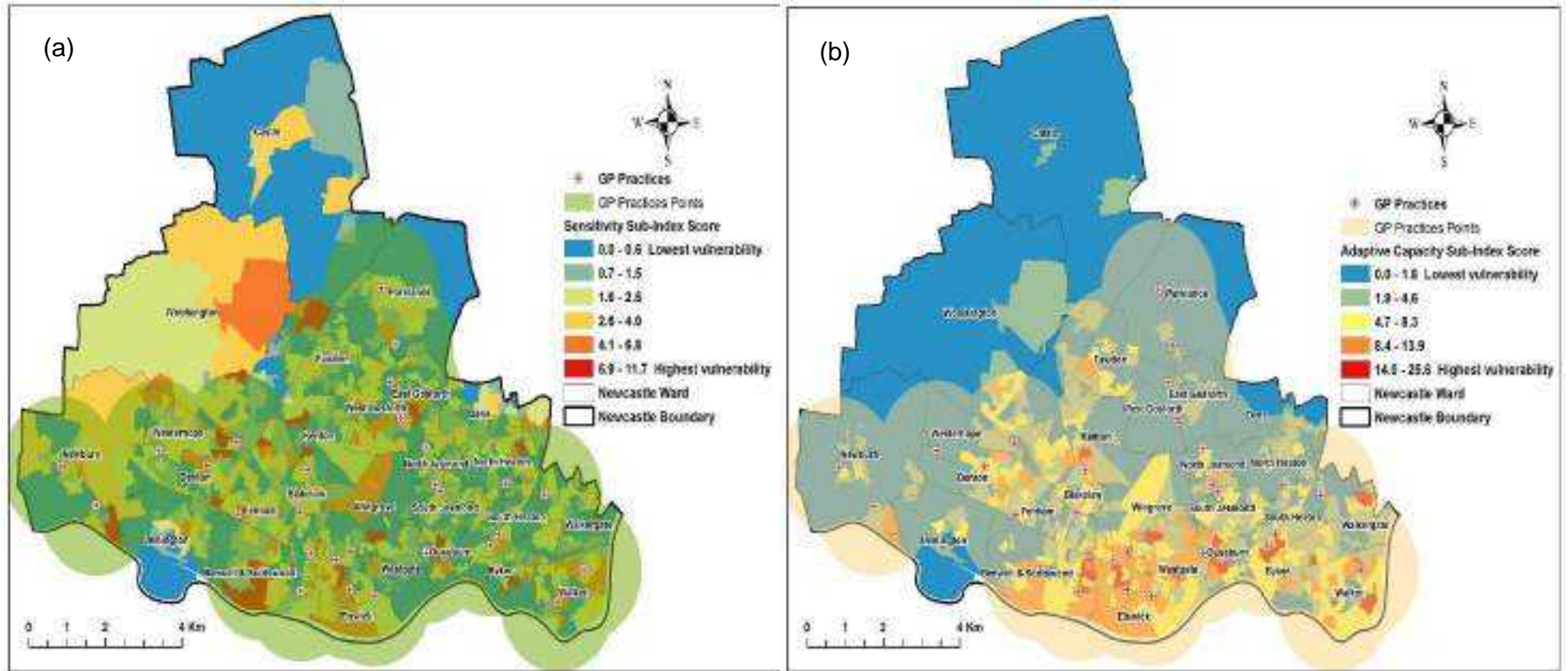


Figure 34: Proximity spatial assessment of GP services and (a) sensitivity (b) adaptive capacity sub-indices of vulnerability in Newcastle

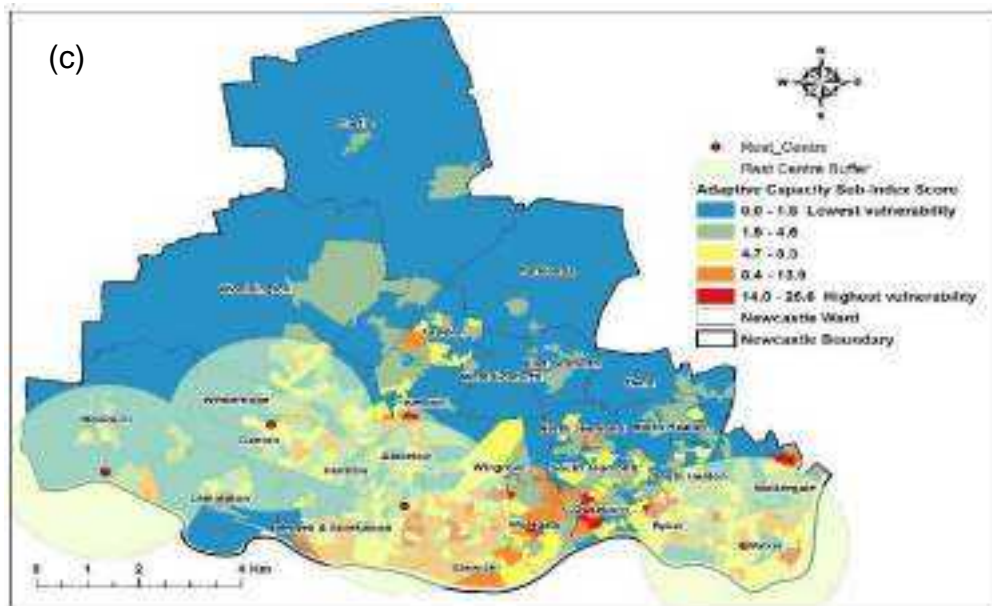
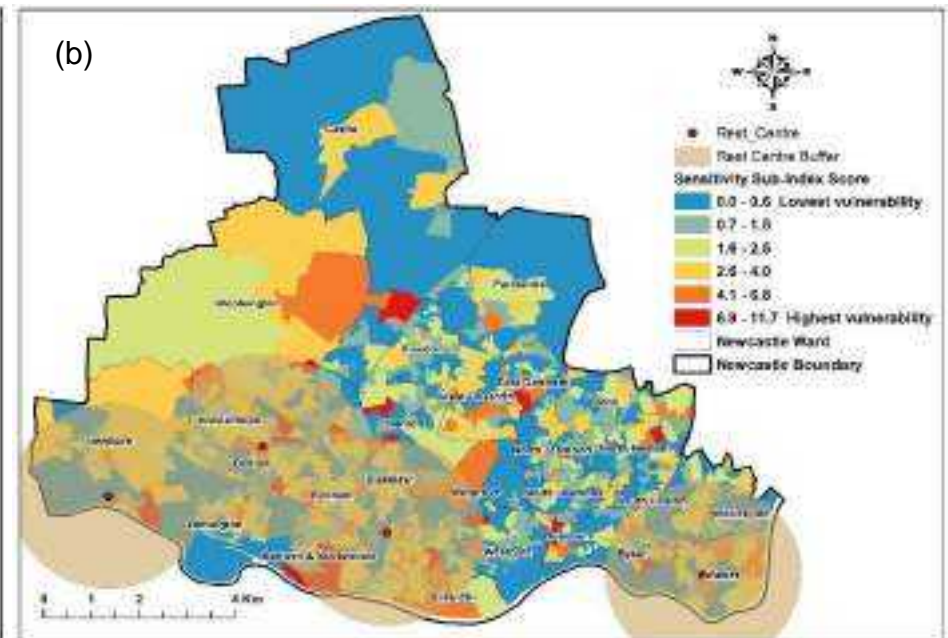
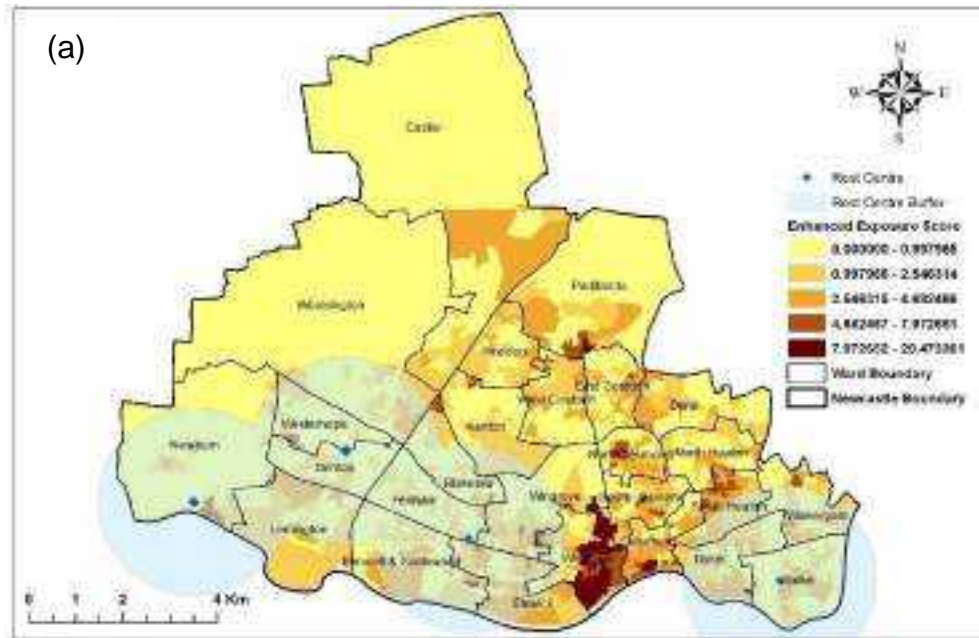


Figure 35: Proximity spatial assessment of EAC facilities with (a) exposure (b) sensitivity and (c) adaptive capacity sub-indices of vulnerability in Newcastle

#### **4.5 Climate Adaptation in Newcastle: The Barrier to Inclusive adaptive Capacity**

Climate adaptation is achievable only where emergency planning is well targeted to the most vulnerable. As well put by Wilson et al., (2014) conclusion, “Adaptation cannot occur in isolation from socio-economic and political drivers, yet the resource implications of dealing with increasing social vulnerability and climate extremes are poorly understood and not currently factored into decision making “ (p.1). In the last 50 years, Newcastle has experienced a steady economic decline following the economic restructuring away from coal mining and heavy industry (OECD, 2006). This has led to a huge expenditure cut in Newcastle City Council. The effect of this recent change is a reduced financial capability of the city council to implementation their adaptation options or effectively perform their social protection objectives. The problem is heightened by the level of joblessness and high number of aging population and poor health in vulnerable zones of the city such as Walker, Elswick, and Gosforth. This implies that social need is growing significantly and will continue to increase irrespective of dwindling institutional capacity to handle the existing social pressure (Newcastle City Council, 2013; OECD, 2006).

Wilson et al., (2014) highlighted four main challenges in climate adaption through to emergency planning. Firstly, a lack of capacity to assimilate adaptation into mainstream services, due to by financial pressures. Secondly, exclusion of extremely vulnerable groups from adaptation policy making. Thirdly, Impact of National/local policy disconnect o welfare reform. This is serious because they have the potential to become mutually reinforcing obstacles to both institutional and individual adaptive capacity. The final point highlighted relates to governance and the framing of climate change adaptation through understanding the interaction between climate and social indicator.

Crucial observations from this study highlight the overbearing need for institutional capacity improvements in managing social emergencies. In terms of extreme temperature vulnerability, social dynamics in Newcastle reveal different spatial clustering patterns which require a holistic emergency preparation for efficient reduction in vulnerability and emergency response. While policy improvements are made on to increase individual level resilience, policy discussion also need to shift to examine institutional preparation for effective emergency response.

## **5. Conclusion and Recommendation**

### **5.1 Conclusion**

Anticipating and responding to communities' emergency needs during and after extreme temperature event, remains a daunting task. To attempt any proactive planning, emergency responders will need to provide a well quantifiable and localized information of who is vulnerable, what makes them vulnerable and where they live. This study has developed a quantitative social vulnerability assessment framework for extreme temperature vulnerability in a context suitable for emergency managers in Newcastle.

The research objectives were actualized by using both direct available demographic data, spatial and statistical analysis of infrastructure datasets. The first objective sought to construct a hierarchical place-based localized framework for quantifying community level social vulnerability. The framework set the foundation for achieving the second objective which assessed the relationship between social indicators using correlation, reliability testing, and regression analysis. As observed in correlation results, there is a weak positive but also statistically significant monotonic relationship between sensitivity and adaptive capacity sub-indices and also between sensitivity and advanced exposure sub-indices. Where the sensitivity and adaptive capacity sub-indices are superimposed, the visual comparisons show that places of varying levels social vulnerability conditions in Newcastle could provide more insight to emergency planners on the potential differential impacts of extreme temperature on household and community health and wellbeing. Notably, the selected social vulnerability indicators were the same irrespective of the distinct temporal or seasonal occurrence of heat wave and cold wave. This observation highlights the latent and inherent nature of social vulnerability independent of hazard nature. It also implies that these study can be used to investigate vulnerability to other climate hazards such as floods. In the case of enhanced exposure, this report has equally shown that regarding, poor housing energy efficiency is associated with old building while also finding that low-income households are related to poor energy efficient housing. This establishes a clear case of clustered fuel poverty in Newcastle.

Finally, the proximity spatial assessment provided an analysis of health and emergency facilities. The results have shown that while there is an even spatial coverage of hospital services, the distribution of ambulance services have poor spatial coverage in the rural communities that have a high population of elderly, and people with poor general health. Moreover, the emergency activity centres which is expected to take more efficient centralized care of most vulnerable groups are more clustered in the southern part of

Newcastle, leaving the northern and eastern zones being disadvantaged. This revelation emphasizes the need to improve the efficiency of emergency response. What this means regarding adaptation is that while Individual-level adaptive capacity is necessary, it is equally relevant to increase emphasis on institutional-level ability to prepare, respond and recover from extreme temperature event (discussed in chapter two, page 6).

The insights presented in this report is expected to instigate improvements in extreme temperature emergency preparedness, as well as inspire further rigorous research in vulnerability science. It is also worthy to note that the development of this social vulnerability indices should not be interpreted as an end goal but rather be used as an investigative tool to facilitate the assessment of information, support decision making, promote policy discussion on an important multidimensional subject. A continuous system should be developed to maintain and refine the overall index with new data.

## **5.2 Recommendations**

Policy recommendations have been made following a synthesis of critical observation from this study. At Firstly, looking at the proximity assessment results which highlighted uneven and ineffective coverage of both ambulance and emergency activity centers in Newcastle. This report, therefore recommends that improvements on individual-level adaptive capacity need to be supplemented by equally improving institutional-level adaptive capacity in Newcastle through emergency preparation. For instance, during extreme heat or cold event, the ability of the emergency responders to deal with a larger number of affected people irrespective of their individual adaptive capacity could make the difference regarding casualties and fatality outcomes.

The high cost of organizing an emergency response and disaster mitigation at the council level could imply that prioritized attention is given to only some severely affected areas, neglecting other areas which deserve attention. This typical emergency approach would hypothetically have an effect on vulnerable low-density communities in cold temperature events and also sparsely-cluster socially vulnerable places during a heat wave. In conclusion, to achieve resilience to extreme temperature events in Newcastle, the two levels of adaptive capacity deserve equal strengthening through institutional-based financial, human capacity and infrastructural improvements on emergency preparedness.

## **5.3 Limitations and Future Studies**

This study had some limitations which should be acknowledged. First, the framework of this social vulnerability research has been intentionally set-up to focus its assessment of

vulnerability using a social construct. The main shortcoming of this social vulnerability model is its failure to address the differential spatial proximity of the people to the source of the hazard (i.e. heat and cold), neglecting the direct interactions between the social attributes of vulnerable communities and the dynamic physical nature of cold weather and heat wave distribution in Newcastle. This study instead lays greater emphasis on the social structural and human sensitivity factors influencing vulnerability to extreme temperature. The methodological hazard-neglect though intended by following the guidance in the Civil Contingency Act (2004) for emergency planning, still makes this project less empirical and more descriptive analysis.

Another area of limitation in this study is linked to the social vulnerability indices structural design. The use of a hierarchical model of social vulnerability has been applied here for easier replicability across scale and future update on the data. However, this design is limited by its inability to weigh which selected indicator is most sensitive and contribute most to the social vulnerability in Newcastle. It will be useful if further studies explore the using of factor analysis such PCA to improve the robustness of this study.

The availability of public health data was another lingering challenge although this paper. Public health data was expected to improve the robustness of the localized scale analysis and evidence presented in this report. However, due to data confidentiality and restriction on public health data in the UK, the health data used in this study was lacking the desired spatial and temporal scale necessary to examine extreme temperature-related specific health outcomes. For this reason, future studies should attempt to integrate health data into this analysis at finer spatial and temporal scale.

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## 7. Appendices

### 7.1 Appendix A: Information on Contacts

The table below shows information on the various individuals who were met during the course of this project. I held several meetings with Laura Turnbull, Kate Cochrane and Helen Hinds (marked with an \*) and the other individuals either in person, email or by phone.

Table 10: Information on Meeting Contacts

Contact	Position	Reason for Contact	Period of Meeting
<b>Louise Bracken</b>	IHRR Director/ Module Convener	To develop dissertation project details	Monthly
<b>Helen Hinds *</b>	Head of Resilience Planning Team	Weekly consultation to discuss the data analysis approach.	Weekly
<b>Kate Cochrane *</b>	Resilience Planning Team	Weekly consultation to discuss the data analysis approach.	Weekly
<b>Kit England</b>	Policy and Communications Business Partner	Discussion on climate adaptation policies in Newcastle	13/6/2016
<b>Laura Turnbull *</b>	Dissertation Supervisor	Periodic meeting for discussion on progress of the research	Every 2 Weeks
<b>Sarah Ledger</b>	Migration and Asylum Coordinator	To get access to public health data for the study.	03/08/2016
<b>Lyndsey Potts</b>	Resilience planning, and Continuity Officer	Identify Existing Emergency Activity centres in Newcastle	01/08/2016
<b>Daniel Lloyd</b>	Principal Research Analyst (Safe Newcastle)	Obtaining data on community related information on social dynamics in Newcastle	08/08/2016
<b>David Fanning</b>	Analyst (Safe Newcastle)	Obtaining data on community related information on social dynamics in Newcastle	08/08/2016
<b>Paul Weir</b>	Assistant GIS Officer	Techniques for organizing data and generating GIS maps	04/07/2016
<b>Craig Blundred</b>	Consultant in Public Health at Newcastle City Council	To get access to public health data for the study.	24/07/2016
<b>Glenn McGregor</b>	Lecturer, Department of Geography. Durham university.	To discuss my method of vulnerability grouping and possible data sources on dwelling type-related vulnerability.	18/08/2016

## 7.2 Appendix B: Z-Score Formulation

The procedure outlined below was used to generate the vulnerability scores presented in this report.

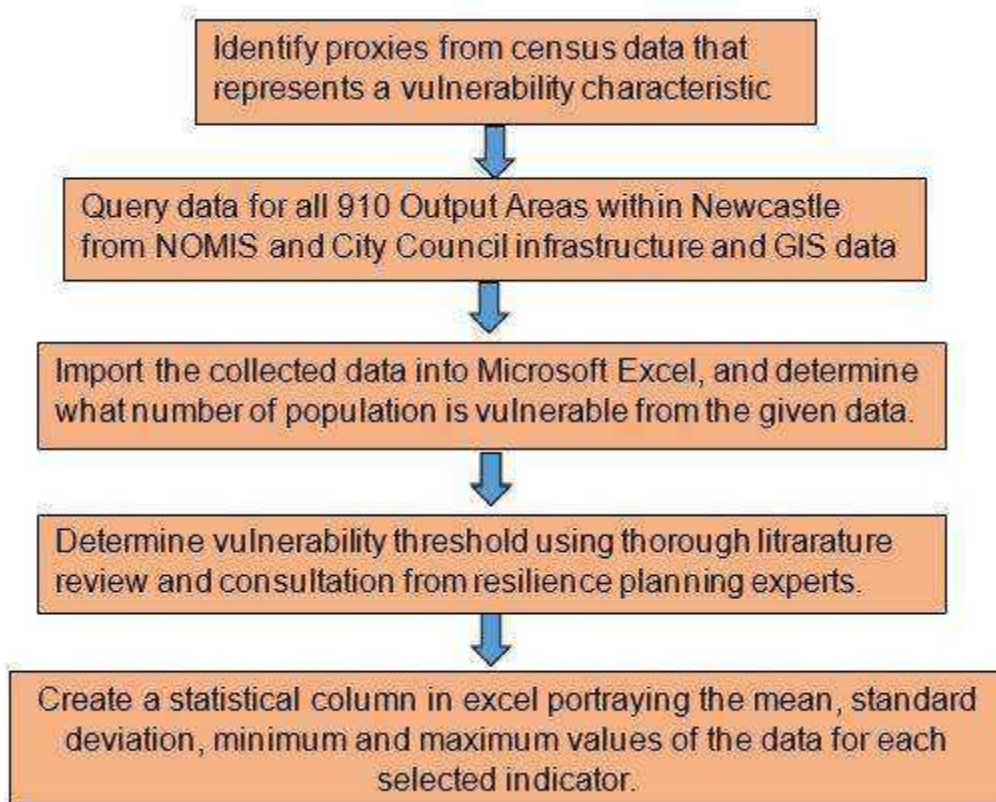


Figure 36: Steps taken in Z-score formulation

Using the formula;  $Z \text{ Score} = x - \mu/\sigma$ , calculation of the Z-Score is done for each of the Output Areas

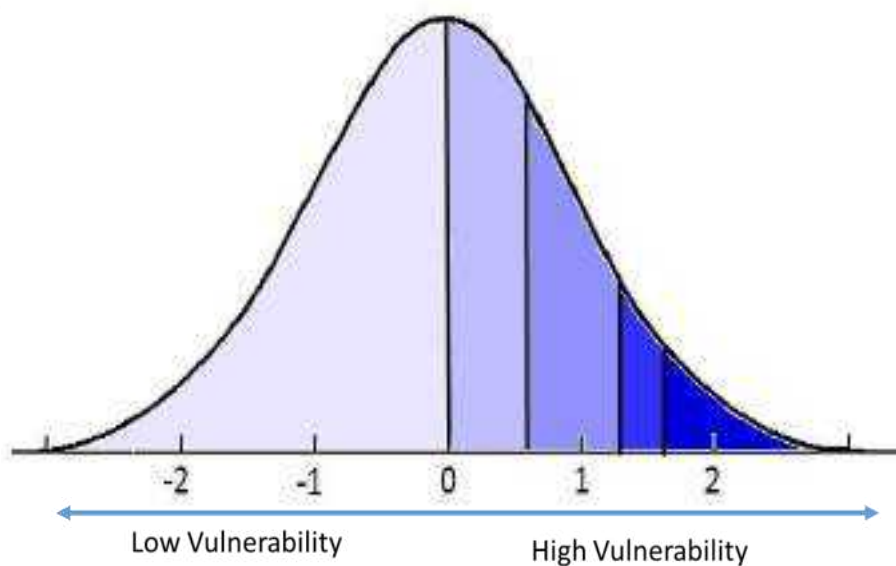


Figure 37: Bell Curve



## **Spatial & Temporal Dimensions of Hazards**

**October 2007 South California Fire Siege**

### **The Witch Fire: Hazard Assessment Report**

**Presented by:**

**Alex Nwoko**



## **Executive Summary**

Recent studies in the last several years have shown the increasing trend in wildfire magnitude and frequency especially in western region of U.S. The present pattern is attributed to changing climate, land use practices and increased urbanization. In California, 18,729 wildfires have occurred since 1980, but the 2007 Witch fire in San Diego was unquestionably one of the most devastating wildfire events in the history of California especially in terms of economic losses. This report examines the Witch fire event characteristics and its impact.

Spatial clustering analysis and satellite-derived estimates of fire severity were used to characterise the spatial and temporal nature of the Witch fire. Results from clustering analysis indicates that Southern California's coastal region is a hotspot for wildfire activities. Sub-regional analysis of frequency and magnitude distribution of wildfires on fire-prone land cover indicates that even with the use of low resolution land cover and DEM data, there is a clear correlation between wide fires and land covers.

This study shows that given the fact that an event of higher magnitude has occurred in recorded history, the data available prior to the 2007 fire siege was sufficient to undertake analysis that would have led to the anticipation of a large wild fire event in the area, given the short return period of the Witch fire extent (14 years). Additionally, the prelude fire-igniting meteorological conditions should have further informed the authorities that the San Diego area was at high risk of a large wildfire.

## Introduction

Wildfires have caused significant damages to humans and their resources, and have long term socio-economic and environmental impacts, particularly in western parts of USA (Hunter *et al.*, 2007). Decades of fire suppression and forest management have created conditions in which catastrophic wildfires are increasingly frequent (Covington and Moore, 1994). Recent studies have acknowledged the increase in the size and severity of wildfires in the southwest forests and linked it to increase in tree density and fuel loading (Swetnam and Baisan, 2003) and climate change (Westerling *et al.*, 2006). Increased wildfire risk has also been linked to urbanization and encroaching Wildland Urban Interface (WUI) particularly in Southern California.

On 21 October 2007, the Witch Fire was reported at 12:35 p.m. in the rural area of Witch Creek, east of Ramona in San Diego County. Southern California experienced an unusually severe fire-igniting weather event characterized by intense, dry, gusty Santa Ana winds. This weather event drove a series of destructive wildfires that took a devastating toll on people, property, natural resources, and infrastructure. Although some fires burned into early November, the Witch fire caused the heaviest damage especially during the first three days when the winds were also the strongest. The Witch fire burned 197,990 acres (655.8 Km<sup>2</sup>) and destroyed 1125 residential structures, 509 outbuildings and 239 vehicles. Additionally, 77 residential structures and 25 outbuildings were damaged. Suppression costs were \$18 million.

During the Witch fire siege, two civilian fatalities and 45 firefighter injuries were recorded. Hundreds of thousands of people were evacuated at the height of the siege. The fires burned over half a million acres, including populated areas, and wildlife habitat. Portions of the electrical power distribution network, telecommunications systems, and even some community water sources were destroyed. Transportation was disrupted over a large area for several days, including numerous road closures. The Witch Fire burned over 1,200 archaeological sites as the most significant archaeological sites within the county were situated within the burn area. While the total impact of the 2007 Witch fire was less than the disastrous cedar fires of 2003, it was unquestionably one of the most devastating wildfire events in the history of California. The cause of the witch fire was investigated and identified as being caused by a power line (Figure 3). This report will investigate the spatial and temporal characteristics of wildfires characteristics of the Witch fire and how it relates to previous wildfire events with the view of determining whether the fire should have been anticipated.

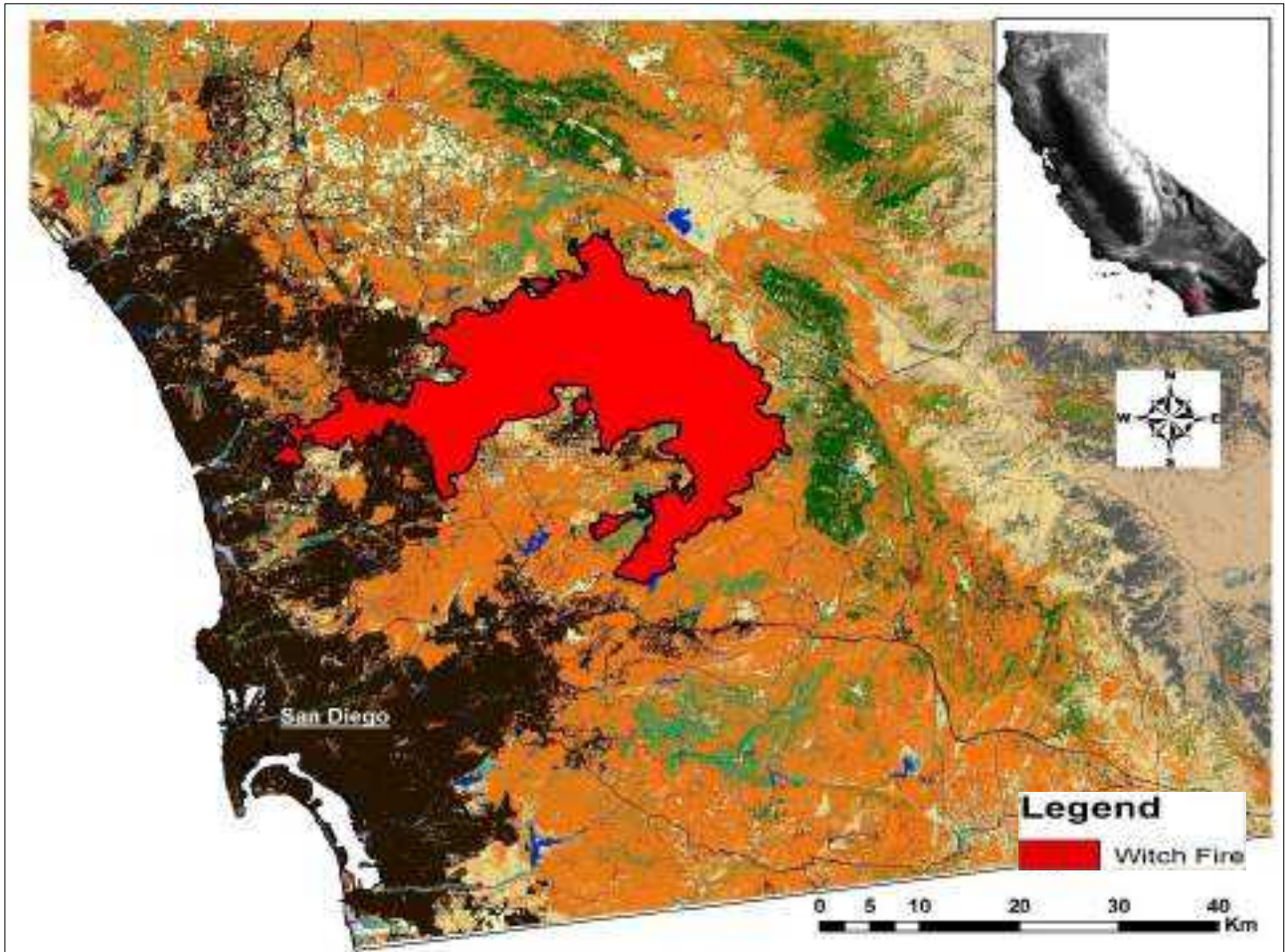


Figure 1 – Map depicting the Witch Fire final area in relation to San Diego and other nearby urban areas. Black areas are urban areas, whilst the red area is the Witch Fire burn scar.

## Methods

To assess wildfires in California, nationally consistent fire shapefiles (1878-2014) was obtained from California Department of Forestry and Fire Protection (CAL FIRE) wildfire GIS database (<http://frap.fire.ca.gov/data/frapgisdata>). The shapefiles were created using Landsat TM and ETM+ satellite images, which have a relatively high resolution (30m) and is a cost-effective, accurate means of mapping fires (Brewer *et al.*, 2005; Eidsenshink *et al.*, 2007).

To identify which land covers are susceptible to wildfires, land cover data from the USGS Gap Analysis Program (GAP) has been compared with the distribution of wildfires. The National GAP Land cover was derived using Landsat TM satellite imagery (1999-2001) and Digital Elevation Models (DEM) as its primary base (Comer *et al.*, 2003; Lowry *et al.*, 2005). Since California has many different land covers, the state has been further divided into Bailey's Ecoregions to define areas of common climate, vegetation and elevation, as done by Malamud *et al.* (2005). This study will focus on the 'California South Coast Ecoregion'.

To assess the burn severity of the witch fire, a processed severity analysis was download from Monitoring Trends in Burn Severity (MTBS) (<http://mtbs.gov/dataaccess.html>) project database. This Burn severity was analysed using the Normalized Burn Ratio calculated for the pre-fire and post-fire Landsat derived images (Equation 1). The Normalised Burn Ratio (NBR) was calculated to enhance the spectral response of fire-affected vegetation (Key and Benson, 2002). Band 4 represents healthy vegetation whilst band 7 represents bare ground, soil and rock (Eidenshink *et al.*, 2007). NBR images are differenced for each fire-scene pair to generate the dNBR. The differenced NBR (dNBR), is calculated using equation 2, and has been used to classify burn severity, as defined in table 1. Burn severity will be compared to land cover, topography, slope and aspect of the burned area. Data for topography (elevation, slope and aspect) have been derived in ArcGIS from a 30m resolution DEM.

$$NBR = [(band\ 4 - band\ 7) / (band\ 4 + band\ 7)] \quad (1)$$

$$dNBR = NBR_{pre-fire} - NBR_{post-fire} \quad (2)$$

Table 1 – Burn severity classification.

dNBR value	Burn Severity
< 0.05	0 = Unburned
0.05 to 0.27	1 = Low severity burn
0.27 to 0.44	2 = Moderate-low severity burn
0.44 to 0.66	3 = Moderate-high severity burn
> 0.66	4 = High severity burn

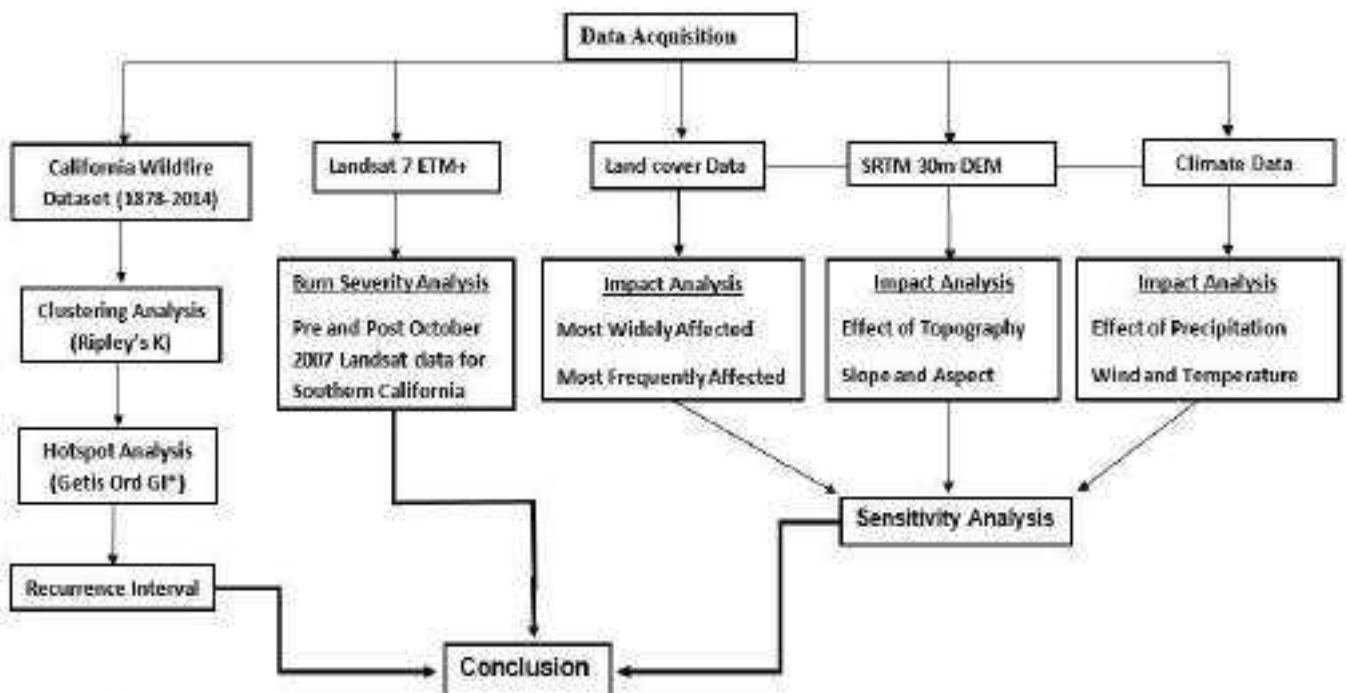


Figure 2. Flow Chart of methodology

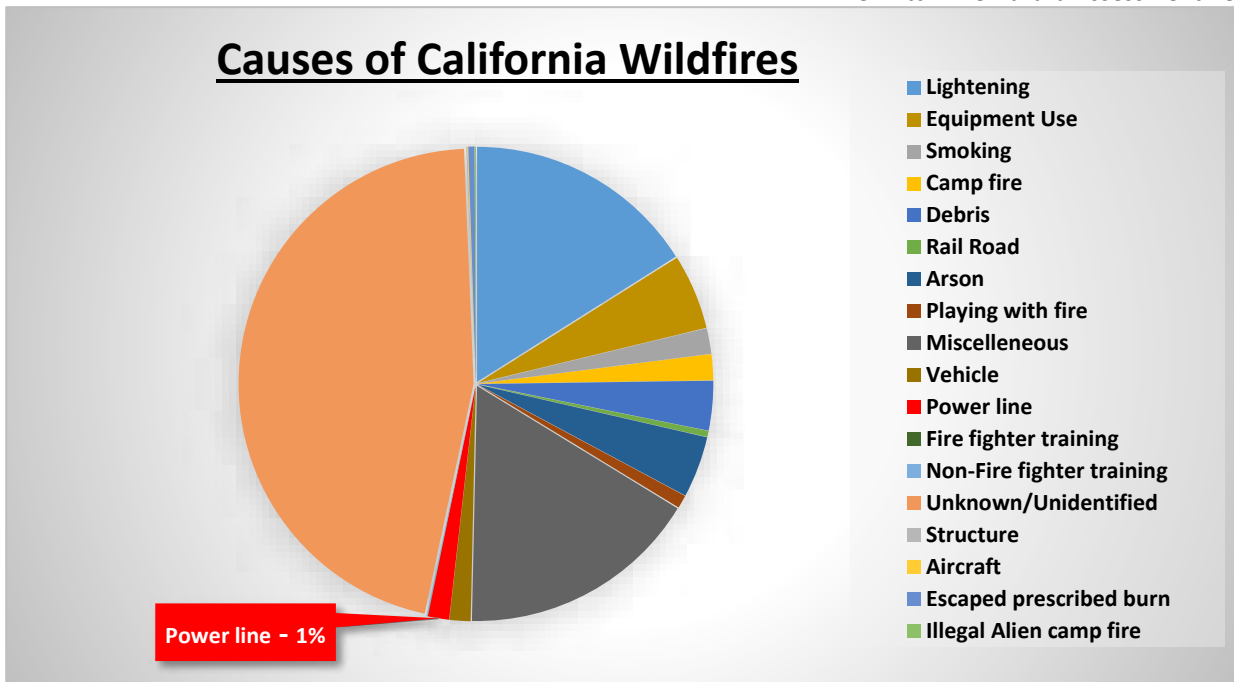


Figure 3. Causes of California Wildfires.

### **Spatial Distribution of California Wildfires**

18,729 wildfires have occurred in California between 1878 and 2014, burning approximately 126289.83 km<sup>2</sup>. Part of this study is to determine the extent to which spatial clustering is present in California wildfires using a two-step approach. The first step involves running Ripley's K function on the wildfire dataset to identify the clustering distance (Ripley, 1976). The Ripley's K analysis applied in this study used 100 bands each 4 km apart. The Ripley's K analysis indicates that the distance at which clustering is greatest is 46.3km (Figure 4).

This value is then used to calibrate the band distance for the Getis-Ord  $G_i^*$  analysis (Getis and Ord, 1992). The iterative process shows that the specifics of the spatial distribution of hotspots depends on the distance conceptualization used. However, from Figure 5 we can clearly see some similarities between hotspot and cold spot areas across the wildfire frequency, maximum area and mean area analyses. We can see that hotspot areas exist along the south west coast of the state which signifies the existence of large and frequent fires. Cold spots persist within the Northern region of California, indicating that the region experiences infrequent yet large fires.

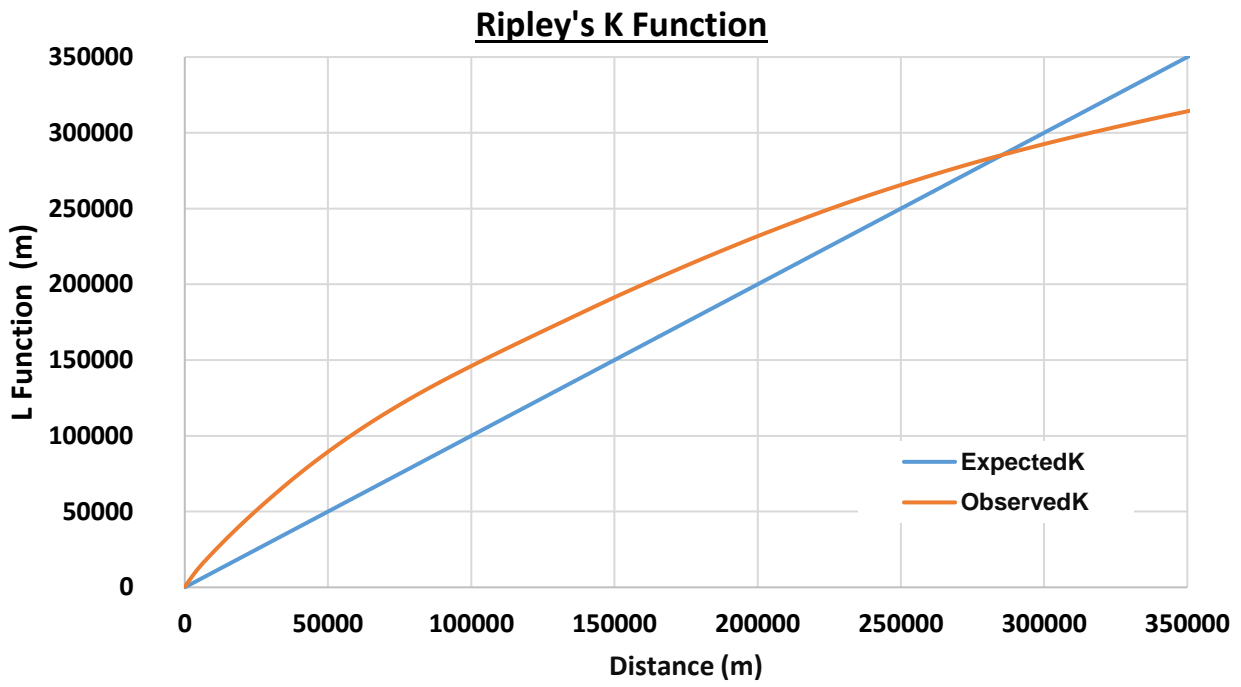


Figure 4. Graphical display of the results of Ripley's K analysis.

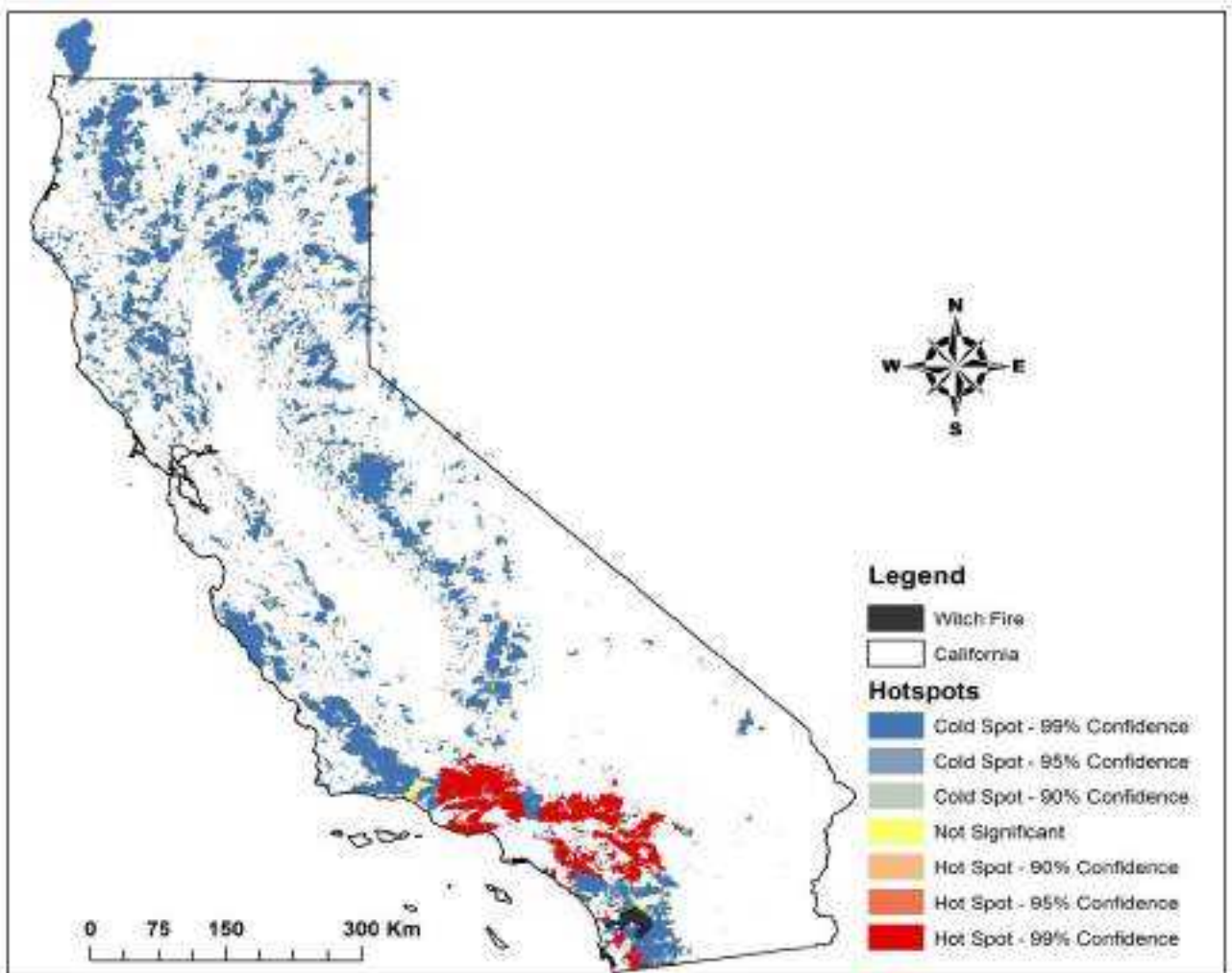


Figure 5. Getis Ord  $G_i^*$  Hotspot Analysis of wildfires in California

To understand the relationship between different land covers and the burn area & frequency characteristics of wildfire requires the usage of areal tabulation. Using the outputs of this process we can quickly calculate the total area burn per land cover type as well as identify land cover types that have experienced multiple burns in the same area. Figure 7 and Table 3 shows that a quarter of the burned areas are located in the California South Coast Ecoregion, burning approximately 53% of the ecoregion. The largest fire also occurred in the California South Coast Ecoregion. Comparatively, relatively few wildfires occurred in the Columbia Plateau, Great Basin, and Sonoran Desert. Significant hotspot activity is clustered in southwest of California, as shown in figure 5. This identifies areas which have burned multiple times between 1878 and 2007. Although wildfires have occurred elsewhere, these fires are not statistically significant due to the lower fire frequency.

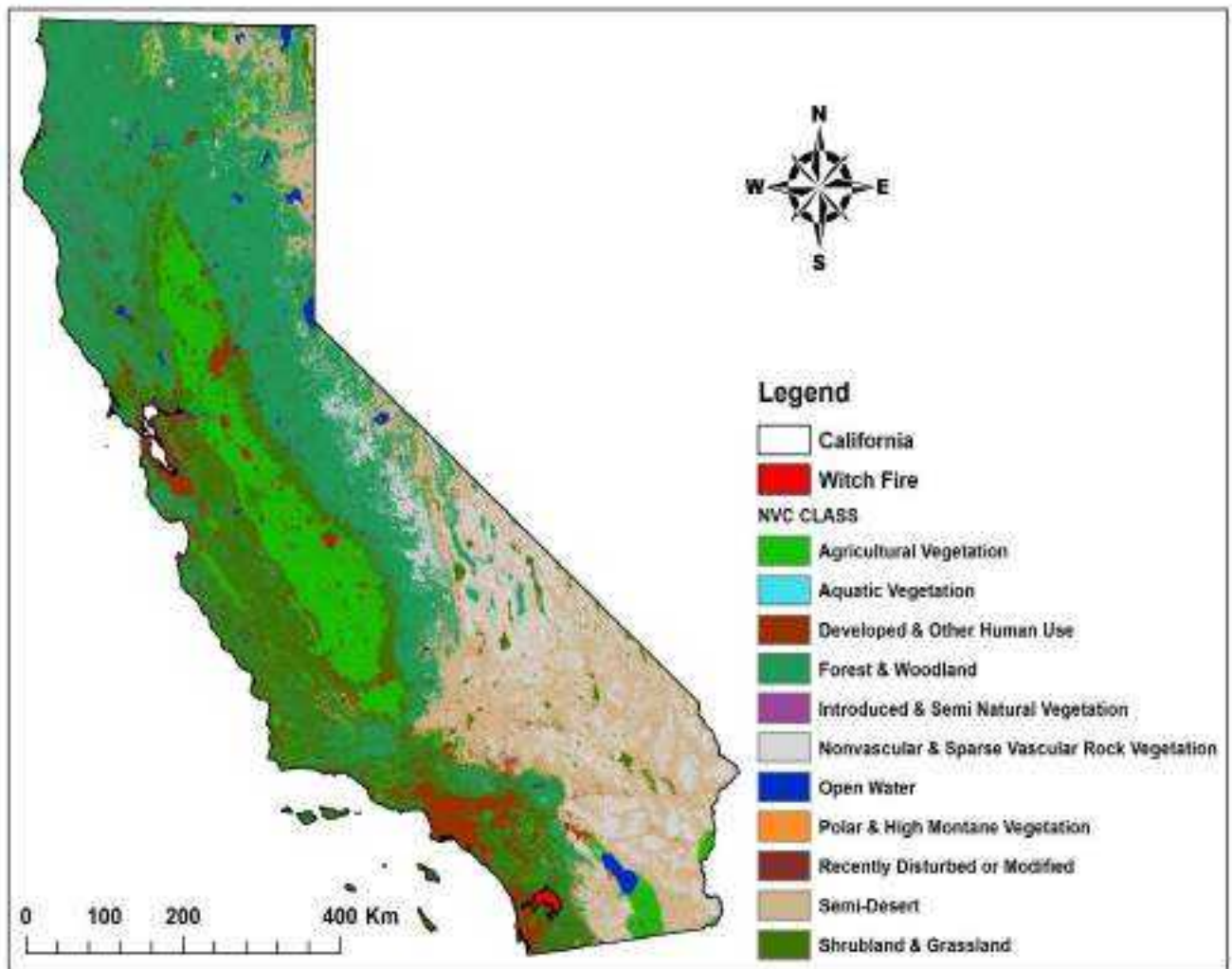


Figure 6 – GAP Land Cover map of California. Level of resolution in this land cover map is the NVC class.

Table 2. Top 10 most widely and frequently affected land cover in California (using the NVC division).

Land Cover	Area (Km2)	Frequency
Western North American Cool Temperate Forest	23277.89	11
Southwestern North American Warm Temperate Forest	16556.58	13
California Scrub	16524.38	14
California Grassland Meadow	6688.013	14
Western North American Cool Temperate Woodland Scrub	3711.324	14
Western North American Cool Semi Desert Scrub Grassland	3589.059	11
Developed Urban	2859.562	13
North American Warm Desert Scrub Grassland	1633.53	13
Southwestern North American Warm Temperate Flooded Swamp Forest	1203.808	13
Recently Disturbed or Modified	907.4941	11

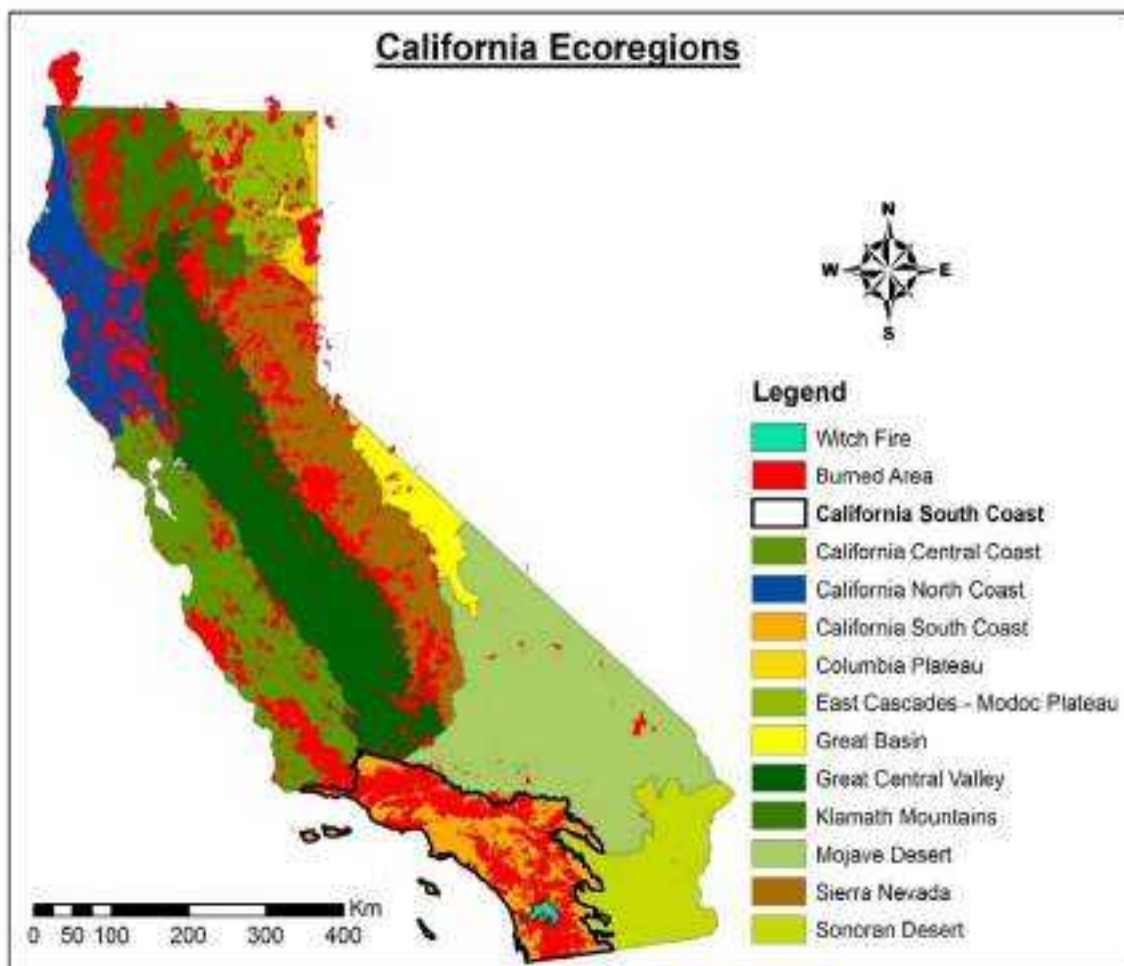


Figure 7. Distribution of historic wildfire events relative to Bailey's ecoregion

Table 3. The magnitude and Frequency distribution of wildfire in ecoregions.

Ecoregion	Area (Km2)	%	Frequency
California South Coast	19990.97	25	10
Sierra Nevada	12931.58	16.2	6
California Central Coast	11808.20	14.8	6
Klamath Mountains	10748.66	13.4	4
Great Central Valley	10352.92	12.9	7
California North Coast	6791.31	8.5	3
East Cascades - Modoc Plateau	4212.66	5.3	5
Mojave Desert	1276.56	1.6	5
Columbia Plateau	1148.91	1.4	3
Great Basin	625.52	0.8	2
Sonoran Desert	76.59	0.1	2

### Frequency Area Assessment

This study undertakes frequency-area analysis on the historic wildfire dataset to gain an understanding of how the Witch Fire’s areal extent compares with previous wildfires and to provide information on the magnitude-frequency relationship of Californian wildfires.

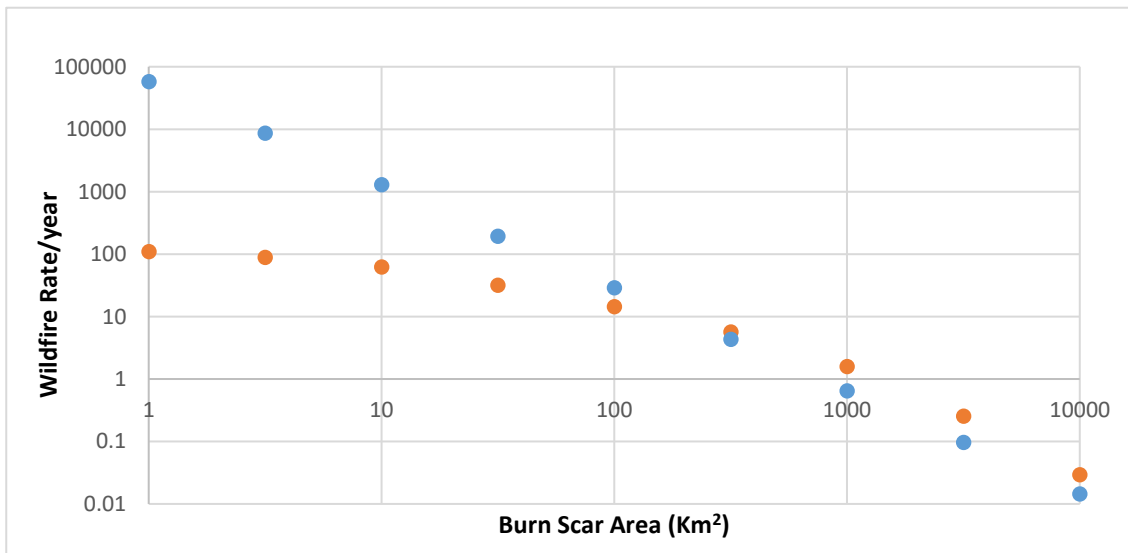


Figure 8. Comparism between the annual observed and predicted wildfire frequency in California

### Temporal Occurrence of Wildfires

The majority of severe wildfires in California has occurred in late summer and early Autumn seasons, between August and October, when temperatures were highest with low moisture vegetation conditions. For example, before the October 2007 Witch fire, the average

daytime temperature was 37.1°C and the average precipitation was 9.22mm, based on climate data from 1949-2013 (<http://www.ncdc.noaa.gov/data-access>).

On average there have been 136 wildfires per year in California; however there is considerable annual variability, as seen in Figure 9. Overall, there appears to be an increasing trend in frequency of fires as well as total annual burned area in California, with the more recent occurrence of mega-fires. Studies by Covington (2000) and Swetnam and Baisan (2003) have also analysed and identified the long timescale increase in the frequency and size of wildfires in the southwest region.

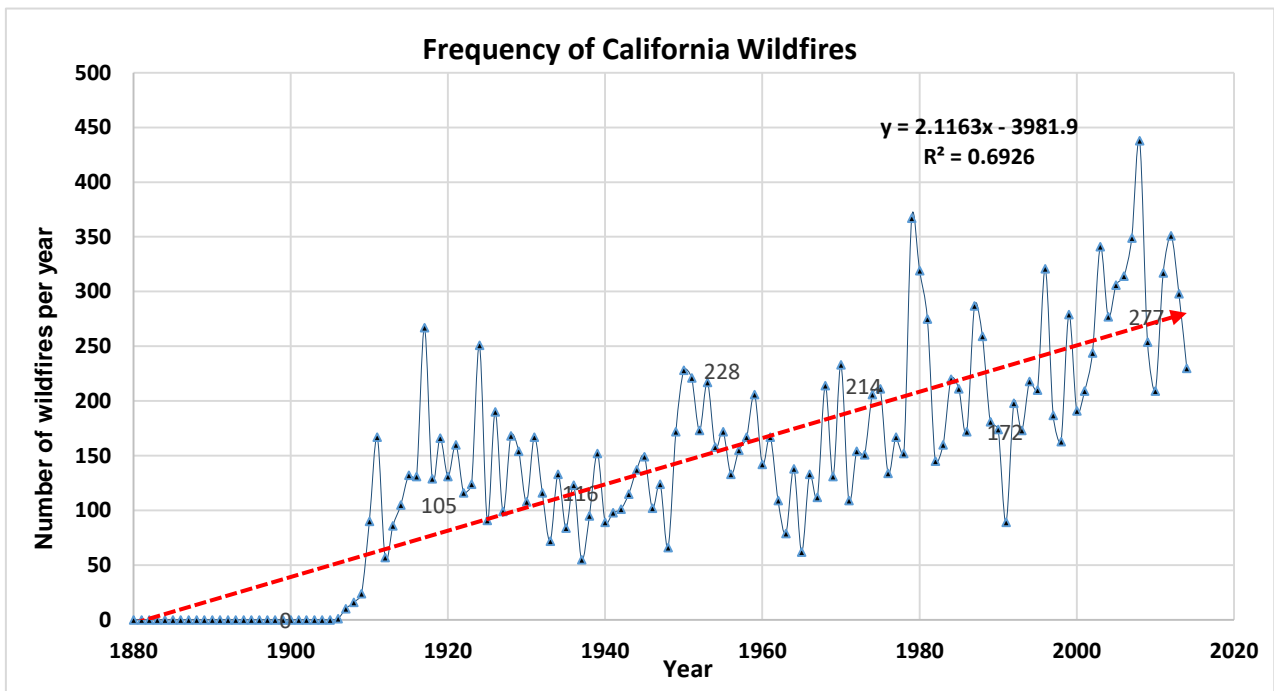


Figure 9. Temporal distribution of wildfires in California.

### Recurrence Interval

The return period analysis is conducted in order to understand the magnitude-frequency relationship of wildfires. To do this, a series of area bins were established and the numbers of wildfires greater than or equal to each bin were calculated. This was achieved by fitting a power law distribution to the wildfire dataset, a practice deemed statistically appropriate in this context since local and broad regional studies of wildfires in the U.S have indicated that wildfire event exhibit power-law behaviour (Malamud et al., 1998; 2005). Exceedance frequencies are fit using the equation:  $\text{freq } A_f \geq A = \alpha A^{-\beta}$ , where  $\alpha$  and  $\beta$  are constants and  $A$  is wildfire area. Power law fits are optimised using a mathematical solver that aims to minimise the sum of the squared residual values between observed and predicted annual wildfire rate. In order to improve the power law fit, values at the lower end of the distribution

are dropped incrementally until the best fit  $\beta$  value is found. From this, the expected recurrence interval of different sized fires was calculated using a Weibull-type equation (equation 3), where “ $r$ ” is the length of the dataset and “ $N$ ” is the total number of wildfires that are expected in the time period.

$$\text{Recurrence Interval (RI)} = \tau_R = \frac{\tau + 1}{N} \quad (3)$$

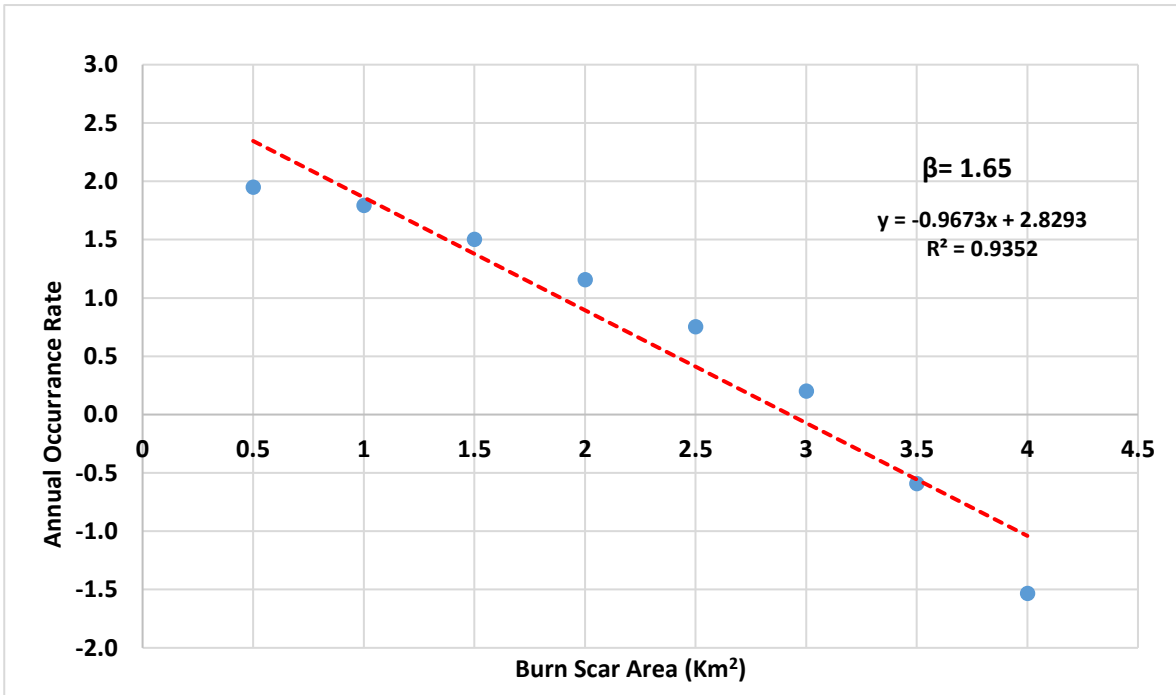


Figure 10. Fitted power-law distribution plotted against observed values in log-log space.

Table 4. Recurrence Interval

Burned Area (Km2)	Return Interval
2027.81	138
1036.71	35
655.88	14

### Fire Severity

The severity map of California South Coast ecoregion clearly shows that the region where the Witch fire happen is a very high risk region (figure 10). Further assessment of the severity of the 2007 witch fire event reveal that over 70% of the entire affected area experience at least a moderate-low burn, while 18% of the Witch area was affected by high severity fire.

Table 2 - Burn severity of the Witch Fire.

Burn Severity	Area (km <sup>2</sup> )	% of Total Witch Fire Area
High	122.64	18.1
Moderately high	166.32	24.5
Moderately low	188.24	27.8
Low	200.67	29.6
Unburned	0.14	0.02

California South Coast Ecoregion Fire Hazard Severity Map

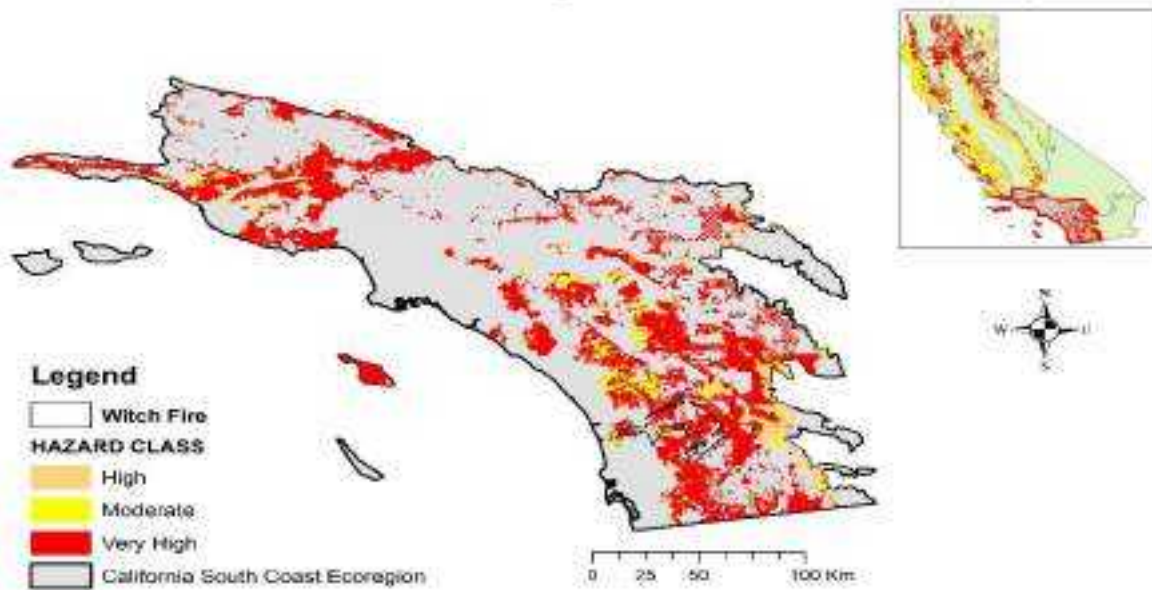


Figure 10. Risk map of California South Coast ecoregion showing wildfire severity within the Witch fire area

Spatial Distribution of Burn Severity of Witch Fire

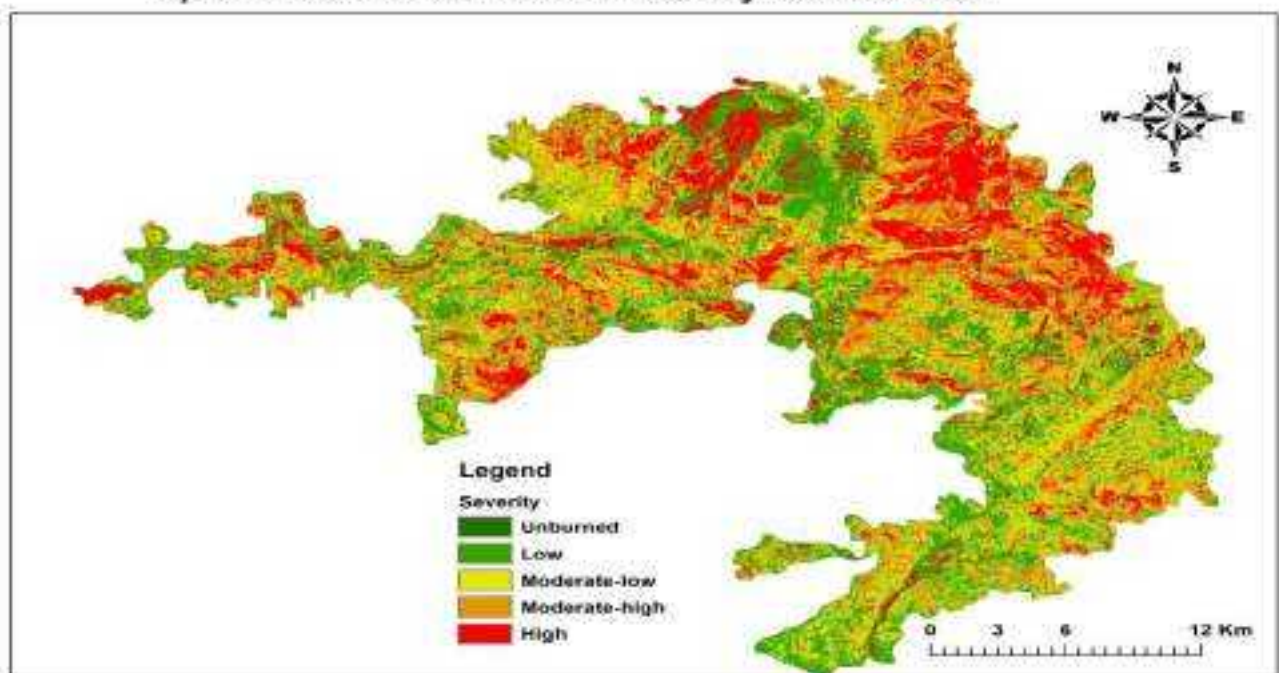


Figure 11 –Spatial distribution of burn severity of the Witch Fire.

## Sensitivity Analysis

In this section, a sensitivity analysis is carried out using land cover dataset, digital elevation Model (DEM) and climate information. This is done to identify fire trends and assess the degree to which the 2007 witch fire event could have been anticipated.

### Land Cover Vulnerability

The land cover characteristics of an area or ecoregion (Bailey, 1995, Malamud et al., 2005) gives an insight to the degree of susceptibility they can have to wildfire events. Different vegetation species possess varying degrees of resistance to adverse heat and severe drought conditions which determine its susceptibility to wildfire (Agee, 1991). Most parts of the western ecoregion of United States have drought imposed dry tree and plant species which area highly prone to wildfire risk. Visual inspection of Table 2 reveals that there is an overlap between the land covers that have burnt the most and those that have experienced the most repeat burns in the same locations. This suggests that the majority of the wildfires in California occurs on land that is prone to frequent burning.

Table 6 – Burn Severity extent of Most widely burned land covers during the Witch fire

	<b>California Scrub</b>	<b>Southwestern North American Warm Temperate Forest</b>	<b>California Grassland &amp; Meadow</b>	<b>Developed &amp; Urban</b>	<b>Herbaceous Agricultural Vegetation</b>
<b>Burn Severity</b>	<b>(Km2)</b>	<b>(Km2)</b>	<b>(Km2)</b>	<b>(Km2)</b>	<b>(Km2)</b>
High	73.29	19.89	11.96	5.92	3.69
Moderate-high	121.37	21.71	5.79	7.33	2.75
Moderate-low	116.91	23.87	19.72	12.98	4.01
Low	92.42	23.51	34.08	19.58	5.74
Unburned	0.013	0.006	0.004	0.023	0

### **Elevation, Slope and Aspect**

The elevation, slope and aspect of a particular area also effect fire severity and extent by immensely increasing wildfire susceptibility of a particular land cover (Falk et al., 2011; Rocca et al., 2014). Topography also affects fire behaviour by creating different microclimates which influence the moisture content of fuels, the air temperature, as well as the biogeographic distribution of plant species (Heyerdahl et al., 2001). High relief and mountainous areas experience very high temperatures, dry soil with drought induced plants (fuel), and heavy wind condition, which provide perfect condition for wild fire ignition and fast

The Witch Fire Hazard Assessment Report spreading (McArthur, 1967; Alexander et al. 2006). However, agricultural areas may be preferentially located on lowlands, and forests in slopes, which may hinder the understanding of the ultimate drivers of fire spread.

From the topography investigation, Figure 9 suggests that high burn severity coincides with higher elevations. For Instance, the mean elevations for low and high burn severities are 531m and 643m respectively. However, there is a large range for all burn severities, indicating large uncertainty. The majority of fires occurred on slopes between  $1.57^{\circ}$  -  $4.2^{\circ}$ , with higher severity burning tending to occur on lower slopes ( $<5^{\circ}$ ). This trend is expected given the influence of the Santa Ana dry wind which force wind movement downslope (Glickman, 2000). In terms of aspect (Figure 13), our result show that across all severity levels, the most affected aspect is the west facing slope. This was also an expected pattern considering the easterly direction of the Santa Ana wind in Southern California.

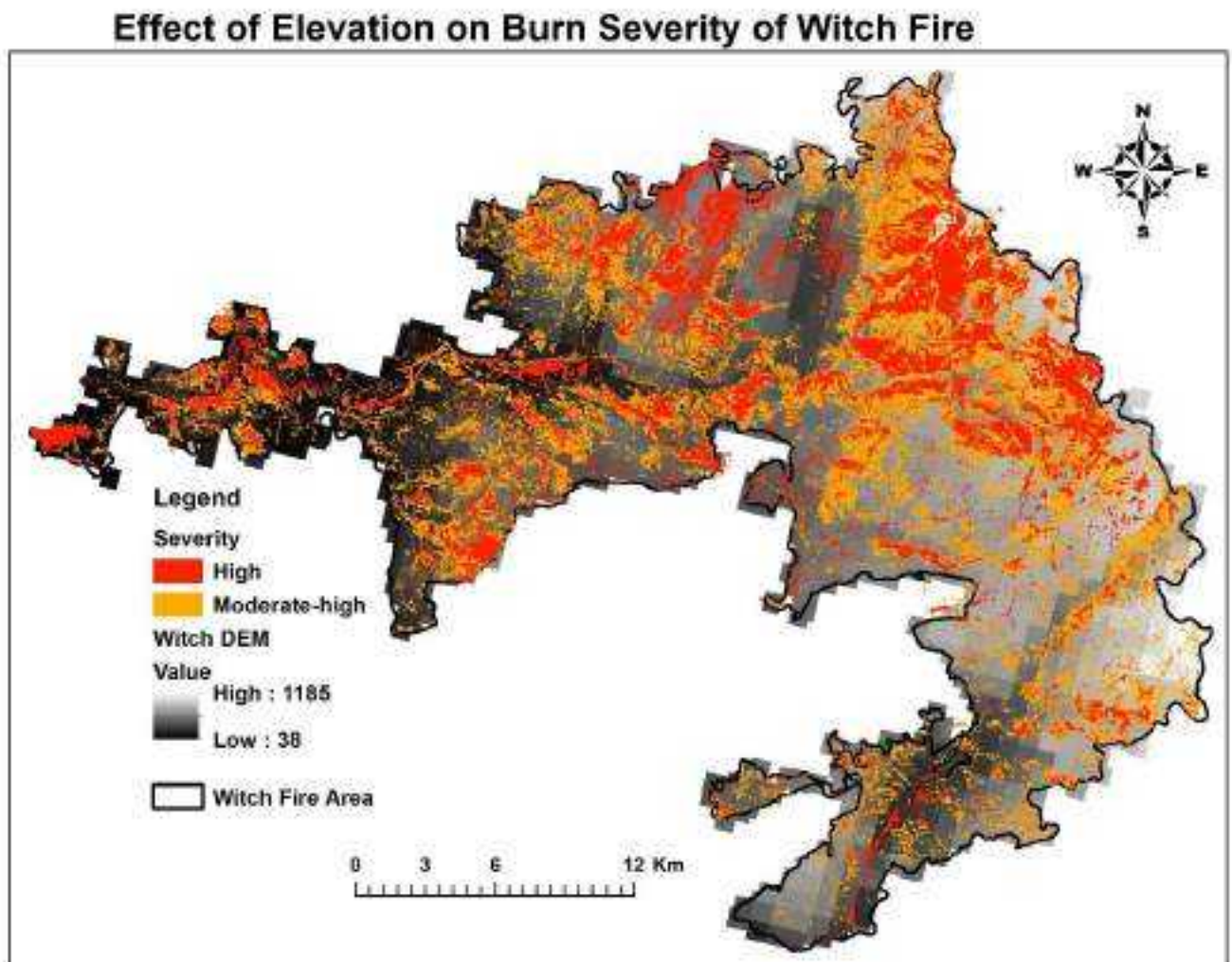
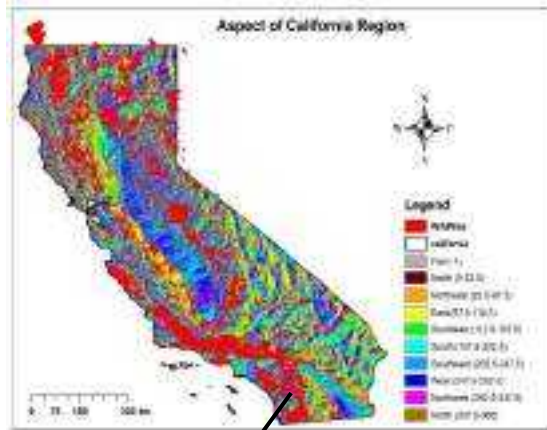
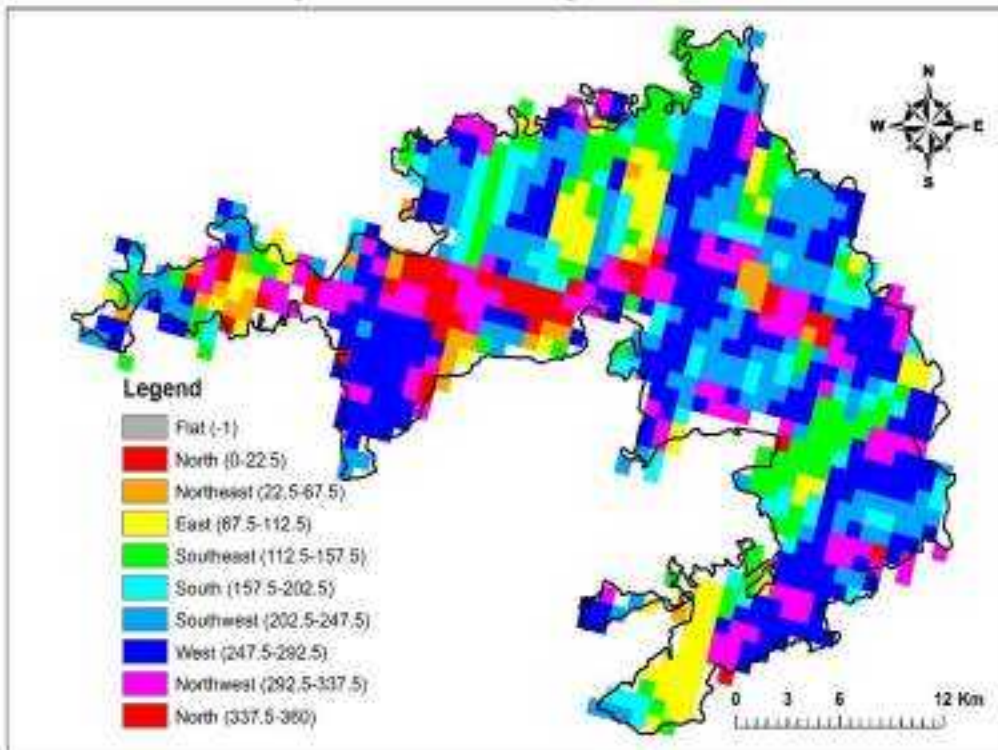


Figure 12 –Spatial distribution of burn severity in comparison to elevation in the Witch fire area



Effect of Aspect on Burn Severity of Witch Fire



Effect of Slope on Burn Severity of Witch Fire

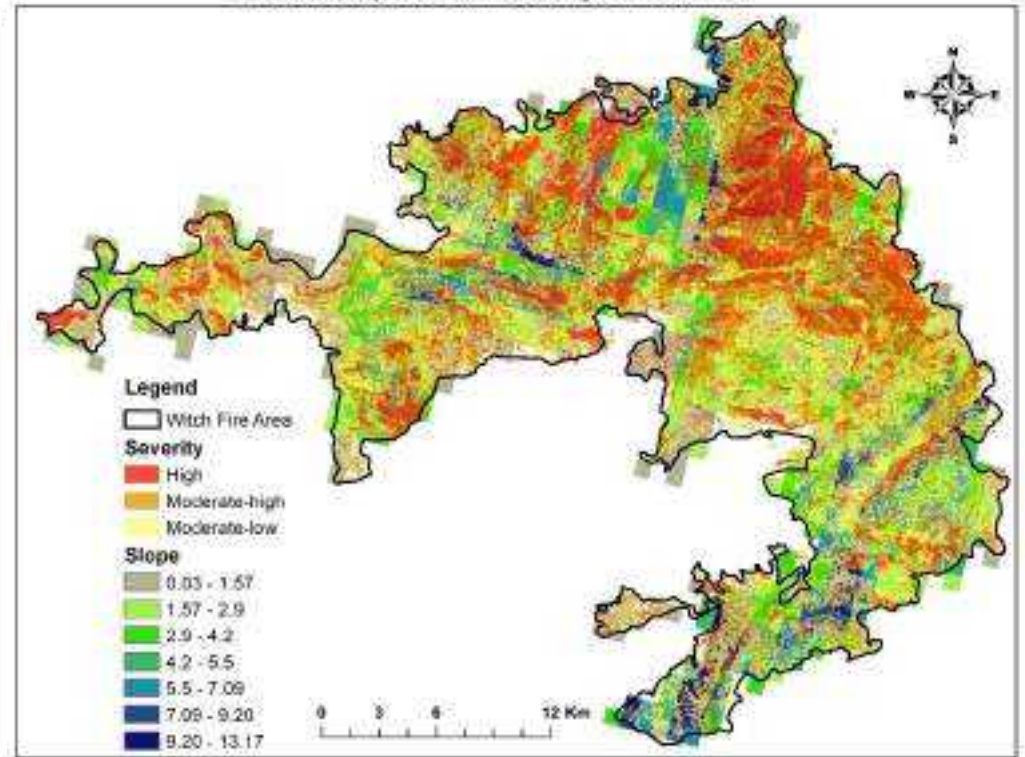


Figure 13 Aspect of Witch fire Area

Figure 14. Slope of Witch fire Area

### Climate Impact on Wildfire Behaviour

Climate variations in precipitation, temperature and wind system have also been identified as one of the factors responsible for the spatial variation in land cover burn frequency and wildfire severity particularly within the south western USA (Jeremy et al. 2009; Hurteau et al. 2014; Rocca et al. 2014). Wildfire and climate correlation studies by Taylor et al., 2008; Swetnam and Brown, 2011; Trouet et al., 2010, also show a significant correlation between wildfire events and impacting climate variations. Temporal variations in El Niño/Southern Oscillation (ENSO) in the region (Swetnam and Betancourt, 1990; Swetnam and Brown, 2011) can increase vegetation drought conditions in southern parts of California. The Dry Santa Ana winds has severe impact on Southern California fire as it promote the ignition and rapid spread of wildfires. Its greatest effect on fire tends to be in autumn, when vegetation has been dehydrated after a long dry summer (Raphael, 2003).

Climate investigation using data from (<http://www.ncdc.noaa.gov/data-access>) reveal that there was very low precipitation in the October 2007, worsened by high temperatures and strong Santa Ana wind with very low humidity value (Figure 15 and 16). This meteorological conditions provided a good condition for the witch fire ignition and rapid spread.

### ■ Peak Wind Speeds: October 20–31, 2007

October 21 highlighted

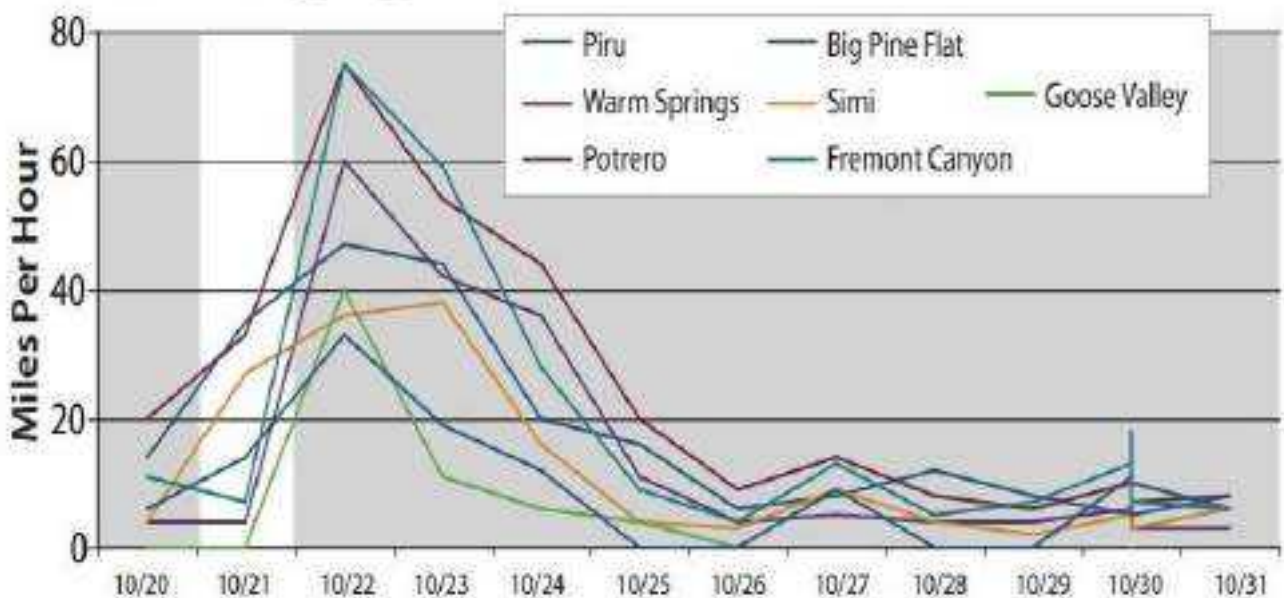


Figure 14. Peak wind speed at various weather stations in San Diego during the Witch fire in October, 2007

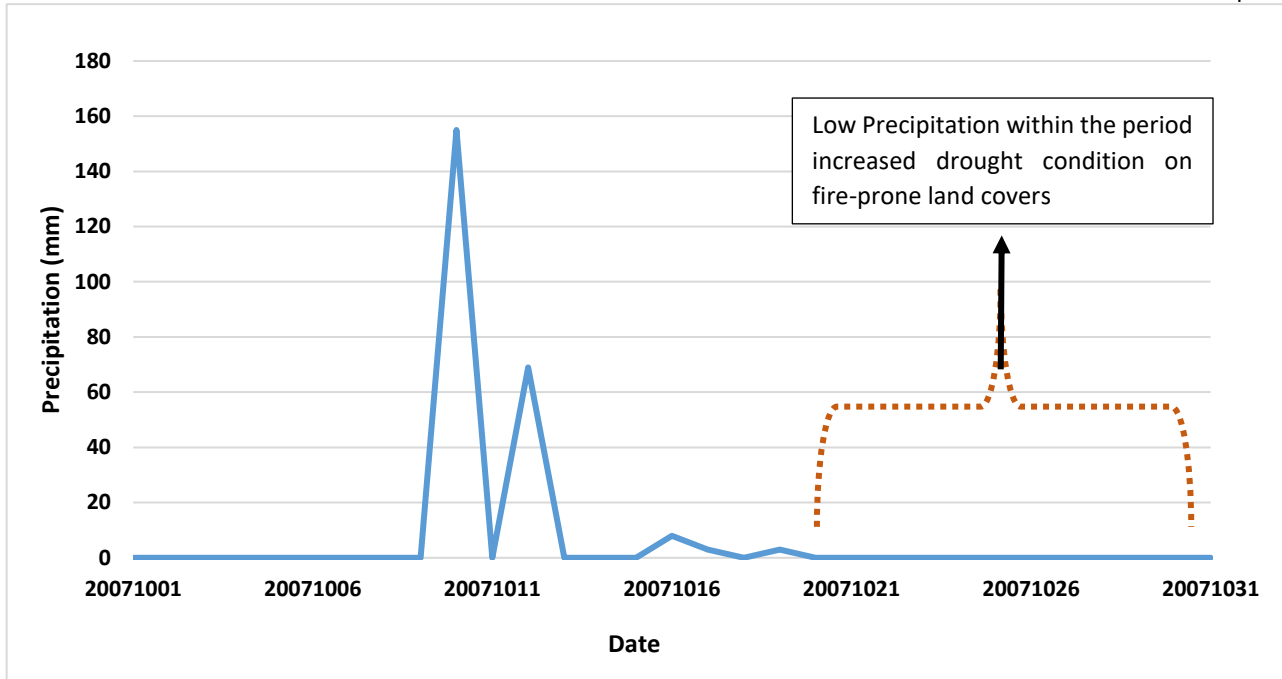


Figure 15. October precipitation in San Diego which increased the severity of the Witch fire in October, 2007

### Wildland-Urban Interface and Fire Management

Development in the wildland–urban interface (WUI) is also growing rapidly in San Diego where the Witch fire occurred (Figure 17). As noted in the US Fire Administration paper (2002) “In the Western US alone, 38% of new home construction is adjacent to or intermixed with the WUI.” The frequency of fires, particularly in times of drought, combined with increased exposure to wildfire risk has created a considerable management problem. Since  $\text{Risk} = \text{Hazard} * \text{Vulnerability} * \text{Exposure}$ , increased exposure by developing in proximity to wildlands increases wildfire losses.

Years of fire suppression have led to the recent increase in frequency of large fires (Brown and Cook, 2006; Swetnam and Baisan, 1996). Given this recent patterns in fire activity, more strategic fuel treatment and land use management approaches are adopted towards reducing fire severity and extent in California. Some of this methods include Buffer Zones, fuel treatment and .The California Department of Forestry and Fire Protection is tasked with the responsibility of reducing wildfire risk in the state. It mandate has been implementing through Vegetation Management Program. Increasing buffer zones and planting fire-resistant plan significantly reduces the wildfire risk particularly in Wildland Urban Interfaces.

### San Diego Wildland-Urban Interface

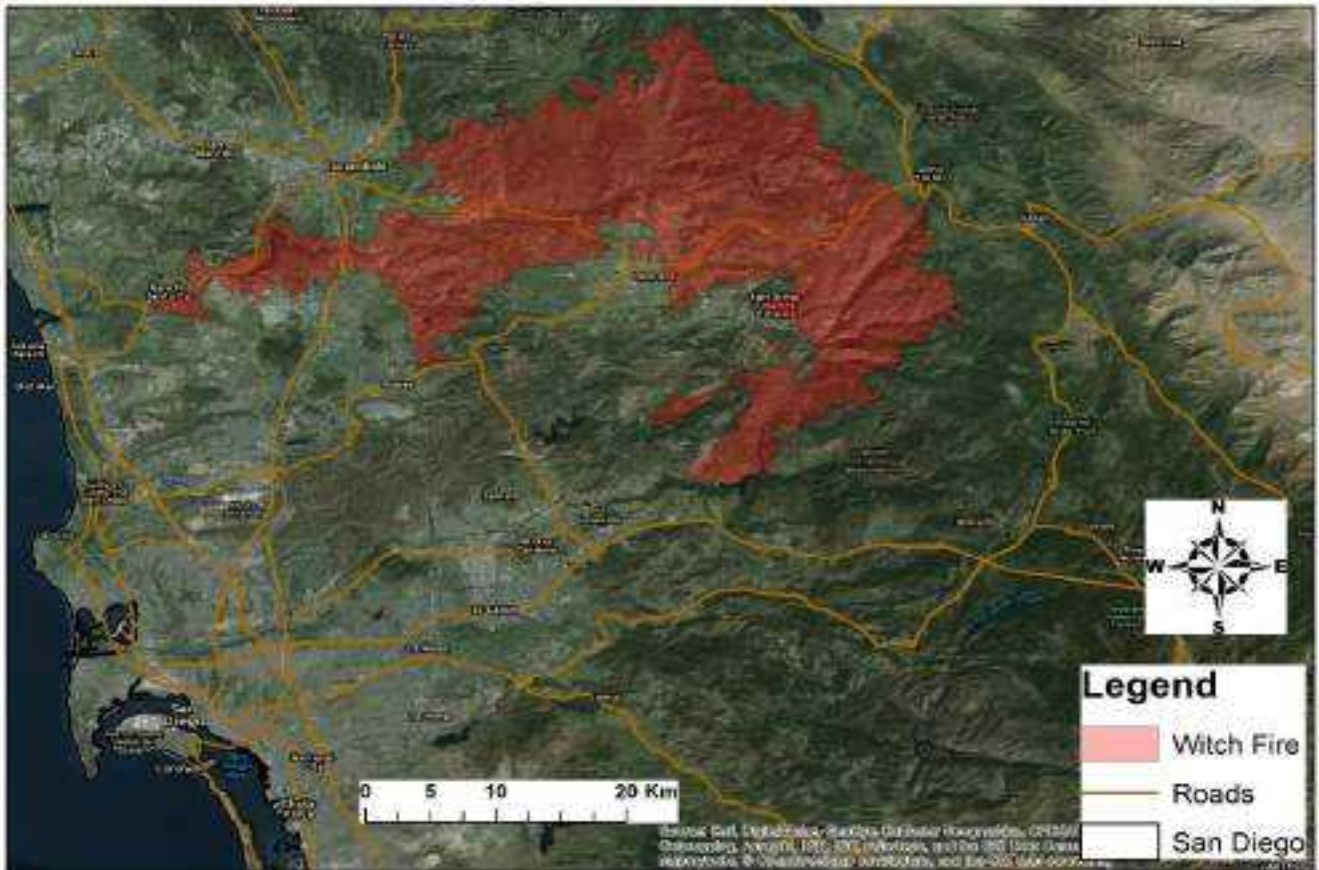


Figure 17. Wildland Urban Interface of San Diego city and the Witch fire



Figure 18- (a) Communities built with fire safe building practices survive the Witch fire. (b) Houses without good Buffer distance from Wildlands are destroyed by the Witch fire.

### Limitations

There are a number of potential sources of error in this study. Data quality and completeness was the most prominent limitation and possible bias of this study. In recurrence interval calculation, data length and quality are very crucial determinants, since the length of available

data evidently affect our understanding of a wild fire return period. Moreover, the fire record used in this analysis could have been incomplete or wrong. The spatial analysis approaches used in this study (Ripley's K and Getis Ord  $G_i^*$ ) also presents different bias depending on the scale over which it is applied (Songchitruksa and Zeng, 2010). For instance, the Getis Ord  $G_i^*$  hotspot analysis misrepresents some fire-prone areas in California South Coastal ecoregion as cold spot which in observation are area with large fires. Moreover the Getis Ord  $G_i^*$  hotspot analysis is a point-based analysis and only considered the frequency of events and not the magnitude (i.e. affected area). This could hinder our understanding of the spatial clustering nature of the wildfire events

However, the Landsat data resolution does not offer the best precision for dictating the spatial extent of wildfire events in California. Its ability to adequately capture areas of low burn severity is argued (Kolden and Weisberg, 2007). For instance, although the spatial resolution of Landsat is relatively good (30m) and cost-beneficial for research, the sensor may not detect significant changes in areas where the unburned canopy obstructs low-severity burning (Cocke et al., 2005).

The land cover data used in this study was categorised using Landsat images from 1999-2000. This land cover data does not provide a correct temporal representation of land cover over the time period, due to interferences such as urban sprawl and wildfires (Lowry et al., 2005). Similarly, although historical data is valuable for understanding past fire regimes, changes in fire management policies, demography and climate means that these patterns are unlikely to continue into the future.

## **Conclusion**

From the overlay analysis, it is evident that there has been past frequent wildfires in the southern parts of California. This spatial cluster of wildfire events is an indication that San Diego is a high wildfire risk area. The frequency of wildfire events in the area also gives a clear signal of how highly vulnerable the land cover is to wildfires. Haven experienced more severe events than the Witch fire, it was even very probable that an event of similar or greater magnitude was possible to occur in the future. A closer view of the event area is provided by wildfire severity hazard maps (Figure 11 and 12) created using data available before and after the occurrence of the Witch Fire.

These maps indicate that the contiguous regions of San Diego city, where the Witch Fire occurred was characterised by a concentration of high risk and fire-prone land cover that could have been identified by using even coarse resolution land cover data. Growth in the

WUI implies increased risk of property loss and increased costs of defending structures against wildfires when threatened. Given the identifiable concentration of well-connected high risk land covers as well as the prelude fire-igniting hot and dry climatic conditions, this study concludes that a large fire in the region should have been anticipated, although the exact timing of the wildfire may have been unpredictable given the range of potential ignition sources.

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Main Implementing Partner



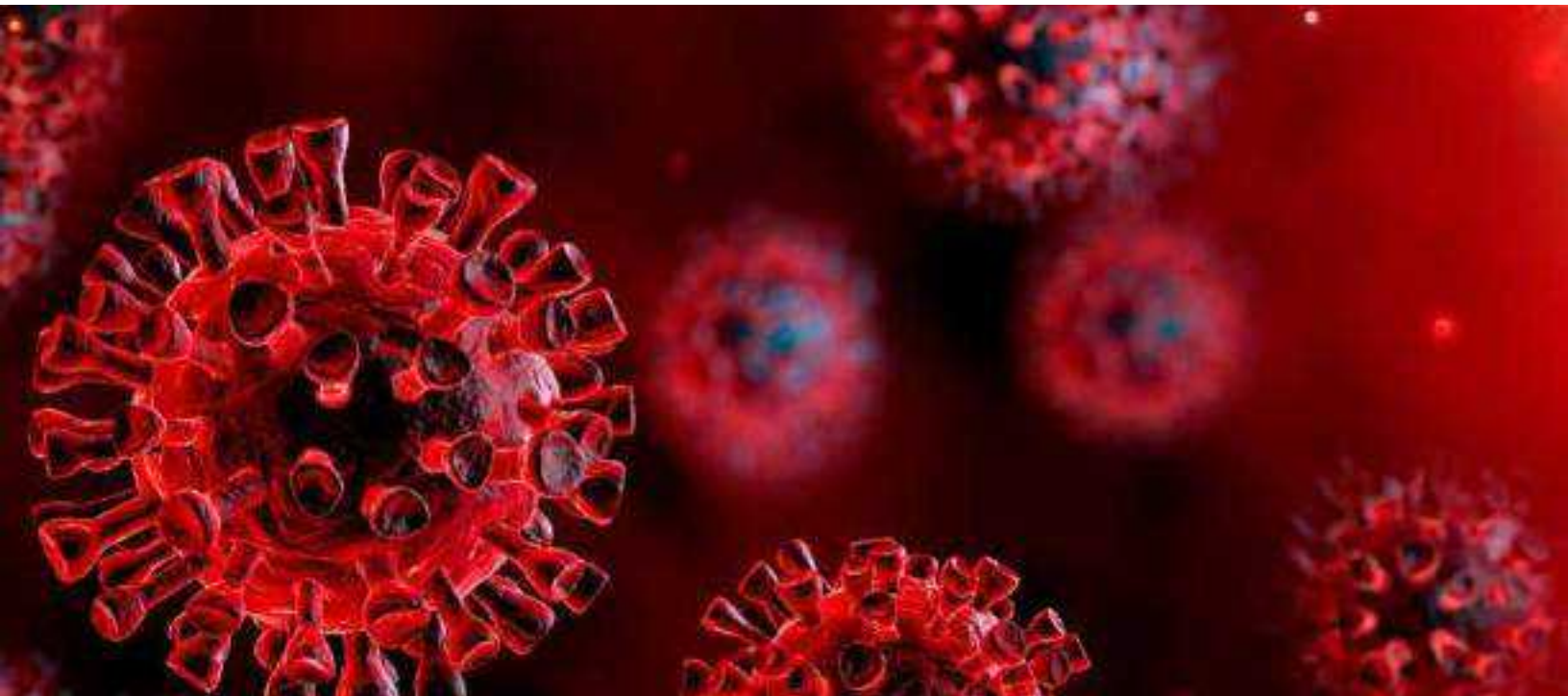
# COVID-19 SITUATION ANALYSIS

CRISIS TYPE: EPIDEMIC



**BANGLADESH**

**MARCH 2021**



**Better Data | Better Decisions | Better Outcomes**

The outbreak of disease caused by the virus known as Severe Acute Respiratory Syndrome (SARS-CoV-2) or COVID-19 started in China in December 2019. The virus quickly spread across the world, with the WHO Director-General declaring it as a pandemic on March 11th, 2020.

The virus's impact has been felt most acutely by countries facing humanitarian crises due to conflict and natural disasters. As humanitarian access to vulnerable communities has been restricted to basic movements only, monitoring and assessments have been interrupted.

To overcome these constraints and provide the wider humanitarian community with timely and comprehensive information on the spread of the COVID-19 pandemic, iMMAP initiated the *COVID-19 Situational Analysis project* with the support of the USAID Bureau of Humanitarian Assistance (USAID BHA), aiming to provide timely solutions to the growing global needs for assessment and analysis among humanitarian stakeholders.

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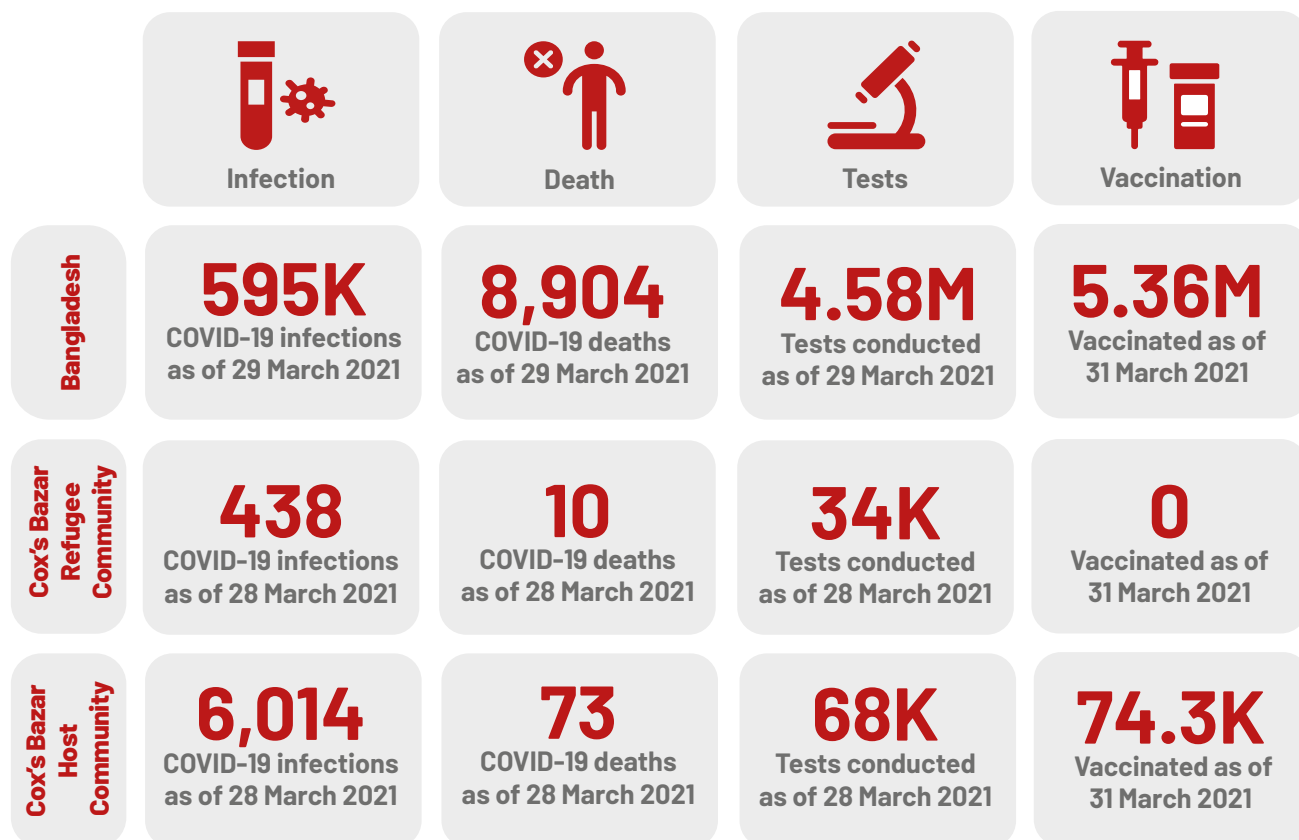
## 6. COVID-19 Impact and Humanitarian Conditions

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# EXECUTIVE SUMMARY / HIGHLIGHTS

**Figure 1. Overall COVID-19 data for Bangladesh** (Source: WHO sitreps, HEOC, Control Room, IEDCR, and DHIS2)



Since March 2021, Bangladesh has been experiencing a surge in COVID-19 cases. After months of gradual decrease, cases have increased by 350% in March compared to the previous month. Deaths also climbed to 496 from 281 in February. In response to the new COVID-19 wave, the government has imposed new regulations and movement restrictions on the public.

The national vaccination campaign is facing some challenges due to a recent temporary halt on exports by the Indian government of the COVIDShield, the Oxford-Astrazeneca vaccine produced at Serum Institute of India. As of 31 March, the health authorities have administered more than five million first doses of the vaccine.

Following the national trend, COVID-19 cases in Cox's Bazar are increasing, especially among the host community, with Cox's Bazar being one of the 31 most affected zones in the country. While vaccination campaigns for international humanitarian workers have started in Cox's

Bazar, campaigns for the Rohingya refugees are planned to start in the coming weeks. However, plans are expected to face some setbacks due to the massive fire in camps 8E, 8W, 9, and 10 which destroyed several vaccination points.

A massive fire broke out on 22 March in the Kutupalong mega camp, affecting camps 8E, 8W, 9, and 10. The fire left thousands of people temporarily displaced after damaging more than 10,000 shelters. The fire also destroyed shops, nutrition and distribution centers, learning centers, and health and WASH infrastructure. The impact of the fire is covered by the findings from the [Inter-Sector Coordination Group \(ISCG\) Rapid Joint Needs Assessment](#) conducted immediately following the fire.

The concern over financial burden has increased among the Rohingya community in the first two months of 2021. Despite continued humanitarian assistance to refugee households largely at the same scale prior to COVID-19, vulnerability of the Rohingya refugees, including

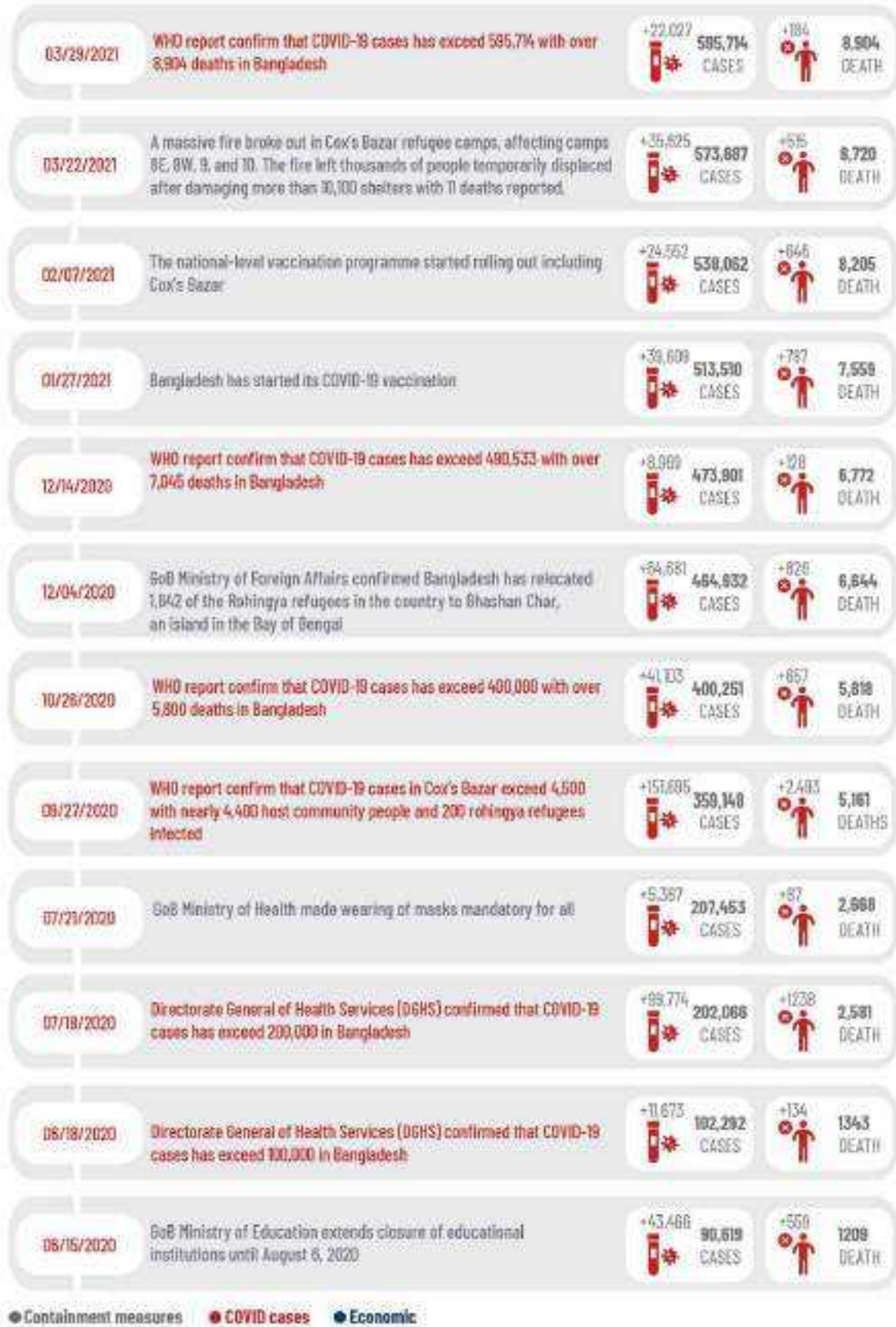
economic vulnerability, and adoption of high risks coping mechanisms, has increased and is likely to be increasing their financial concerns.

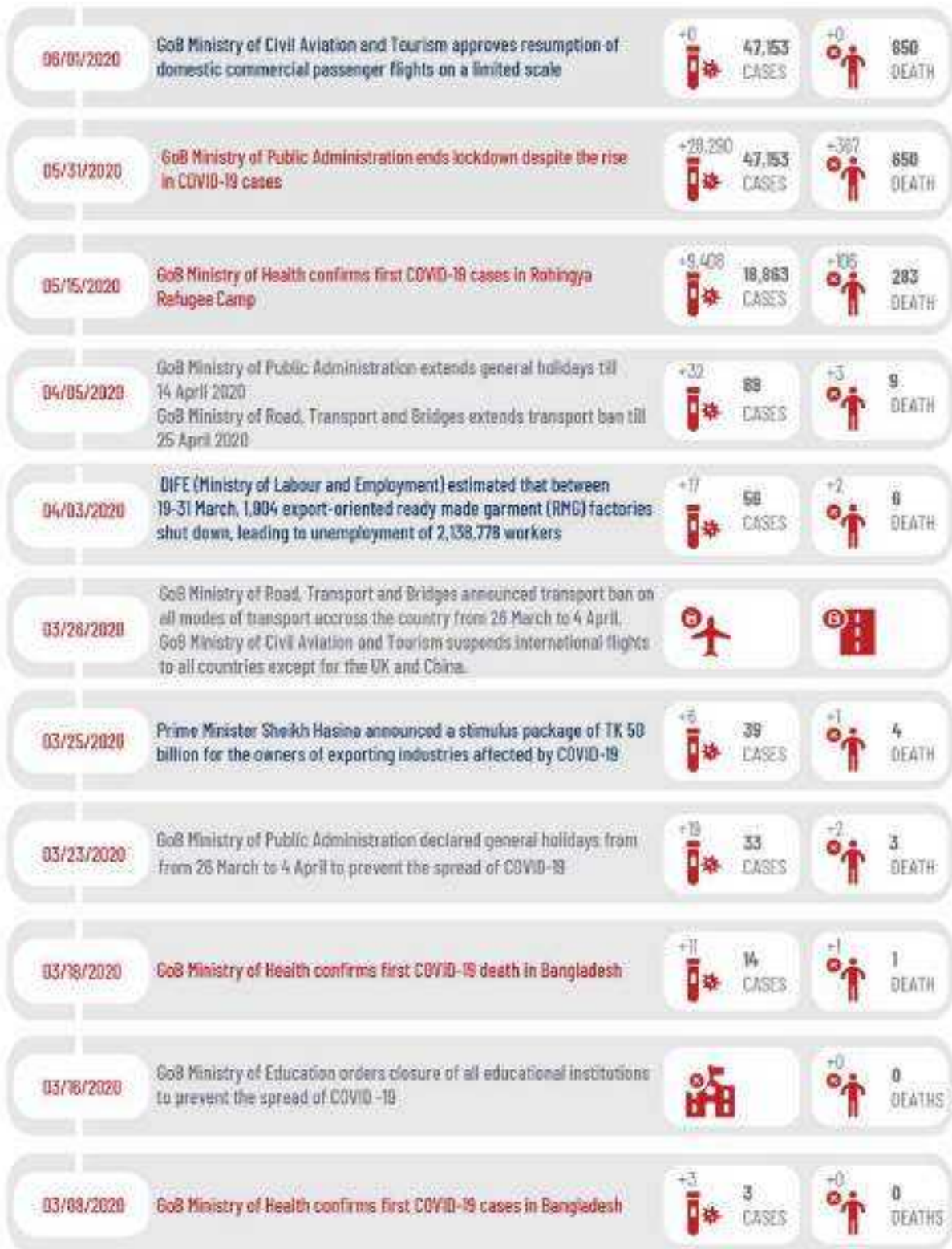
Schools and other learning facilities continue to be closed. A recent assessment of the Education Sector for the Rohingya and the host communities by [REACH](#) highlights the many challenges in the availability and accessibility of distance learning for students from both communities. Lack of electricity, internet, and technological devices contributes to the inability of students to access quality education. However, financial constraints remain one of

the most reported challenges for the host community. For the refugee community, existing problems and barriers before the pandemic add further challenges for students.

Protection risks remain high, as result of the massive fire which damaged a substantial number of child and women-friendly spaces in the camps, and left many women and children sleeping in unsafe areas and some children unaccompanied. The continued school closures also expose children to increasing risks such as child labor, child marriage, kidnapping, and human trafficking.

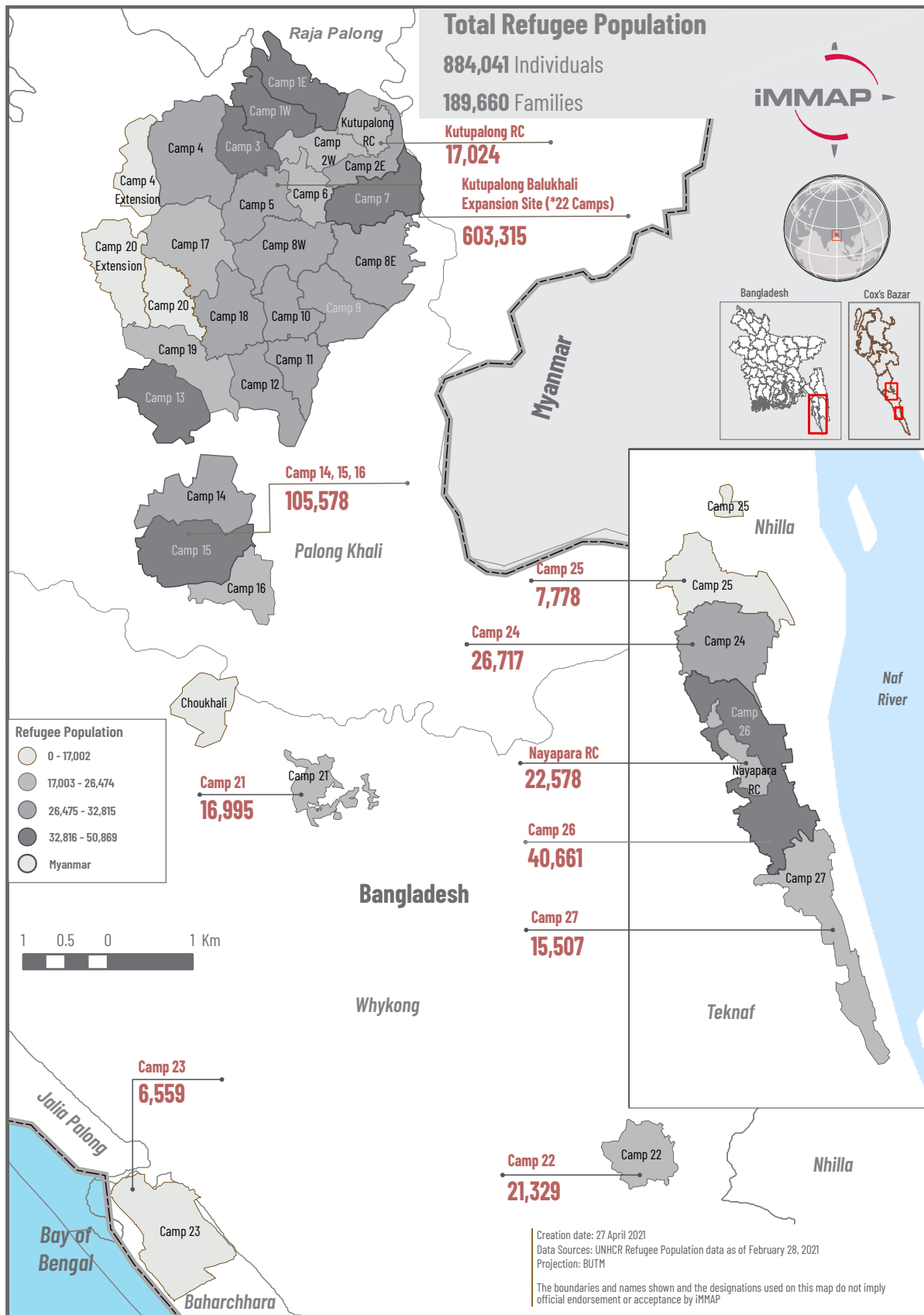
**Figure 2. Timeline of Major Events**





● Containment measures ● COVID cases ● Economic

**Figure 3. Refugee population by camp as of 31<sup>st</sup> March 2021** (Source: [UNHCR 31/03/2021](#))



# CONTEXT - ECONOMIC

## Socio-economic Impact and Poverty Level in Bangladesh

About a year after the first cases of COVID-19 emerged in Bangladesh, the country is yet on the brink of another socio-economic disruption due to another lockdown following the fresh surge of cases and fatalities. The pandemic has already unsettled Bangladesh's long-standing macroeconomic stability. Movement restrictions are expected to once again disrupt economic activity. Fiscal risks include a shortfall in international support for COVID-19 vaccination programs, cost overruns on major infrastructure projects, and delays in tax reforms. In the event that external financing for the Rohingya response declines, additional public expenditure may be required. In turn, higher borrowing from domestic banks could constrain the availability of credit to the private sector. Challenges in the implementation of credit and social protection programs under the government's economic stimulus program could also undermine the recovery. External risks stemming from the fragile global economic recovery, include weak demand for ready-made garments (RMG) products and reduced employment of Bangladesh's overseas workforce. Low public debt levels and a low risk of public debt distress provide some buffer, although risks remain tilted to the downside. COVID-19 has intensified the needs of vulnerable groups, including informal and returning overseas migrant workers. The pandemic-related economic effects threaten to undermine years of steady progress in poverty reduction in Bangladesh ([World Bank 12/04/2021](#)).

The government's [Report on SDG's](#) in June 2020 showed that the COVID-19 pandemic decreased employment opportunities for the poorest, setting back progress in reducing the poverty rate which had fallen from **40%** to **20.5%** between 2005 to 2019, before increasing to **29.5%** in 2020. Despite the economic rebound in the second half of 2020 through a recovery in trade and remittances, the persistent negative impact of the pandemic on the economy resulted in the overall decline of the economic growth of the country. Bangladesh, the fastest growing economy of the South Asian region, experienced a **50%** reduction in economic growth, from **8.4%** in 2019 to **4.3%** in 2020 ([UNDESA](#)).

The COVID-19 pandemic is poised to translate into a substantial economic cost in the long run especially with the prolonged school closures. A recent simulation note by the [World Bank](#) quantified the loss of learning in terms of labour market returns and indicated that the

average Bangladeshi student will face a reduction in annual earnings of between **\$198** to **\$335** once they enter the labour market, which represents between **4%** and **6.8%** of annual income. In the intermediate scenario, aggregating for all students, this would cost the Bangladesh economy to lose **\$89 billion** in **Gross Domestic Product (GDP)** annually.

## Government Fiscal and Monetary Policy

The government has been implementing various short, mid-term, and long-term plans giving priority to attaining high growth and maintaining macroeconomic stability. To offset the shock from COVID-19, the government has thus rolled out some 23 stimulus packages involving a total sum of **BDT. 1,24,053 crore** [**\$15.5 billion**], amounting to 4.4% of the country's **Gross Domestic Product (GDP)** ([Dhaka Tribune 20/01/2021](#)). The **FY21** Budget includes higher allocations for health, agriculture, and social safety net programs, although effective targeting remains a challenge. As a precautionary measure, the government has decided that 25% of budgetary allocations for development projects will be placed on hold, affecting low-priority projects. In January 2021, the government increased the COVID-19 Emergency Response and Pandemic Preparedness Project costs by **BDT. 56.6 billion** [**\$666.7 million**] mostly reflecting the procurement, preservation, and distribution of vaccines. The government has announced two additional stimulus packages **BDT. 15 billion** [**\$176.7 million**] for the micro and cottage entrepreneurs and **BDT. 12 billion** [**\$141.36 million**] cash assistance program for the disadvantaged elderly people, widows, and female divorcees ([IMF 06/04/2021](#)).

The Export Development Fund was raised from **\$3.5 billion** to **\$5 billion**, with the interest rate slashed to **1.75%** and the refinancing limit increased. [Bangladesh Bank](#) has created several refinancing schemes totaling **BDT. 390 billion** [**\$4.6 billion**], a 360-day tenor special repo facility, and a credit guarantee scheme for exporters, farmers, and SMEs to facilitate the implementation of the government's stimulus packages. Bangladesh Bank also announced an agriculture subsidy program that will be in place until mid-2021. In addition, the government has taken measures to delay non-performing loan classification, relax loan rescheduling policy for NBFIs, waive credit card fees and interests, suspend loan interest payments, relax credit risk rating rules for banks, extend tenures of trade instruments, and ensure access to financial services. Recently, the bank imposed an additional **1%** general provision against

loans that have enjoyed deferral/time extension facilities.

### Impacts on Trade and Labor Market

As one of the countries in South Asia most exposed to global economic conditions, with a high share of foreign trade and dependence on remittances, Bangladesh is predicted to enjoy a stronger rebound in 2021. However, the recovery is now facing significant risks with further lockdowns. The growth pathway seems uneven and economic activity well below pre-COVID-19 estimates, as many businesses need to make up for lost revenue and millions of workers, most of them in the informal sector, still reel from job losses, falling incomes, worsening inequalities, and human capital deficits ([World Bank 12/04/2021](#)).

Recent [World Bank](#) updates on Bangladesh indicate exports fell by 16.8% in FY20 due to supply chain disruptions and depressed external demand for RMG (which still made up 83% of the country's merchandise exports in FY20). Imports also declined by 12.1%. Lower industrial activity limited the demand for intermediate goods. A depressed business outlook and low investment growth weighed on capital goods and machinery imports which declined by 33.8% in FY20. As a result, the trade deficit widened by 7.7% in FY20. In the first eight months of FY21 (July 2020 to February 2021), merchandise exports began to recover gradually, but total merchandise exports were still 1.1% below what they were over the same period of FY20. Likewise, the recovery in imports has also been slow, with total imports declining by 6.8% in the first seven months of FY21 (July to January). Retail sales data from key export markets suggest that the apparel sector continues to struggle, with ongoing movement restrictions, particularly in Europe.

### Employment and Labor Market

Bangladesh experienced a significant rise in unemployment among low-income groups, where 90% of the jobs are in the informal sector. A significant portion of these is the daily wage earners such as transport workers and vehicle drivers, street hawkers and vendors, small businesses, tea-stall or food stall owners, and daily labourers. The impact on job losses has been worse in the Micro, Small, and Medium Enterprises (MSMEs) sector which plays a critical role in providing jobs, employing 20.3 million people in Bangladesh (about 20% Bangladesh adult population). A staggering 37% of Bangladesh's workers have lost their jobs, temporarily or permanently, and 58% of firms have reduced their working hours. More jobs may be at risk as the end to the pandemic is not insight ([World Bank 18/02/2021](#)).

A recent study result from the International Food Policy Research Institute (IFPRI) and Cornell University shows, in between June 2020 and January 2021, the proportion of pandemic-induced unemployment witnessed a 70% decline. In June 2020 the month after the government-announced lockdown in Bangladesh ended 17.2% of main household earners of a sample population in rural Bangladesh reported being unemployed, but that percentage dropped to only 5.1% in January 2021 ([Bangla Tribune 10/04/2021](#)). Migrant returnees are also vulnerable to a number of challenges such as the current unemployment, ill health, debt repayment aside from battling with the social stigmas related to return ([IOM 08/03/2021](#)).

### Socio-economic Profile and Poverty Level in Cox's Bazar

Cox's Bazar district had a high level of poverty even before the pandemic and has among the lowest development indicators in the country before the 2017 refugee influx ([UNICEF 13/08/2020](#)). According to the Bangladesh Bureau of Statistics, Cox's Bazar is one of the lowest-performing districts in Bangladesh in terms of education and skills training, with about 33% of the population living below the poverty line ([IOM 26/02/2021](#)).

Adding to that education deprivation and poverty, the region has been facing the impact of COVID-19 in the local economy. Almost 700,000 people have lost their source of income, since the COVID-19 outbreak in mid-March 2020. About one year after the COVID-19 lockdowns in Cox's Bazar, most people still have limited access to jobs and women are less likely than men to secure any job at all. Adding to the struggle for jobs are the many migrants forced back to Cox's Bazar due to job losses overseas. According to the Ministry of Expatriates Welfare and Overseas Employment, over 400,000 migrant workers have returned to Bangladesh since March 2020. The return of the migrants heightened competition over the already scarce livelihood opportunities and contributed to the collapse of the local economy due to their inability to pay back loans ([IOM 26/02/2021](#)).

For the refugees within the camp setting, the contraction of the local economy and the reduced humanitarian footprint as a consequence of the containment measures had a severe impact on their already unstable local income-generating and self-reliance activities. Although the findings from Refugee influx Emergency Vulnerability Assessment ([REVA 4](#)) indicated some recovery in the second half of 2020, the findings also showed an increase in economic vulnerabilities in comparison to 2019.

# COVID-19 EPIDEMIC OVERVIEW

## Epidemic Overview at National Level

### Surge in both caseload and fatalities raises concerns

Throughout the month of March, Bangladesh experienced a surge in caseload and deaths with the monthly incidence (confirmed number of new cases) reported at **49,498** spiking from **11,077** in February 2021. At the same time, the monthly death toll rose to **496**, up from **281** in the previous month. As of 28 March 2021, according to the Directorate General of Health Services (DGHS) there were **595,714** COVID-19 cases confirmed by RT-PCR, GeneXpert, and

Rapid Antigen tests including **8,904** related deaths (CFR **1.49%**). The trend remained alarming as in the last week of March (epidemiological week 12, 2021), new cases reported an **84.2%** increase with a **47.6%** increase in weekly new deaths compared to the previous week. The weekly average test positivity rate (TPR) is **13.8%** is also up. Bangladesh remained among the top 33 countries and accounts for **0.47%** of the COVID-19 cases of the world. The number of tests conducted is increasing but still, concerns remain as it is only about 106 in a million, leaving a huge population potentially exposed yet undetected ([WHO 29/03/2021](#)).

**Figure 4.** Total tests, COVID-19 cases, and deaths for Bangladesh (Source: [WHO sitreps](#))

Bangladesh	02-Nov	30-Nov	31-Dec	31-Jan-21	1-Mar-21	29-Mar-21
Cases this month	50,433	53,944	48,578	21,629	11,077	49,498
Total confirmed cases	410,988	464,932	513,510	535,139	546,216	595,714
Tests this month	440,320	410,999	454,897	424,124	392,305	544,803
Total tests conducted	2,361,702	277,2701	3,227,598	3,651,722	4,044,027	4,588,830
Deaths this month	773	678	915	568	281	496
Total deaths	5,966	6,644	7,559	8,127	8,408	8,904

### Mass vaccination continues despite supply uncertainty and pockets of hesitancy

As of 31 March 2021, the health authorities have administered more than **5 million** first doses of the Oxford-Astrazeneca vaccine to people across the country of which, about **3 million** were men and **2 million** were women ([DGHS 31/03/2021](#)). The government has planned for a five-stage vaccination programme targeting over **138 million** people as the pathway to eliminating COVID-19 as a public health threat in Bangladesh. However, the ongoing mass vaccination program has been facing challenges as the Indian government has recently put a temporary halt on exports of the coronavirus vaccine as it plans to ramp up its own immunisation

drive ([BDNews24 29/03/2021](#)). Bangladesh launched the COVID-19 vaccination with the **Oxford-Astrazeneca** vaccine produced by Serum Institute of India, from **27 January 2021**. The national-level vaccination programme started rolling out on **7 February 2021**, comprising 46 vaccination centres in the capital and around 1000 across the country ([WHO 16/02/2021](#)). So far, **9 million** doses of the privately acquired vaccine have been received by Bangladesh. At the same time, [The Government of Bangladesh](#) has been exploring multiple sourcing for vaccines while reporting that Bangladesh has joined **COVAX AMC** countries to secure COVID-19 vaccines. As per the **COVAX** allocation, Bangladesh expects to receive vaccine doses equal to **20%** of its population (**34,561,877**) followed by additional doses equal to at least **40%** of its

population (**69,123,754**) based on the availability of vaccine and weighted allocation. But, the expected timeline might still challenge the uninterrupted demand and supply continuation of the ongoing vaccination drive.

A national web portal has been developed and people have been asked to register by visiting the official [website](#) to receive the vaccines. Emergency hotline numbers for information on vaccines are also in place. But widespread misconceptions & rumors created some significant hesitancy among people about taking vaccines. This caused Bangladesh's vaccination drive to have a gradual declining trend. Public health experts addressed that they attributed the lower number of vaccinations in recent days to the lack of coordination among government entities and the virtually non-existent awareness campaign. Some **133,396** people had been vaccinated every day on average and the health authorities said they had the capacity to inoculate over **350,000** people daily ([Dhaka Tribune 25/03/2021](#)).

### **New variants, limited capacity, and public resistance keep the challenges high.**

Health experts suggested poor adherence to health safety rules as the root cause of the surge in the virus infection rate in the country. The detection of new variants, notably the more infectious UK and South African variant has also become a cause of concern ([Dhaka Tribune 23/03/2021](#)). Following the recent upsurge of COVID-19 transmissions and fatalities in the country, the government imposed a fresh set of 18 restrictions effective from 28 March 2021, including a ban on all public gatherings in areas with high rates of infections. Gatherings at all tourist spots, as well as social, political, and religious events are also being limited. However, the directive appears to have had little effect as the public continues to flout restrictions, even resisting aloud in some cases. Lack of adherence to basic public health measures like wearing masks and social distancing has become common ([Dhaka Tribune 02/04/2021](#)).

## **Epidemic Overview in Cox's Bazar**

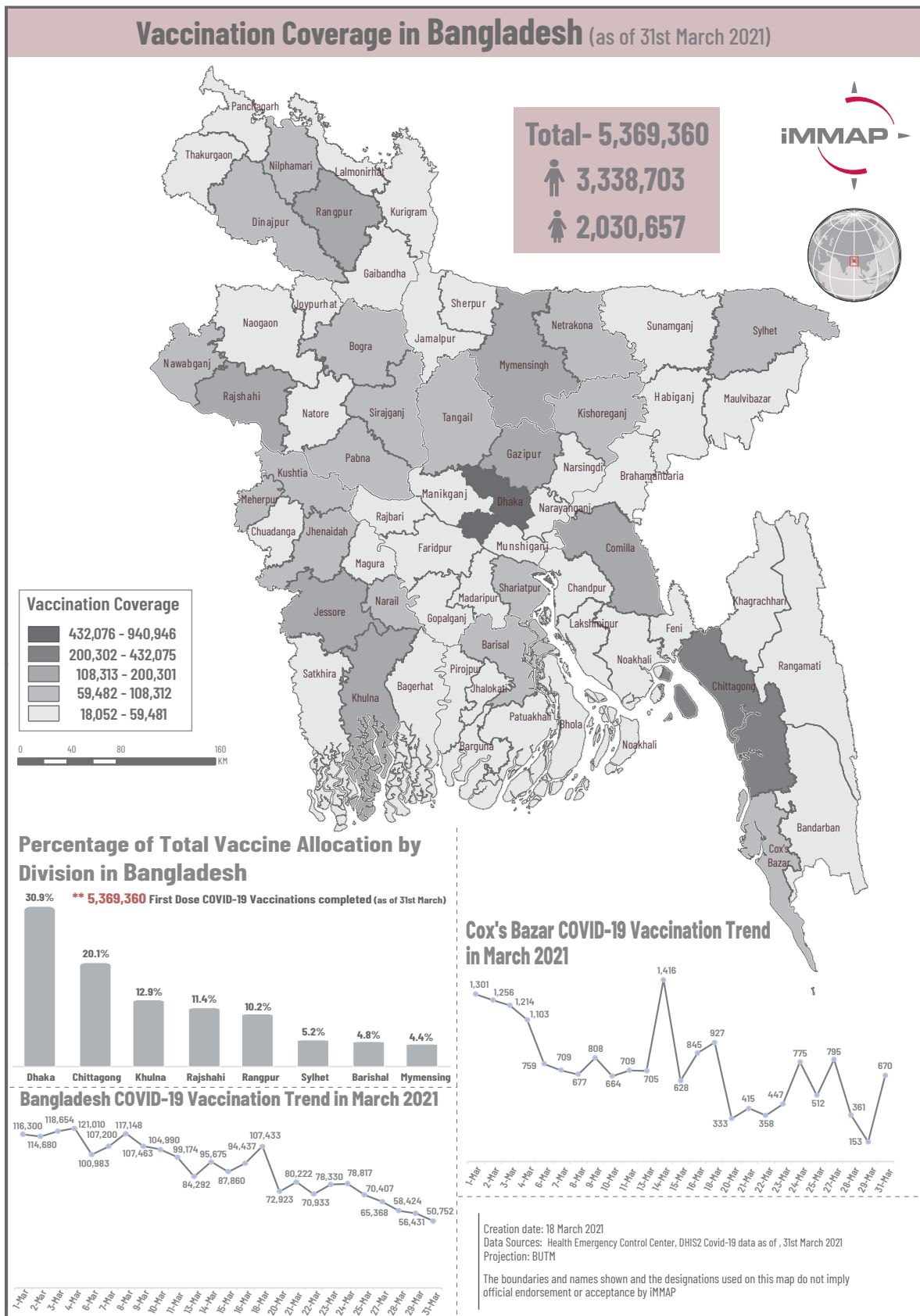
Cox's Bazar has been listed among the **top 31** most infected zones in the country following the fresh wave of countrywide COVID 19 transmission ([DGHS 31/01/2021](#)). In March at Cox's Bazar, an increasing trend in the positive cases among the host community has been observed. The Test Positivity Ratio (**TPR**) also rose from **2.2%** in Epidemiological week 8, to **8.8%** in week 12. More than **50%** of new cases (**247** out of **426**) are in the municipality area.

Though no deaths have been recorded, **60%** of ICU beds were occupied during the last two weeks of March. As of 28 March 2021, a total of **438** COVID-19 cases have been reported among Rohingya/FDMN. In total since the outbreak began, **10** deaths due to COVID-19 have been reported in the camps with a case fatality ratio of **2.3%**. The number of tests per week is relatively static. Currently, **26** sample collection sites are operating for suspected COVID-19 patients ([WHO 02/04/2021](#)).

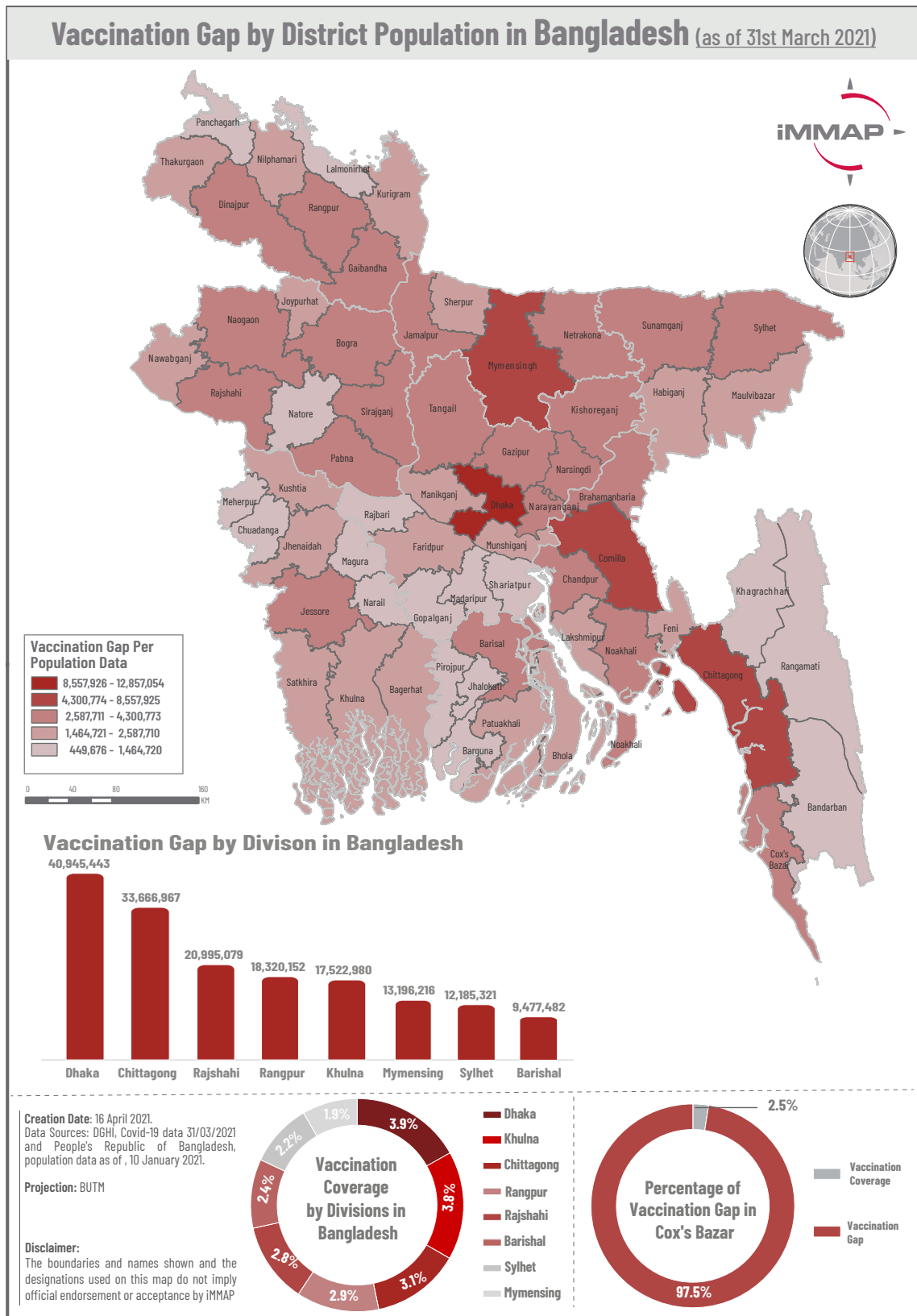
Along with the countrywide COVID-19 vaccination campaign, vaccination for international humanitarian workers has started in Cox's Bazar. WHO and Health Sector partners continue supporting the Government of Bangladesh (GoB) in the preparation for the COVID-19 vaccination campaign for the Rohingya community, scheduled to start in the coming weeks, pending the revised arrival date of the allocation of vaccines from the **COVAX** facility for Bangladesh ([WHO 02/04/2021](#)). However, plans are expected to face some setbacks due to the massive fire in camps 8E, 8W, 9 and 10 which have destroyed vaccination points ([ISCG 25/03/2021](#)).

In response to the increase in the number of cases among the host community, the Government of Bangladesh and the Office of the Refugee Relief and Repatriation Commissioner (**RRRC**) in Cox's Bazar have imposed movement restrictions and other mitigation measures in district and camp areas. All tourist activities will remain closed in the district until further notice.

**Figure 5. Vaccination map of Bangladesh showing Cox's Bazar in Chittagong division** (Source: DGHS 31/03/2021)

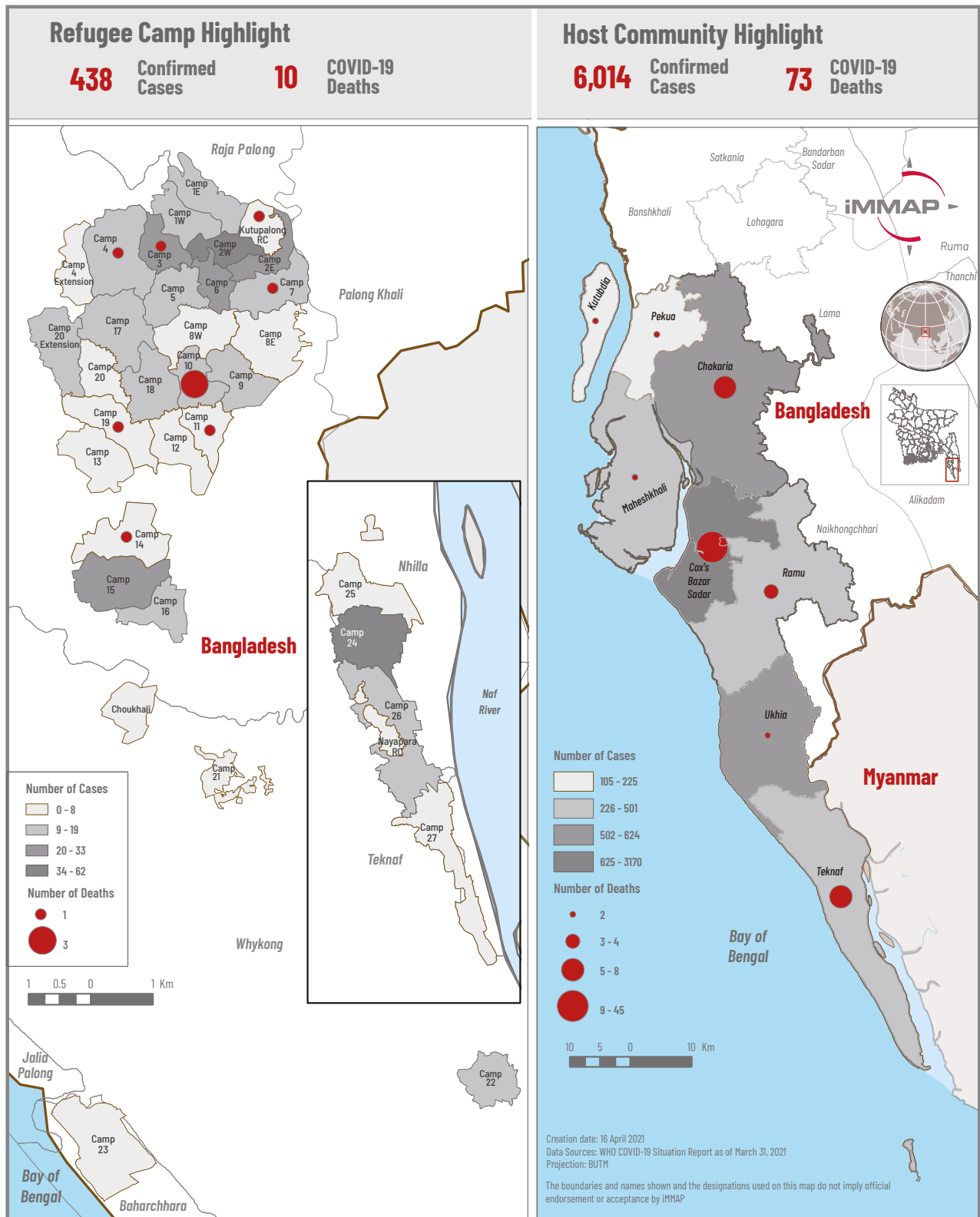


**Figure 6. Vaccination gap map for Bangladesh showing Cox's Bazar in Chittagong division** (Sources: DGHS 31/03/2021, Bangladesh Population data 10/01/2021)

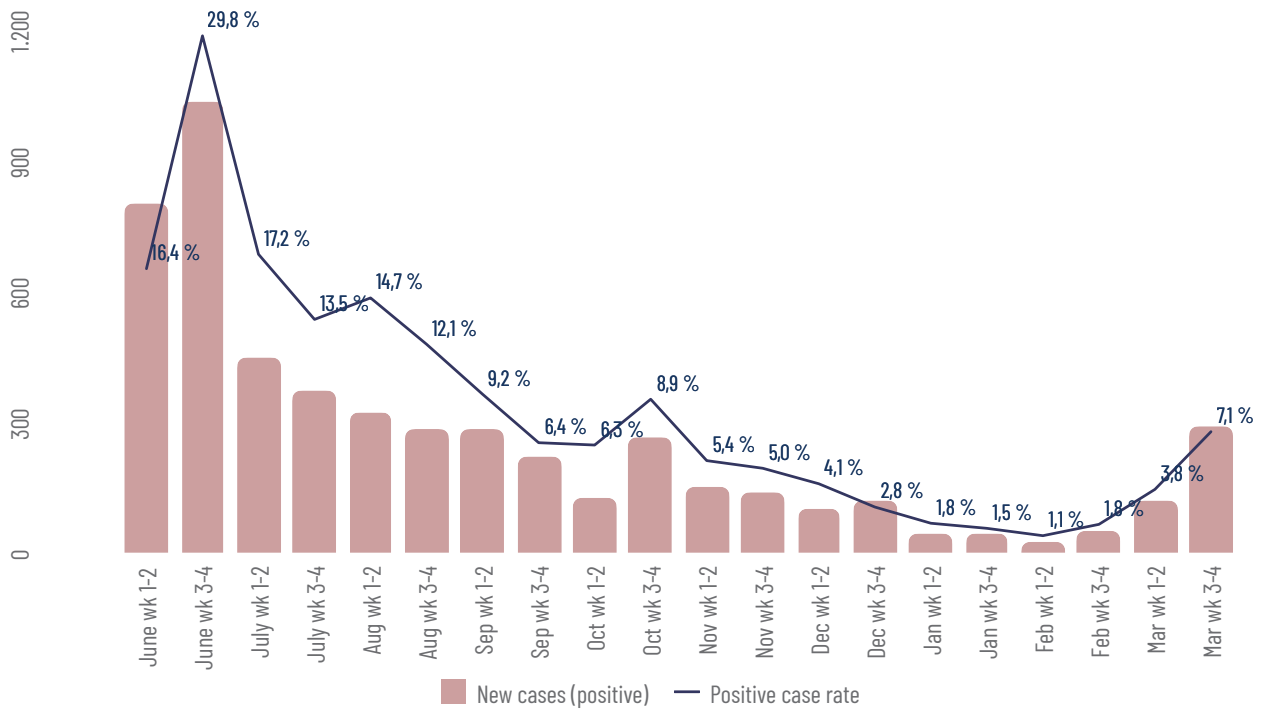


# The Trajectory of COVID-19 in Cox's Bazar

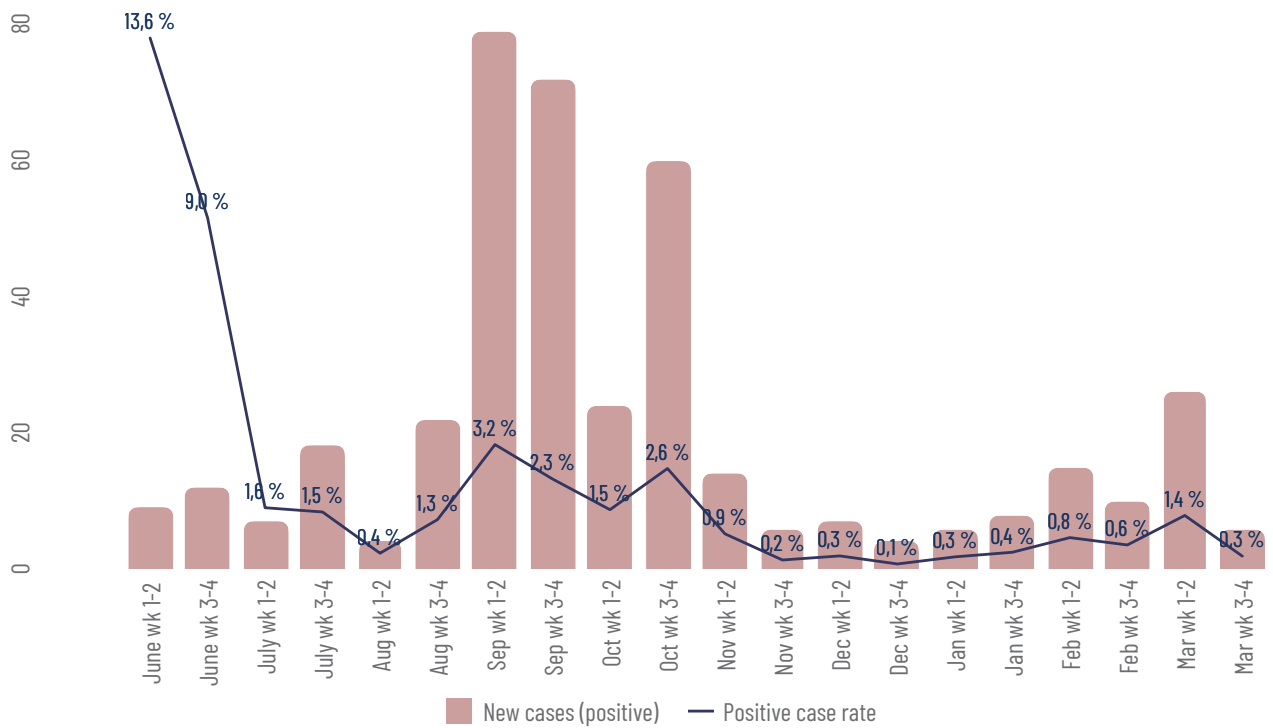
**Figure 7.** COVID-19 cases in Cox's Bazar as of 31st March 2021 (Data Source: WHO 31/03/2021)



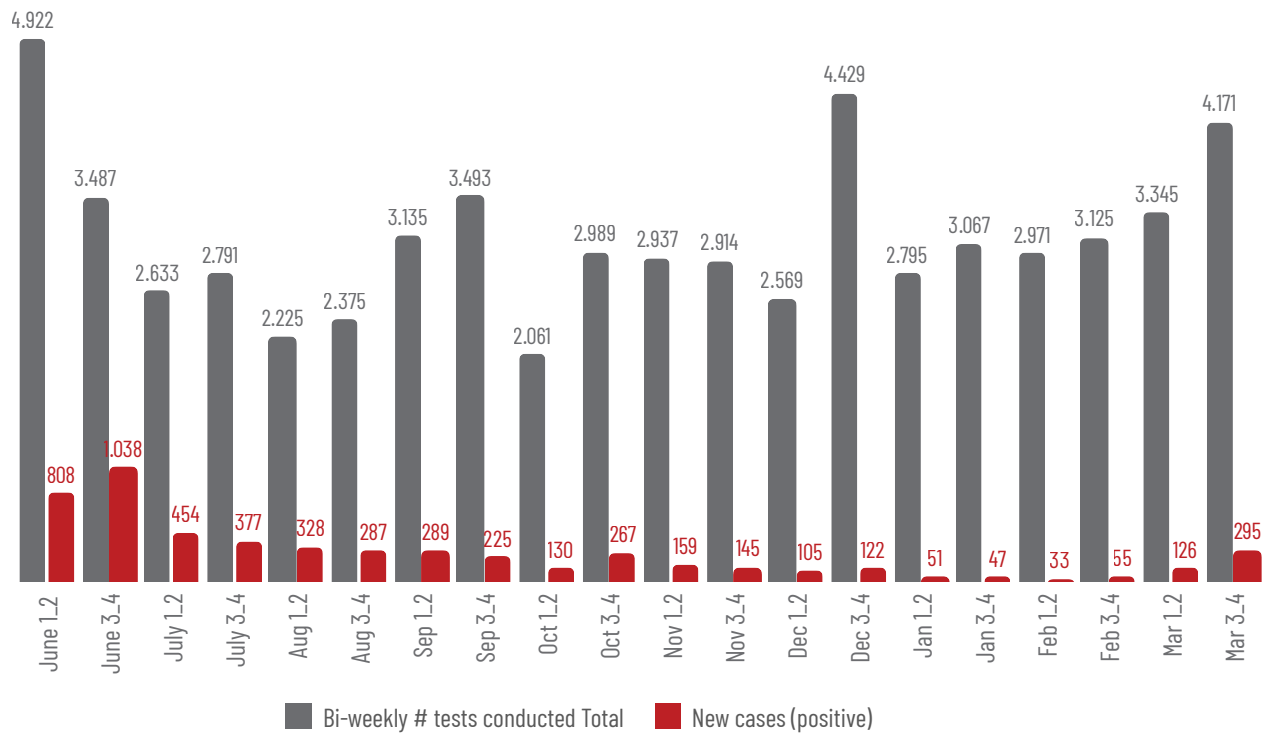
**Figure 8. Bi-weekly positive case rate in host community** (Source: WHO 31/03/2021)



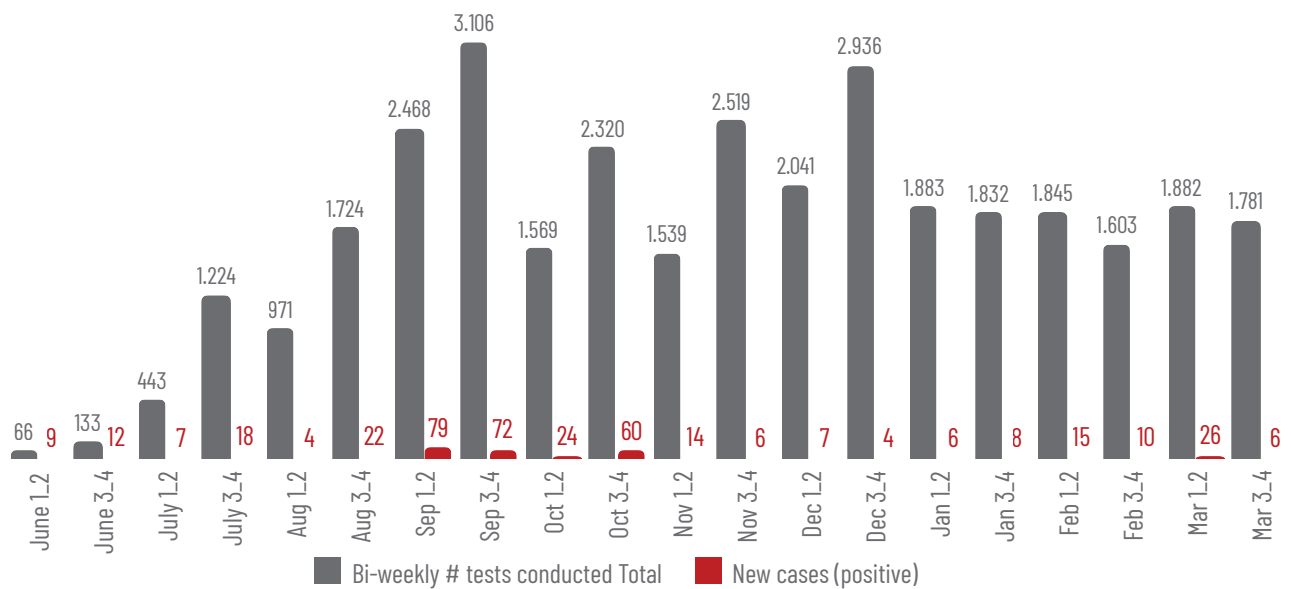
**Figure 9. Bi-weekly positive case rate in refugee community** (Source: WHO 31/03/2021)



**Figure 10. Bi-weekly total tests conducted and new cases in the host community** (Source: WHO 31/03/2021)



**Figure 11. Bi-weekly total tests conducted and new cases in the refugee community** (Source: WHO 31/03/2021)



# COVID-19 CONTAINMENT MEASURES

Many movement restrictions inside Bangladesh were lifted after the gradual resumption of economic activities across the country, but the daily infection rate is now rising rapidly. Therefore the government has imposed a new **18-set ban** to prevent the COVID-19 epidemic, including restrictions on all public gatherings and public gatherings in high-infection areas, restrictions on tourism activities, a **50% capacity** limit for public transport, new quarantine and hygienic measures including the compulsory wearing of masks. Citizens are also instructed not to leave their houses **after 10 pm** unless urgent ([Dhaka Tribune 29/03/2021](#)).

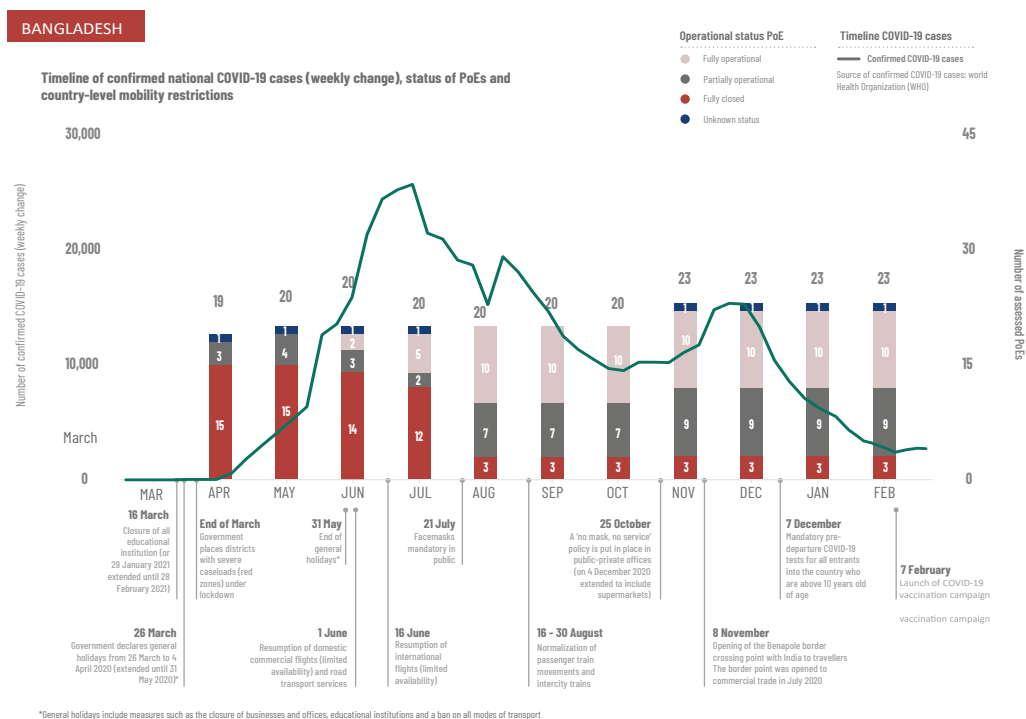
## COVID-19 Containment Measures at the National Level

The government has decided to extend the school and college closure until May 23. Prior to the government imposing a new **18-set ban** on March 29, to halt the spread of the virus, the Ministry of Education agreed to resume classes at the primary, secondary, and higher secondary levels on March 30. This is because the Qawmi madrasas were reopened in August with special consideration. And in February of this year, several university students

protested the resumption of educational activities ([UNB 30/03/2021](#)). To address the latest COVID-19 outbreak, the Bangladesh government has imposed new restrictions on public movement. In some places where the coronavirus transmission rate is higher, the Ministry of Health has proposed partial lockdowns to control its transmission ([Dhaka Tribune 30/03/2021](#)).

The government initiated a **“No Mask, No Service”** policy and is imposing fines on health guideline violations to prevent the spread of the virus. However, people are still reluctant to follow the basic health guidelines and wear masks in public places. A recent survey (covering all of Bangladesh) found that **19%** of respondents said they wear masks rarely and **8%** said they never wear a mask; **38%** of respondents who do not wear masks said they do not wear a mask because it is uncomfortable, and **32%** think they have no chance of contracting COVID-19. ([UNCT 23/03/2021](#)). Temperature screening is also continued at most of the entry points. Thousands of citizens are being kept under quarantine all across the country ([WHO 29/03/2021](#)).

**Figure 12. Point of Entry analysis of COVID-19 at Bangladesh** (Source: [LOM\\_01/04/2021](#))

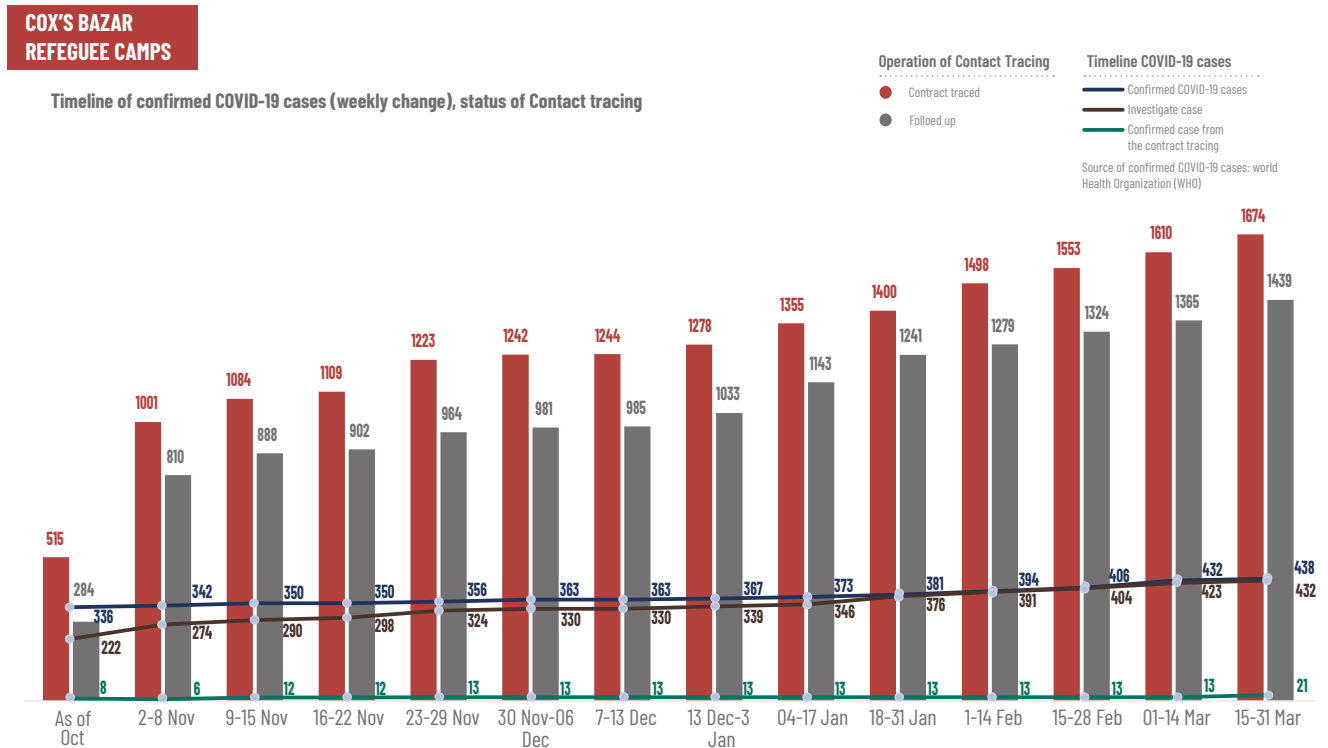


## Containment Measures in Cox's Bazar

In Cox's Bazar, the national COVID-19 containment measures are being adopted locally. In response to the increase in the number of cases among the host community and refugee camps, the Government of Bangladesh and the Office of the Refugee Relief and Repatriation Commissioner (RCCC) in Cox's Bazar have imposed movement restrictions and other mitigation measures in district and camp areas. All **tourist activities** will remain closed in the district. Restrictions to prevent COVID-19 transmission have been maintained for humanitarian activities within Cox's Bazar camp. To avoid the spread of COVID-19, organizations are asked to maintain strict protocols such as physical distancing, hand washing, and the use of masks. Education centers like schools and learning centers remain closed inside the camps and also in the host community (WHO 31/03/2021).

Humanitarian actors are continuing to help in the detection of COVID-19 cases, provide COVID-19 hygiene education, and refer patients with fever to local health facilities for medical treatment. A camp-wide dedicated Contact Tracing (CT) network with 34 supervisors and 311 volunteers was embedded in October in the Rapid Investigation and Response Teams (RIRTs) for mitigation of the transmission of COVID-19. A total of **432** confirmed cases (out of **438** as of 31 March) have been investigated by RIRTs, including the **1,674** contacts to be followed up. Out of these, **1,439 (86%)** contacts have completed follow-up visits and were released from quarantine. **Twenty-one (1.3%)** became confirmed cases during the follow-up period (WHO 31/03/2021).

**Figure 13. Contact tracing at Cox's Bazar refugee camps** (Source: WHO 31/03/2021)



# INFORMATION AND COMMUNICATION FOR COVID-19

The government has been trying to strengthen awareness campaigns and implementing policies like ‘no mask, no service’ with different directives & monitoring initiatives to prevent the spread of COVID-19 in Bangladesh but community feedback clearly indicates most of the people are not taking it seriously and no one is enforcing the mandate ([BBC Media Action](#) 14/01/2021). In Cox’s Bazar various NGOs and INGOs are conducting door-to-door awareness campaigns and providing leaflets related to COVID 19 and its preventive public health measures along with distributing masks and sanitizers to both host communities and refugees ([UNICEF](#) 28/02/2021).

## Information Channels and Means

Different NGOs and agencies partnering with WHO and UNICEF are continuing to disseminate key messages regarding the COVID-19 pandemic and its preventive measures among Rohingya refugee and host communities through English, Bangla, and Burmese versions of radio broadcasting, videos, and posters ([WHO](#) 02/03/2021). The outreach campaign also included hundreds of volunteer community health workers, many of them refugees, carrying out door-to-door visits to share information ([UNHCR](#) 18/03/2021).

Agencies are also using the social media platforms utilizing their strong outreach to deliver risk communication messaging to women and youth with. People are also getting engaged in sharing concerns and questions through

RCCE (Risk Communication and Community Engagement) support services led by DGHS with technical support from UNICEF with other UN partners and an extensive NGO network ([UNCT](#) 23/03/2021).

Over 11 million female followers and over four million followers between the ages of 13 and 17 were reached with risk communication messaging on COVID-19 prevention; symptoms; hand washing; mask wearing; mental health care; adolescent health; nutrition for immunity; advice for vulnerable populations such as the elderly, sick, and pregnant women and essential workers; routine immunization; school reopening; vitamin A campaign; the national measles and rubella vaccination campaign; helplines and gender-based violence. Social media has been an effective platform for reaching women and children during the process ([UNCT](#) 23/03/2021).

## Information Challenges

Misinformation and the spread of rumors are affecting the adherence of health safety protocols among the population. As mass vaccination programmes began across the country, and with the declining infection trend in the last couple of months, there was a spike in the spread of rumors and misinformation regarding vaccination ([Dhaka Tribune](#) 13/03/2021). A recent online survey by the [UNCT](#) shows that while the spread of COVID-19 related misinformation and rumors decreased, there was a spike in the spread of inaccurate information regarding vaccination.

# COVID-19 IMPACT AND HUMANITARIAN CONDITIONS

Data available for March situation analysis shows that the impact of COVID-19 related measures continues to have a ripple effect on the Rohingya and host communities, vulnerabilities of the population continue to be high due to loss of livelihoods and income-generating activities. Movement restrictions such as school closures as well as certain restrictions on program implementation modalities continue to be in place. As a result, associated protection risks remain of concern.

The report analyzes the impacts of a massive fire that broke out in the Rohingya camps, in the Kutupalong mega camp on 22 March 2021. The fire started in Camp 8W and later spread through camps 8E, 9, and 10. The fire left thousands of people temporarily displaced. Eleven deaths have been confirmed by the government. The fire destroyed shelters, shops, nutrition and distribution centers, learning centers, and health and WASH infrastructures. It is expected that the destruction and loss resulting from the fire will worsen the situation caused by COVID-19 containment measures.

Fire is a common hazard in the camps. There have been several fires that erupted in the Rohingya camps since the beginning of 2021, some of their impact is covered in the [January 2021 Situation Analysis Report](#). This month's report includes an analysis of the impact of the fire at the sector level. It relies heavily on findings from the Inter-Sector Coordination Group (ISCG)'s [Rapid Joint Needs Assessment](#) conducted immediately following the fire. The following analysis is based on initial assessments, the real impact of the fire incident on the different sectors will be further understood when more detailed assessments are carried out.

- **Concern over the increased financial burden significantly increased** among the Rohingya community in the first two months of 2021. This is likely due to increased economic vulnerabilities, the adoption of high risks coping mechanisms, and decreased ability to absorb potential shocks.
- **The fire resulted in the destruction of shops and markets, impacting access and disrupting related economic activities at larger scales.** The fire also destroyed a General Food Distribution point and LPG storage sheds, and led to the temporary closure of an e-voucher outlet. **Food needs are reported widely in**

**all three most affected camps.**

- **10,100 shelters were damaged following a massive fire** in camps 09, 08W, 08E, and 10. People displaced by the fire are being hosted by other Rohingya or relatives, staying in adapted facilities, or sleeping outdoors in open spaces. **Camps are becoming even more congested putting people at risk of disease outbreaks including COVID-19.** Quick reconstruction of durable homes is important as the monsoon season approaches.
- Antenatal care and essential health services are still constrained by COVID-19 fears and restrictions. **The destruction of health facilities due to the fire is likely to have an impact on refugees and host communities to adequately meet their health needs despite the setting up of temporary health centres.**
- **Two nutritional centers were destroyed in the fire and two other nutrition sites are temporarily closed in the affected camps.** Severe and Moderate Acute Malnutrition rates (SAM and MAM) within camps remain unchanged as of the end of 2020 in comparison to the previous round, but the number of children that now fall into the "at-risk" category of malnutrition is increasing.
- **An estimated 4,000 water, sanitation, and hygiene infrastructure structures have been either damaged or destroyed.** Refugees in camps were already lacking a comprehensive waste management system, the destruction is expected to worsen the situation, and **increase the risk of disease outbreak, including COVID-19.** Repair work to water supplies and temporary repairs to latrines and bathing spaces has already started.
- The fire damaged a substantial number of child and women-friendly spaces in the camps. **COVID-19 increased risks related to gender-based violence (GBV), the fire exacerbated these existing risks** and exposed women and children to additional threats to their personal safety.
- Reported cases of trafficking have decreased in recent months likely due to movement restrictions and **reduced activity of protection services and authorities.**

 **LIVELIHOODS**

- Children in camps were already struggling to access education even before the pandemic, as they face barriers to education beyond those created by COVID-19 containment measures. **Closure of learning facilities has widened inequalities and further disadvantaged children in camps and poorer children in the host communities** in terms of education service provision.
- The fire destroyed 176 learning facilities, and some of the remaining functional facilities are being used as shelters for people affected by the fire. **The limited number of available educational facilities is expected to have an impact on children's access to education when schools are finally allowed to open.**

### Information Sources and Gaps

[BBC Media Action's](#) report on community feedback data (collected in January and February 2021) shows the impact of COVID-19 on the refugee community, highlighting the increased concerns of the population over financial burdens. The potential long-term impact of the pandemic on the livelihoods of the Bangladeshi in Cox's Bazar is provided in the [UN Bangladesh Country Report](#). Details of the damage caused by a serious fire in camps 09, 08W, 08E, and 10 to shelters are provided in [ISCG's](#) initial rapid assessment. The impact of the fire on food security, and the response to the needs, is also provided by [ISCG](#), [IRC](#), [FSS](#). Food security figures for refugee camps in Ukhiya and Teknaf Upazilas and host communities adjacent to the camps are provided by [FAO](#). Preliminary findings from the Refugee influx Emergency Vulnerability Assessment ([REVA 4](#)) (data collected from 7 November to 3 December 2020) are also utilized. Analysis of the final [REVA 4](#) report will be added in the next situation analysis report covering April.

### The fire destroyed an unknown number of shops and markets, impacting access to markets

The fire which broke out in Rohingya refugee camps in Ukhiya on 22 March resulted in the destruction of shops and markets. According to the ISCG initial assessment, all key informants reported problems in accessing markets. Across the three most affected camps (09, 08W, 08E) lack of money was the main challenge in accessing markets, followed by the loss/destruction of e-voucher cards and the destruction of distribution points ([WFP 23/03/2021](#)). An increase in prices was also reported by some KIs ([ISCG 25/03/2021](#)). According to local media sources, the fire also burnt Balukhali Balibazar, the biggest local market in the Rohingya camp, destroying products worth at least Tk50 crore ([Dhaka Tribune 23/11/2021](#)). The number of shopkeepers and traders affected by the fire is unknown. The fire is likely to disrupt the relevant economic activities at larger scales.

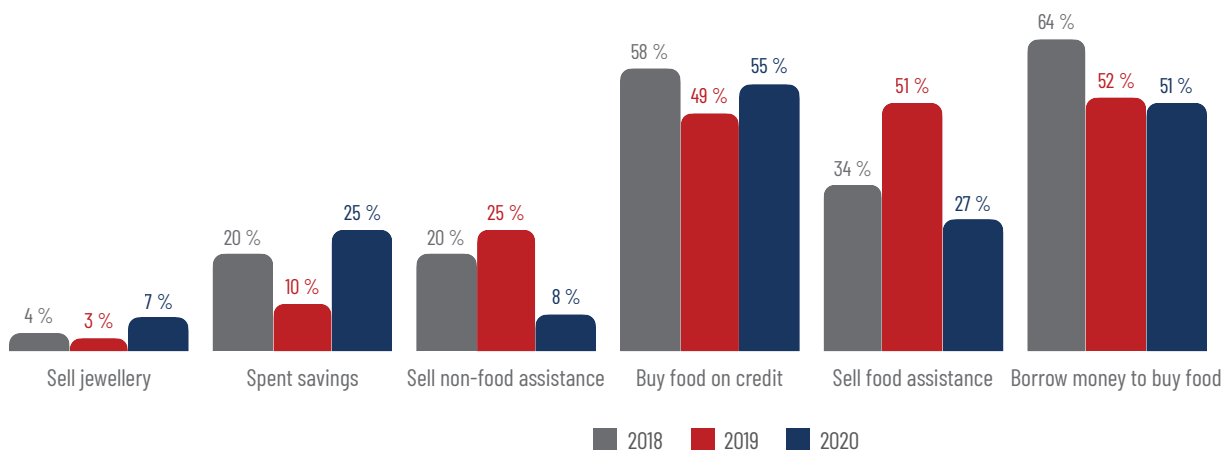
### Risk mitigation measures to prevent the spread of COVID-19 and security measures resulted in a significant disruption of refugees' self-reliance and socioeconomic activities in refugee camps in Cox's Bazar increasing their economic vulnerability and leaving them exposed to potential shocks

Rohingya refugees, particularly unregistered refugees, continue to face a lack of regular income-generating and self-reliance activities this is due to regulations on employment, lack of work available, and skill gaps. Sixty-

five percent of unregistered Rohingya refugees work as unskilled day laborers, largely in construction, cleaning, and as porters (REVA 4 07/02/2021). The lack of income-generating activities available for refugees makes them consistently reliant on humanitarian assistance. However, evidence from a recent community feedback report shows that relief items and aid are often not sufficient, and refugees still resort to volunteer stipends, negative coping mechanisms, and daily skilled and unskilled labour

to supplement the aid they receive (BBC Media Action 31/03/2021, REVA 4 07/02/2021). Many refugees have found work via self-reliance and Disaster Risk Reduction (DRR) programmes organised by different agencies. However, since their movements are now restricted due to security measures such as fences erected around the camps as well as pandemic containment measures their access to income-generating activities has been limited (BBC Media Action 31/03/2021).

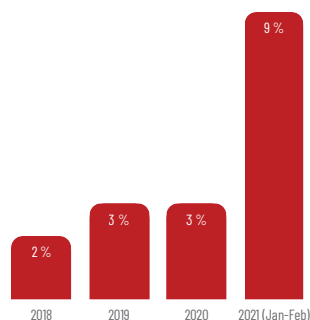
**Figure 14. Negative livelihood coping strategy 3-year trend for the refugee community** (Source: REVA 4 07/02/2021)



This has translated into a concern over the financial burden among the Rohingya community. The level of concern over increased financial burden stayed the same in 2019 and 2020 at 3% but reached 9% in just the first two months of 2021. The steady level in financial concern in 2019 and 2020, could be attributed to the fact that humanitarian assistance to refugee households continued largely at the scale prior to COVID-19. However, in just the first two months of 2021, there has already been a 6% increase in the number of people concerned over financial burden (BBC Media Action 31/03/2021). While it is still unclear the changes that caused this sudden increase, it is evident

by the REVA 4 findings that the economic vulnerability of both refugees and the host community increased in comparison to pre-crisis data. Twenty-four percent of refugee households moved into a higher vulnerability bracket (REVA 4 07/02/2021). This means that even if the situation in camps is the same as before the crisis, refugees are more vulnerable – as per the most recent data available – and less able to absorb potential shocks, including events like fire incidents and destruction caused by the monsoon season, and it is likely to explain the increase in concerns over financial burden with the start of 2021.

**Figure 15. Increasing financial burden among refugee camps** (Source: BBC Media Action)



**Missing out on educational opportunities for a long period of time is likely to have an impact on future earnings and the country's GDP.**

COVID-19 is increasing indicators such as school dropout and subsequently child, early, and forced marriage. An increase in these indicators is expected to be followed by a decrease in income-earning and ultimately impacting the country's GDP. As COVID-19 has intensified pre-existing vulnerabilities, it is expected that the pandemic will have the most substantial impact on the future earnings of children already in poverty. This in turn can result in the intergenerational transmission of poverty and long term disparity ([UNCT 23/03/2021](#); [Citizen's Platform for SDGs 01/01/2021](#)).



### Information Sources and Gaps

Food security figures mentioned in this section for refugee camps in Ukhia and Teknaf Upazilas and host communities adjacent to the camps are provided by [FAO](#). Preliminary findings from the Refugee Influx Emergency Vulnerability Assessment ([REVA 4](#)) (data collected from November to December 2020) shows that despite continued food assistance, refugee households witnessed a marginal decline in food consumption levels in comparison to pre-pandemic crisis levels. Analysis of the final [REVA 4](#) report will be added in the next situation analysis report covering April. Details of the damage caused by a serious fire in camps 09, 08W, 08E, and 10 to shelters are provided in [ISCG's](#) initial rapid assessment & [ACAPS](#) situation report. The Rapid Joint Needs Assessment by [ISCG](#) & [Food Security Cluster](#) reports food needs are among the top reported priority needs identified by key informants in all three affected camps, second only to shelter. The impact of the fire on food security, and the response to the needs, is also provided by [IRC](#), [WFP](#), and [BRAC](#).

**The fire that erupted on 22 March in the main Kutupalong section of the Rohingya Refugee Camps destroyed household food stock and storage facilities, a food distribution point, Non-Food Items (NFI) like utensils, cooking fuel, etc.**

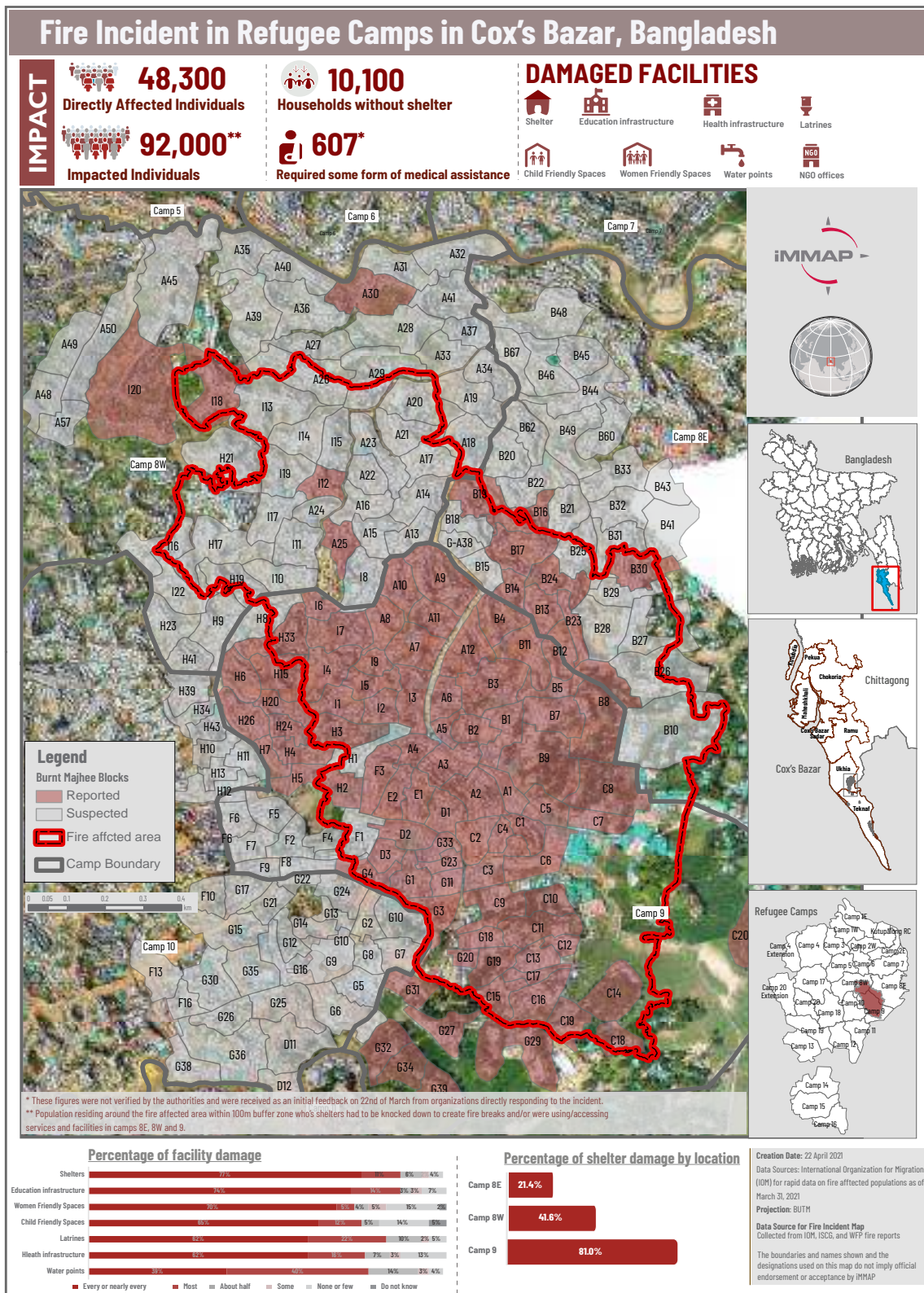
The fire outbreak resulted in the loss of critical infrastructure including a General Food Distribution point and LPG storage sheds and led to the temporary closure of one of WFP's e-voucher outlets ([ISCG 31/03/2021](#), [WFP 23/03/2021](#)). Affected households lost cooking items, liquefied petroleum gas (LPGs), water containers, and food stocks ([IRC 23/03/2021](#)). This destruction and loss are likely to put those affected by the fire, particularly pregnant mothers, newborn babies, and children under five at risk of not meeting their basic food needs and accessing food-related services. Many of the affected households are also without necessary items to store food and water, or essential facilities, NFI, and fuel needed for cooking ([ACAPS 25/03/2021](#)).

This disruption led to a change in food assistance services. As of 22 March, high-energy biscuits and cooked meals for lunch and dinner are distributed by humanitarian agencies to fire-affected households without the need for any documentation. A high calorie mix of proteins, and vitamins are included in these cooked meals, while some components were excluded such as meats and eggs, due to hot weather, hygiene conditions, long transit, and traffic delays ([WFP 23/03/2021](#), [WFP 29/03/2021](#), [BRAC 28/03/2021](#)). As pre-cooked meals will remain

being distributed until affected people have access to LPG and kitchen kits (ISCG 31/03/2021), it is important to

continue ensuring that people have access to diversified and nutritious food.

**Figure 16. Fire incident in refugee camps** (Source: WFP 23/03/2021, ISCG 30/03/2021, IOM 31/03/2021)

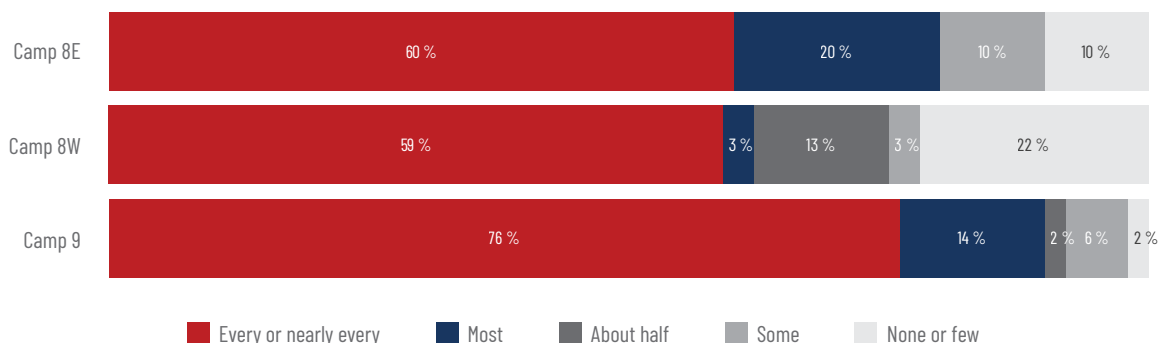


Food needs are reported widely in all three most affected camps and challenges in accessing markets are reported across all 3 camps and likely to affect other food and non-food needs which are not covered by assistance to affect the food status of the affected population.

of the key informants reported that nearly everyone did not have enough food stocks to cover the next five days at the time of the assessment. The highest percentage was reported in Camp 9(76%), followed by Camp 8W(59%), and Camp 8E (60%)([ISCG 25/03/2021](#), [Food Security Cluster 31/03/2021](#)).

According to the Rapid Joint Needs Assessment, over half

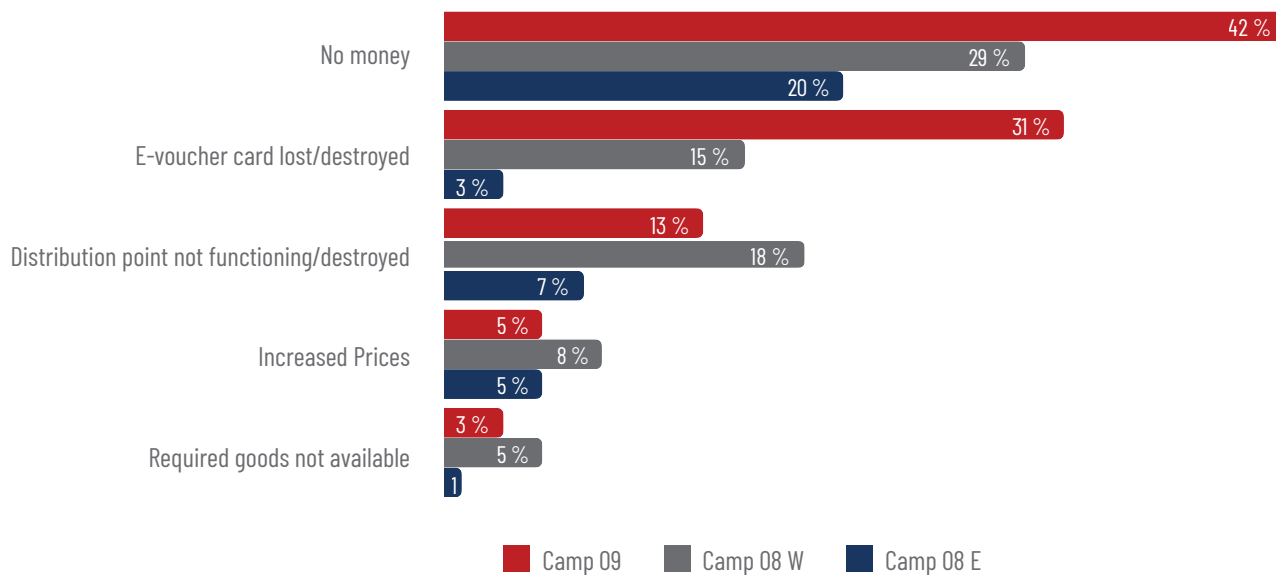
**Figure 17. Percentage of the population without food in the last five days of March** (Source: [ISCG 25/03/2021](#))



Food needs are among the top reported priority needs by key informants in all three affected camps, second only to shelter ([Food Security Cluster 31/03/2021](#)). Food needs were already high across all camps before the fire incident. Data from the most recent REVA 4 assessment reveal that 88% of the Rohingya community cited food as their priority need ([REVA 4 07/02/2021](#)), indicating the need for continued food assistance beyond emergency food distribution.

The aforementioned challenges in accessing markets, such as lack of money, the loss of e-voucher cards, destruction of distribution points, and increased prices ([ISCG 25/03/2021](#)), are likely to impact refugee's ability to access other food and non-food items not covered by assistance. The destruction in shops and markets highlights the importance of quick reconstruction and assistance in mitigating the impacts.

**Figure 18. Difficulties in accessing markets for refugee camps in Camp 9, 8W and 8E** (Source: [ISCG 25/03/2021](#))



**More than a million people targeted for food and livelihoods assistance in 2021 in Ukhia and Teknaf Upazilas.**

The impact of COVID-19 on unemployment, households' purchasing power, food prices, and food availability has impacted food security among the population (FAO 2020). As of March 2021, more than 1.2 million people are food insecure, this includes the refugee population of almost 900,000 and those from the host community who live in proximity to the camps (FAO 11/03/2021).

Despite continued food assistance, refugee households witnessed a marginal decline in food consumption levels in comparison to pre-pandemic crisis levels. For the host community, the sustained impact of COVID-19 livelihoods contraction has a greater impact on their consumption, with more households moving from acceptable to borderline consumption (REVA 4 07/02/2021). While host community households are better off in terms of income opportunity, both in terms of access and remuneration, they do not have blanket aid coverage like Rohingyas to cushion them from any shock. This meant host community households are highly impacted during periods of lockdown when livelihood opportunities are limited and many have lost their sources of income.



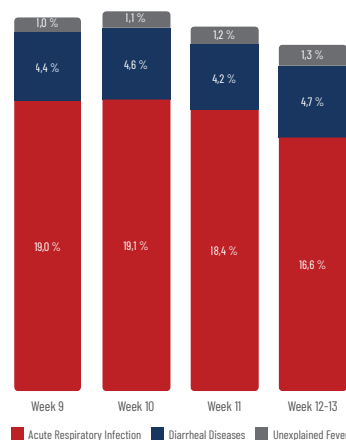
**Information Sources, Gaps, and Challenges.**

Regular data on disease prevalence was provided through the weekly Epidemiological Highlights [week 9](#), [week 10](#), [week 11](#), and [week 12-13](#). Information related to the recent fire event is taken from a [Joint ISCG Statement](#), an [ISCG Response Summary](#) and assessment reports from [ACAPS](#), [BRAC](#), [IOM](#), [IRC](#), [UNICEF](#), and the [ISCG](#). The wider impact of COVID-19 on health services across Bangladesh comes from two WHO ([WHO No53](#) and [WHO No56](#)) Sitreps. A press release from [MSF](#) reported a general deterioration in service provision including health services due to the COVID-19 pandemic and associated containment measures, but there is little current data to make a comparison of current health service provision compared to that provided pre-pandemic.

**Morbidity and disease prevalence rates continue to remain relatively static.**

Based on the Early Warning Alert and Response System (EWARS)(Indicator-based surveillance), Acute Respiratory Infections(16.6% - 19.1%), Diarrheal Diseases(4.2% - 4.7%), and Unexplained Fever (1.0% - 1.3%) were the diseases with the highest proportional morbidity in March (weeks 9 - 13). A total of 71 diphtheria cases have been reported so far in 2021 which is a slight increase in recent months but still roughly on par with the prevalence rate in 2020 which was 226 cases in the year ([WHO 07/04/2021](#), [WHO 19/01/2021](#)). A total of 2,895 cases of diarrheal diseases were reported in EWARS in week 13, which is in line with similar figures from 2020 and represents a small decline during recent weeks.

**Figure 19. Diseases with highest proportional morbidity rate in March at refugee camps** (Source: [WHO 07/04/2021](#))



### **Antenatal care and essential health services still constrained by COVID-19 fears and restrictions.**

Across Bangladesh antenatal care (ANC) and postnatal care (PNC) services were highest in the first 1st quarter (Q1) of 2020, but dropped off considerably after the initial outbreak of COVID-19 and lockdown restrictions were imposed. Services were reaching pre-pandemic levels by around October–December 2020 but have since dropped off again with January 2021 service provision between 70%–80% of that provided in January 2020 ([WHO 01/03/2021](#)). Both Inpatient and Outpatient care are still running at approximately 10% and 20% lower, respectively, than at the same time in 2020 ([WHO 22/03/2021](#)). Fear of catching COVID-19 as Bangladesh endures a second wave is probably one contributing factor to this reduction alongside a reduction in household expenditure on health services due to the economic impact of COVID-19 household incomes.

### **Massive fire incident results in damage to critical health infrastructure and raises mental health concerns.**

A massive fire that broke out in the main Kutupalong section of the Rohingya Refugee Camps on 22 March 2021 and rapidly spread through four camps (8e, 8w, 9, and 10) resulted in the loss of critical infrastructure including damage/destruction of six health facilities and one secondary health facility. It is reported that fencing around the camp hampered the ability of refugees particularly women and girls to escape and caused significant delays in refugees accessing medical attention along with greater damage to the health facilities. Fleeing in these circumstances is even more difficult, if not impossible,

for refugees with disabilities.

Findings from an initial assessment indicated that many of those in the camps affected by the fire or living nearby had lost access to health care. 60% of KIs in camp 9 reported that all or most people do not have access to health facilities, as did 50% of KIs in camp 8W and 55% in camp 8E. The health facilities that were destroyed did not only serve the camps in which they were located but also served the broader Rohingya and Bangladeshi populations. However, the wider aid community provided tents, medical supplies, and equipment to those facilities affected by the fire to ensure the temporary provision of health services for the refugee camps affected and various organizations. In addition, many existing health care facilities continue to provide care to those affected as well as providing normal health services.

The loss of these health facilities which served the wider Rohingya population, and the Bangladeshi host community is likely to have a long-term impact on refugees and host communities to adequately meet their health needs as well as the short-term impact that includes the loss of many critical health supplies. In addition, the fire outbreak has also disrupted the COVID-19 vaccinations program in the camp ([UNICEF 23/03/2021](#), [ISCG 24/03/2021](#), [ACAPS 25/03/2021](#), [BRAC 28/03/2021](#), [ISCG 30/03/2021](#), [ISCG 31/03/2021](#)).

Children who had already fled fires in Myanmar are at risk of being re-traumatized and are experiencing additional stress from the recent fire outbreak in Cox's Bazar. In addition to that, Rohingya refugees are also likely to have high levels of anxiety and fear related to repatriation and forced relocation due to the fire flashbacks ([IOM 30/03/2021](#), [IRC 23/03/2021](#), [ISCG 31/03/2021](#)).

### Information Sources, Gaps, and Challenges.

The section draws on preliminary findings available from the Action Against Hunger (ACF)/Nutrition Sector SMART nutrition survey that was undertaken in the Host Community, Cox’s Bazar during January–February 2021. The section also provides a brief summary from the yearly Action Against Hunger (ACF)/Nutrition Sector (COVID-19 modified) round five SMART nutrition survey that was undertaken in Makeshift (MS) Camps, Nayapara (NYP) and Kutupalong (KTP) Registered Camps (RC) during November–December 2020. Survey data quality ranged from Good to Excellent. Additional information for March comes from ISCG JNA – Joint Needs Assessment and following SitReps with the [response](#) reports on the fire outbreak describing its impact on nutrition service provision. The malnutrition situation is regularly assessed through mass MUAC screening in the Rohingya camps. It is

expected that a clearer picture of the current nutritional situation of children under five will be provided when the April 2021 set of nutrition mass MUAC screening data from UNICEF becomes available (the end of April 2021).

### Prevalence of Malnutrition in Cox’s Bazar Host Community.

Preliminary findings are available from the Action Against Hunger/Nutrition Sector SMART nutrition survey that was undertaken in the Host Community, Cox’s Bazar during January–February 2021. Data from the previous February – March 2018 SMART survey indicated an overall prevalence of Global Acute Malnutrition (GAM) of 11.4 % (8.9 – 14.5, 95% confidence interval), however, there were no separate estimates for two Upazilas. Survey data quality the 2021 survey for both Ukhiya and Teknaf Upazilas is considered “excellent”, further details of the sampling and methodology can be sourced from the Nutrition Sector/ACF ([ACF/FSC 25/03/2021](#)).

### Key findings from the SMART survey

**Figure 20. Single Weighted Prevalence for Entire Population** (Source: [ACF/FSC 28/01/2021](#))

Children 6– 59 months	Wasting (WHZ)	Stunting (HAZ)	Underweight (WAZ)
Global Weighted Prevalence	9.3%	23.7%	23.5%
Severe Weighted Prevalence	0.7%	3.0%	3.7%

The overall GAM rate was 9.3%, which is considered “Medium” as per the WHO/UNICEF malnutrition classification (and is lower than the 11.4% reported in 2018). The GAM prevalence by WHZ was higher than MUAC-based GAM and the concordance of wasting case detection between WHZ and MUAC in both Upazilas was very poor. The overall SAM rate (WHZ) was at 0.7%.

A relatively higher GAM rate by WHZ observed among boys

and older children (24–59 months). At Upazila level MUAC based GAM prevalence was significantly higher in Teknaf compared to Ukhiya Upazila (3.5% vs 0.7%).

The overall chronic malnutrition (Stunting) rate was 23.7%, classified as “High” as per WHO/UNICEF malnutrition standards with older children (24–59 months) significantly more stunted than younger (6 – 23 months) (ACF 25/03/2021).

**Figure 21. Stunting prevalence by age and Upazila** (Source: [ACF/FSC 28/01/2021](#))

Stunting (HAZ)	6 – 23 months	24 – 59 months
Ukhiya Upazila	16.1%	23.2%
Teknaf Upazila	18.3%	29.2%

The overall underweight prevalence of 23.5% can be interpreted as “Serious” >20% as per WHO malnutrition classification. A Significantly higher underweight rate observed among older children in Ukhiya Upazila.

### Malnutrition trends.

Despite COVID-19, the overall acute malnutrition trends for Ukhiya and Teknaf continue to be downward with GAM (WHZ) down to 9.3% compared to 11.4% in 2018, and GAM (MUAC) down to 3.8% compared to 8.1% over the same

period. Chronic malnutrition rates follow a similar pattern with the overall stunting rate down to 23.7% compared to 33.1% in 2018 and underweight prevalence dropping more modestly to 23.5% from 27.2% three years ago.

### Acute malnutrition (Wasting) prevalence by Upazila.

GAM/SAM rates by WHZ were slightly higher in Ukhiya, however the GAM/SAM rates by MUAC showed much higher rates in Teknaf (ACF/25/03/2021).

**Figure 22. Acute malnutrition rates for Ukhiya and Teknaf Upazila** (Source: [ACF/FSC 28/01/2021](#))

Children 6 - 59 months	Prevalence by WHZ		Prevalence by MUAC		Combined prevalence by WHZ and/or MUAC and/or Oedema	
	Ukhiya Upazila	Teknaf Upazila	Ukhiya Upazila	Teknaf Upazila	Ukhiya Upazila	Teknaf Upazila
GAM	9.90%	8.90%	0.70%	3.50%	9.80%	9.90%
MAM	9.00%	8.50%	0.70%	3.10%	-	-
SAM	0.90%	0.50%	0.00%	0.50%	0.90%	0.70%

### Underweight and Chronic Malnutrition (Stunting) Prevalence by Upazila.

Global and Moderate stunting rates were higher in Teknaf, but severe stunting rates were at similar levels across both Upazilas. Conversely global and moderate underweight

(WAZ) prevalence rates were higher in Ukhiya, although the severe underweight prevalence was found at a higher rate in Teknaf (4.2% compared to 2.8% in Ukhiya) ([ACF/FSC 25/03/2021](#)).

**Figure 23. Underweight and Chronic Malnutrition (Stunting) rates in Ukhiya and Teknaf Upazila** (Source: [ACF/FSC 28/01/2021](#))

Children 6-59 months	Stunting (HAZ)		Underweight (WAZ)	
	Ukhiya Upazila	Teknaf Upazila	Ukhiya Upazila	Teknaf Upazila
Global Prevalence	20.70%	25.80%	25.80%	21.90%
Moderate Prevalence	17.50%	22.70%	23.00%	17.70%
Severe Prevalence	3.20%	3.10%	2.80%	4.20%

### Massive fire destroys nutrition centers and affects nutrition service provision.

Nutrition services have been negatively impacted by

the recent fire in the Rohingya refugee camps in Ukhiya, Cox's Bazar which destroyed two nutritional centers (one each in camps 8E and 9), and forced UNICEF and WFP supporting services to close two other nutrition sites.

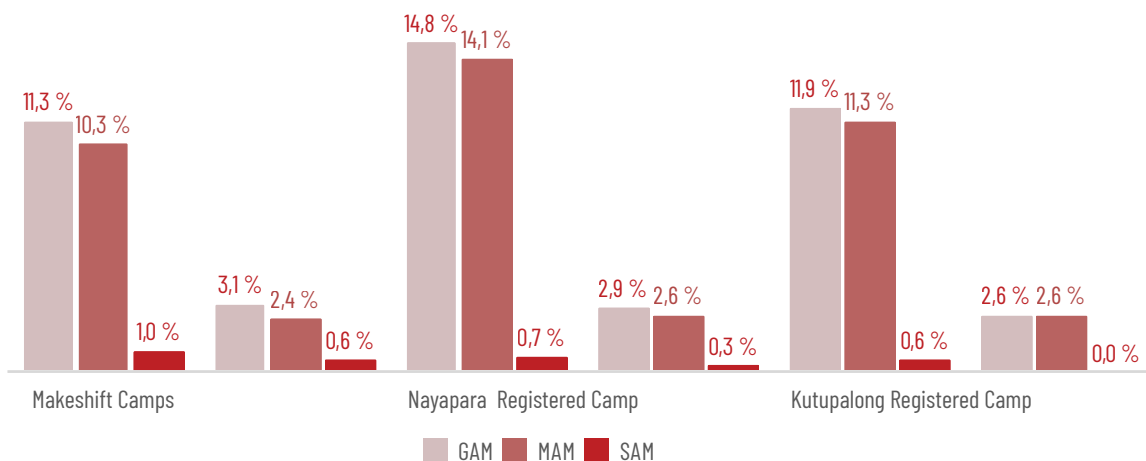
Almost immediately, temporary integrated nutrition facilities were installed to provide uninterrupted life-saving nutrition services. The rapid emergency assessment was initiated the next day to allow teams to assess the damage. Currently, three temporary integrated nutrition facility sites are operational in the two camps (ISCG 31/03/21, ISCG 31/03/21). Other initiatives such as the provision of bottled water and support to complementary feeding (hot meals) are being implemented to support those affected by the

fire and prevent malnutrition (ISCG 31/03/21).

#### Prevalence of acute malnutrition in refugee camps.

Global Acute Malnutrition (GAM) rates amongst children aged 6-59 months in all three target locations were found to be in the High/Serious range (10-15%) according to WHO/UNICEF classification and were highest in Nayapara RC. Severe Acute Malnutrition (SAM) rates were highest in Makeshift camps (1.0% WHZ, 0.6% MUAC) (ACF/FSC 28/01/2021).

**Figure 24. Acute malnutrition rates in refugee camps** (Source: ACF/FSC 28/01/2021)



#### Prevalence of stunting.

Global stunting rates were just over 34% for Makeshift Camps and Kutupalong RC (in the very high range ( $\geq 30$ ) according to WHO/UNICEF classification). However, it dropped below this level in Nayapara RC (29.1%). Amongst those children that are stunted, 80%-85% are moderately stunted whilst 15-20% are severely stunted. In terms of

age, the prevalence was higher amongst the older age groups (approx 34 - 37%), for the younger age group the rate was around 30% for Makeshift Camps and Kutupalong RC and much lower at 20.8% for Nayapara RC (ACF/FSC 28/01/2021). This age differential suggests that children born in the last two years have had on average, better nutrition than older children.

**Figure 25. Prevalence of Stunting in refugee camps** (Source: ACF/FSC 28/01/2021)

Stunting children 6 - 59 months	Makeshift Camps	Nayapara RC	Kutupalong RC
Global stunting/CM	34.2%	29.1%	34.7%
Moderate stunting/CM	27.2%	24.1%	27.7%
Severe stunting/CM	7.0%	5.0%	6.9%
6-23mth	30.8%	20.8%	30.4%
24-59mth	35.9%	33.7%	36.8%

## Overall results, trends, and anomalies.

The overall results show a GAM (WHZ) of 11.3% which is in the High/Serious range (10-15%) according to WHO/UNICEF classification. The stunting rate was 34.2%, which falls in the Very High range ( $\geq 30$ ) according to WHO/UNICEF classification.

When comparing back to round four conducted in September-October 2019, GAM, MAM, and SAM prevalence by WHZ show a minor increase in Makeshift Camps and Nayapara RC, as has MAM prevalence in Kutupalong RC. However, GAM and SAM rates in Kutupalong RC have shown a slight decrease since round four.

For GAM, MAM, and SAM prevalence by MUAC the results are more mixed. Makeshift camps have seen a significant decrease across GAM and MAM, but a small increase in SAM. In Nayapara RC all Acute Malnutrition (MUAC) rates saw a slight increase. For Kutupalong RC, GAM and MAM rates increased slightly, but the SAM rate dropped to 0.0%.

In terms of Chronic malnutrition, prevalence rates were similar to round four except in two cases. (1) Stunting and Underweight rates in Nayapara RC dropped considerably with the stunting rate (HAZ) falling from 39.0% to 29.1%, below the high range threshold. One possible explanation is linked with sampling characteristics where there is a comparatively higher percentage of younger children (6-29m) compared to older children (30-59m). Younger children are less likely to be stunted. (2) Underweight prevalence in Kutupalong RC increased from 27.7% to 34.6% although the stunting prevalence rate remains almost unchanged ([ACF/FSC 28/01/2021](#)).

## Effect of COVID-19 on Nutrition.

The data from the nutrition survey shows both Acute and Chronic malnutrition rates remain mainly unchanged (with a couple of exceptions). In addition, significant improvement of diarrhoea prevalence was observed in all three survey areas with rates below 15% in three survey locations. Rates of crude and under 5 death rates (CDR and U5DR) were well below the emergency thresholds with no major concern. These figures all suggest a limited short to the medium-term impact of COVID-19 and associated containment measures on current acute malnutrition rates within the camps.

### Use of MUAC by mothers along with sector partner screening continues to identify SAM and MAM cases.

The sector continues promoting good hygiene behaviours and COVID-19 preventive measures together with providing nutrition services. In March 2021, sector partners trained 2,988 mothers of children under five in the use of MUAC for diagnosis of malnutrition and self-referral through the Mother Led MUAC project. Those mothers referred 3,162 suspected SAM and MAM children to the integrated nutrition facility (Nutrition Sector 23/04/2021).

In March 2021, the sector partners screened 146,177 children under five and 32,251 PLW in the Rohingya camps. Out of all screened children under five, 436 girls and 233 boys were admitted to the SAM treatment (OTP) programme; 1,651 MAM girls and 821 boys were admitted to the MAM treatment (TSFP) programme. Out of SAM and MAM children, 31 girls and 10 boys were with different types of disabilities (Nutrition Sector 23/04/2021).



### Information Sources and Gaps.

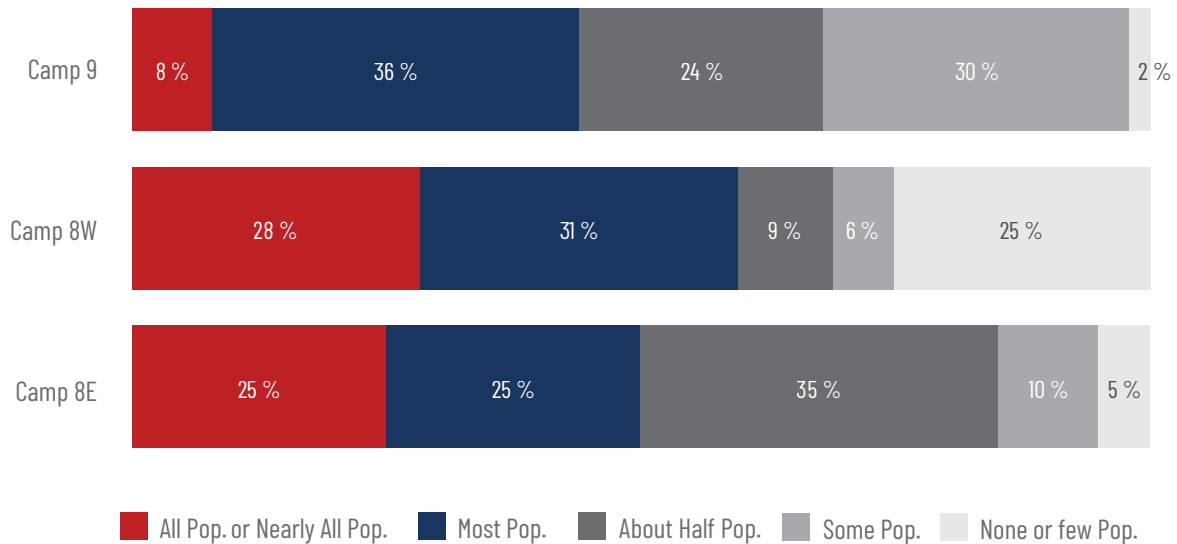
Assessment of needs of the affected people and damages to the WASH sector caused by the fire is covered in the [Inter Sector Coordination Group \(ISCG\)](#) initial rapid joint needs assessment and their latest [ISCG](#) report on the Joint Humanitarian Response to the fire incident (as of 31st of March), and [BRAC](#) situation report. Already existing challenges in the WASH sector are covered by the preliminary findings from the Refugee influx Emergency Vulnerability Assessment ([REVA 4](#)), despite the assessment not specifically covering the affected areas, but all camps, it provides an understanding of issues that might arise with the destruction of WASH facilities.

**The recent fire in the camps of Cox's Bazar destroyed thousands of WASH facilities and led to people waiting for hours to get water.**

An estimated 4,000 water, sanitation, and hygiene infrastructure structures have been either damaged or destroyed, mainly within camp 9 ([ISCG 31/03/2021](#)). The fire also destroyed hygiene items stored by camp residents ([IFRC 26/03/2021](#)).

According to the initial rapid joint needs assessment by ISCG (31 March), 82% of key informants reported that most latrines or nearly all latrines were damaged. The assessment shows that all camps were almost equally impacted in terms of damages to latrines. Sixty-four percent of KIs in camp 9, 66% of KIs in camp 8W, and 65% of KIs in camp 8E reported that most or all people do not have access to functional latrines ([ISCG 25/03/2021](#)). According to REVA 4, one of the sanitation problems most reported by refugees in 2020 was a lack of functional facilities ([REVA 4 07/02/2021](#)), the destruction in facilities caused by the fire is expected to worsen the situation, and increase the risk of disease outbreak.

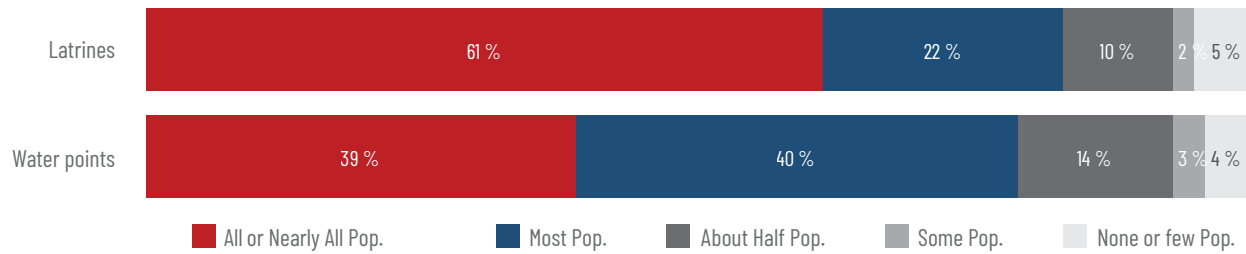
**Figure 26. Percentage of population with limited access to safe drinking water** (Source: [ISCG 25/03/2021](#))



Seventy-nine percent of key informants reported that most or nearly every water point was damaged ([ISCG 25/03/2021](#)). As a result of this damage, there have been reports of long queues with people waiting for hours to get water. Queuing at water points, lack of sufficient water points, and distance to these points were already some of

the most widely reported water access problems in 2020 by the refugee community ([REVA 4 07/02/2021](#)), it is likely that also these issues will be exacerbated as a result of the fire. Additionally, access to adequate water points is essential in decreasing the COVID-19 transmission rate.

**Figure 27. Percentage of damaged wash facilities in refugee camps 9, 8 W and 8E** (Source: [ISCG 25/03/2021](#))



Repair work to water supplies has already begun in the affected camps. Some temporary water tanks have been installed and temporary repairs were carried out in latrines and bathing spaces. The materials used in the temporary repairs or the construction of temporary emergency latrines are bamboo poles and sheeting for the superstructure, while it provides minimum dignity standards ([ISCG 31/03/2021](#), [Medair 29/03/2021](#)), these materials are susceptible to extreme weather conditions and fire.

**Already existing problems in waste management facilities and drainage systems were compounded by the fire, if left unchecked for an extended period of time it could lead to the spread of waterborne diseases.**

The fire has damaged numerous collection facilities, including the collection and recycling locations. It also burnt a fecal sludge treatment plant in Camp 9 ([Islamic Relief 24/03/2021](#), [ISCG 31/03/2021](#)). Refugees in camps were already facing problems to maintain cleanliness and hygiene due to poor waste management and drainage

systems, which, in some cases, refugees have reported that they are left overflowing or blocked. Highlighting the need for a comprehensive waste management system and the importance of fast and complete reconstruction to reduce the risk of waterborne, mosquito-borne, and other water-related diseases ([Biomedcentral 26/02/2021](#), [BBC Media Action 31/03/2021](#)).

Compounding the problems is the new waste generated from the food distribution to the affected people following the fire. Much of the packaging is then thrown in the drains and surrounding areas, as there are no designated waste bins or garbage disposals ([BRAC 28/03/2021](#)). In response to this issue, the Food Security Sector is calling on partners to ensure packaging going into the camps transitions away from Styrofoam as the landfill capacity is limited and Styrofoam waste is bulky and single-use ([Food Security Cluster 31/03/2021](#)). It is unclear whether these calls have been widely implemented or not. Improper disposal practices can have a significant impact on the remaining functional WASH facilities.

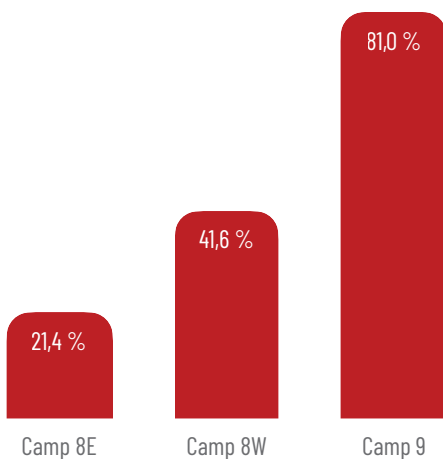
### Information Sources and Gaps

Details of the damage caused by a serious fire in camps 09, 08W, 08E, and 10 to shelters are provided in [ISCG's](#) initial rapid assessment. The response to the fire is provided by [ISCG's](#) joint humanitarian response report, [IOM One Week later](#) report, and the [Shelter/NFI sector](#) report. Information on the conditions of shelters the refugees are returning to is unavailable.

### Almost 50,000 people are left without shelter following a massive fire in camps 09, 08W, 08E, and 10

According to the initial rapid joint assessment, 10,100 shanties (individual residential huts) were partially or fully damaged as a result of the fire. Eighty-eight percent of key informants indicated that most or all shelters were damaged. Nearly all of camp 9's population lost their shelters, approximately half of the population of camp 8W lost their shelters, and some of the population of camp 8E. Minor damages were also reported in camp 10, along its border with camp 9 ([ISCG 31/03/2021](#), [IOM 30/03/2021](#), [ISCG 25/03/2021](#), [Shelter/NFI Sector 25/03/2021](#)). The significant damages and destruction to shelters is reflected in the top priorities reported by KIs, with shelter being reported as first priority across all camps ([ISCG 25/03/2021](#)).

**Figure 28. Percentage of shelter damaged in refugee camps 9, 8 W and 8E** (Source: [Shelter/NFI Sector 25/03/2021](#))



The vast majority of the people affected and were forced to move from their homes are in camps 9, 8W, and 8E, however, many refugees living in adjacent camps evacuated their shelters temporarily ([UNHCR 24/03/2021](#)). Almost 50,000 refugees and over 1,000 members of the host community were left homeless by the fire. Some are being hosted by other Rohingya or relatives, some are staying in adapted facilities (such as learning centres or women friendly spaces), and some are sleeping outdoors in open spaces ([UNHCR 27/03/2021](#), [Project HOPE 26/03/2021](#)). As of 31 March 2021, more than 30,000 individuals reportedly have returned to their original camps following the distributions of shelter kits ([ISCG 31/03/2021](#)). However, it is still unclear the condition of the shelter and the camps where people are returning to. Additionally, the destruction of the shelters have led to camps becoming even more congested putting the people at risk of disease outbreak and likely to increase their exposure to COVID-19.

### The shelters in refugee camps are often built with temporary and weak material making it vulnerable to fire. While temporary shelters are urgently needed, quick reconstruction of durable homes is important as the monsoon season approaches

Fires occur regularly in the refugee camps, including one in January that destroyed hundreds of homes ([CERF 25/03/2021](#)). The shelters in the Rohingya camps are often made of weak materials and highly flammable bamboo and tarpaulin. Although it is still unclear how the fire started, the materials of the shelters meant that fire spread rapidly across the camps, especially that the affected areas are some of the most congested in the Rohingya camps ([MSF 23/03/2021](#), [Project HOPE 26/03/2021](#), [IOM 31/03/2021](#)). The temporary electricity lines crisscrossing the camps and the usage of LPG cylinders for cooking increase the danger ([Al Jazeera 27/03/2021](#)). While temporary shelters are urgently needed, quick reconstruction of durable permanent homes and repair of damaged ones is important ([Concern Worldwide 23/03/2021](#), [ACAPS 25/03/2021](#)). According to the BBC Media Action community feedback data for the first two months of 2021, some of the most pressing concerns for the Rohingya community are the vulnerability of their shelters to landslides; houses in the hill-areas in Cox's Bazar are at risk of landslides. This highlights the need to build more disaster-resilient shelters and retention walls to protect shelters, especially as the monsoon season approaches ([BBC Media Action 31/03/2021](#), [Dhaka Tribune 17/02/2021](#)).

# EDUCATION

## Information Sources and Gaps

A new assessment by [REACH](#) (data collected from October 2020 to January 2021) on the education sector in Cox’s Bazar for both the refugees and host community, highlights the impact of the COVID-19 on accessing education, especially remote learning including challenges faced by children, caregivers, and teachers. The Joint Multi-Sector Needs Assessment ([J-MSNA](#)) (July-August) is also utilised to detect continuing trends. There is data missing on how much children are studying on average per week compared to before the pandemic. It is also unclear to what extent are students finding distance learning harder or easier than in-person classes. This might give an idea of how much learning was actually lost throughout the school closures. It is also unclear when teachers were first allowed to do home visits in the camps.

**Children in camps were struggling to access education even before the pandemic, but as students were forced to move to distance learning, the refugee community and poorer households have been further disadvantaged in terms of education service provision**

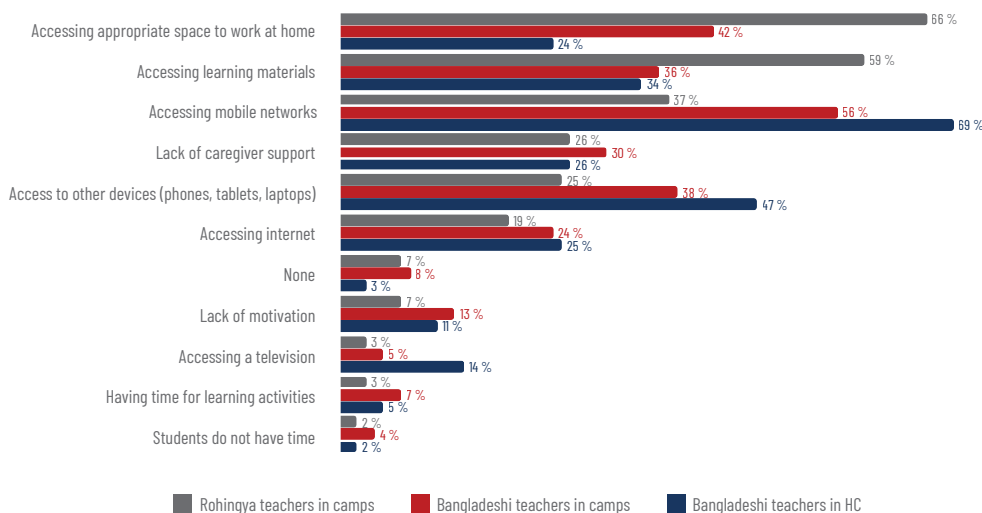
Enrolment rates were already lower in the camps than in the host community according to pre-crisis data. Even before the pandemic, Rohingya children were not able to attend formal schools, leaving the Rohingya community relying on the education services provided by the humanitarian agencies ([REACH 29/03/2021](#)). Findings from the latest [REACH](#) assessment conducted between October 2020 and February 2021, show a continuing trend, where the proportion of students who have no access to

learning opportunities since schools and learning centres closed is reportedly higher in camps than in the host community. Additionally, the closure of learning centers, and the move towards remote learning modalities widened inequalities and strengthened existing challenges. This is especially true for Rohingya children and children in poorer households.

According to the [REACH](#) assessment, 65% of caregivers reported that their children had no access to electricity for learning purposes and 90% reported children are unable to access the internet. The primary reason behind inaccessibility is a government directive imposed in 2019 banning internet access within the camps citing “security” reasons ([IRC 25/08/2020](#)), this has also impacted the learning modalities adopted in the camps. Internet methodologies were not fully developed or utilised in the camps, therefore access to the internet does not necessarily mean accessibility to education ([REACH 29/03/2021](#)). It is important to note that, as of the end of 2020, 78% of school-aged children from the refugee community were not studying, 50% of which are not studying because of COVID-19-related reasons ([REVA 4 07/02/2021](#)), which indicates that students in the camp have barriers to education beyond those created by COVID-19 containment measures.

For the host community, economic constraints remain the main barrier to education ([REACH 29/03/2021](#)). This is consistent with findings from J-MSNA (July - August 2020) where one of the main barriers reported for accessing distance learning for the host community was the inability of parents among poor families to support due to lack of education and lack of money ([J-MSNA 01/10/2020](#)).

**Figure 29. Barriers of students remote learning** (Source: [REACH 29/03/2021](#))



Access to electricity in the host community is relatively better compared to the refugee community. According to the assessment, 82% of children had access to electricity for at least 6 hours per day, while over half of children do not have access to the internet (REACH 29/03/2021). But improving access to technology, will not necessarily translate into improved technology-enabled learning. A survey (conducted between May and June 2020) of secondary schools in Bangladesh found that despite most students being aware of the government TV-based learning programs, only half of the students with access to these programs choose to watch them. Of the 21% of children who can access online learning programs, only about 2% choose to access them (World Bank 16/07/2020).

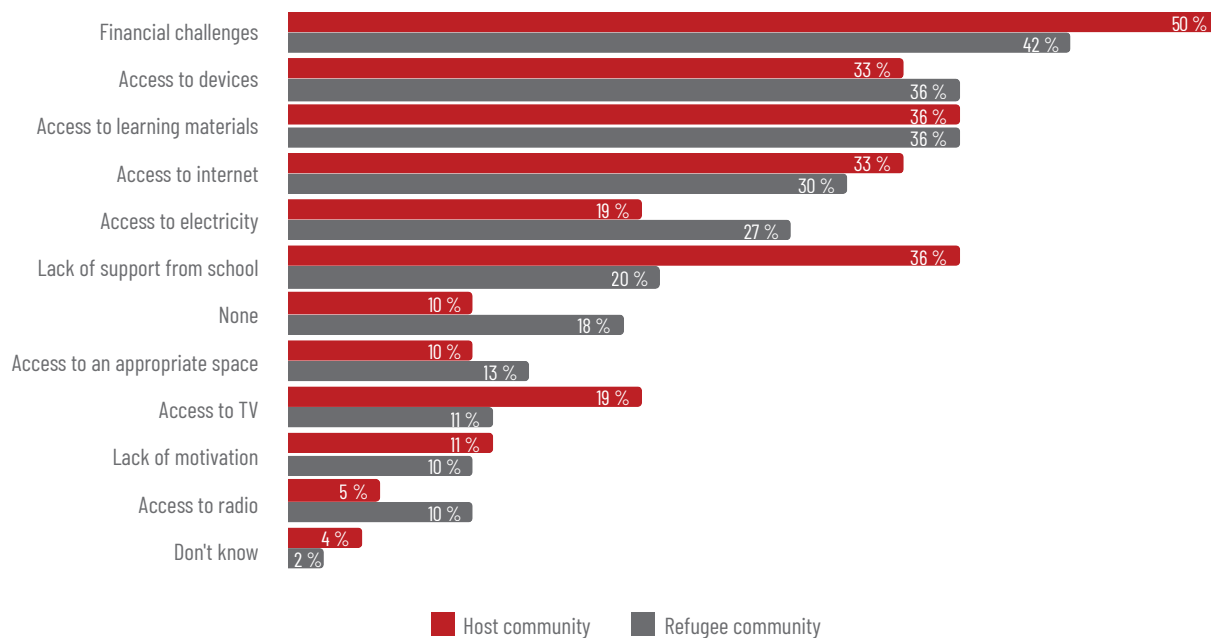
Overall, schools in the host community have been able to adapt and follow government recommendations for distance learning, while in camps learning centers do not have access to the same resources. Sixty-one percent of caregivers in camps reported that their children had no access to any learning modalities and technologies, while in the host community it was at 50%. Another difficulty in the camps is the challenge in recruiting and retaining qualified teachers. Bangladeshi teachers reportedly are more qualified than their Rohingya counterparts, with 75% of Bangladeshi teachers having at least higher secondary or tertiary qualifications, compared to 15% with Rohingya. However, since the beginning of the pandemic Bangladeshi teachers had reduced access to the camps (REACH 29/03/2021).

**Students are facing difficulties in accessing distance learning modalities, especially technology, which are creating significant barriers to education. Other barriers to remote learning were reported by teachers such as access to appropriate workspace in the home, and lack of caregiver support**

The most commonly reported challenges in accessing distance learning modalities is financial according to both the host community (50%) and the refugee community (42%)(REACH 29/03/2021). As previously mentioned this is consistent with findings from mid-2020 by J-MSNA where lack of money to pay for private tuition was cited as one of the main barriers to studying remotely by both the refugees and the host community (J-MSNA 01/10/2020). This means that poorer students and refugees have been disproportionately affected by the school closures.

Financial constraints are also some of the main reasons behind the limited ability to use the internet and electricity-based technologies such as online and television classes. This limitation is reflected in the modalities used for remote schooling. In both communities, paper learning materials are the most accessible modality (approximately 30%), while access to technological devices such as smartphones or mobile phones is limited, especially in camps. Having said that, there is a perception among both caregivers and teachers that the internet is a valuable tool and perceive the lack of access to it as a significant barrier to education (REACH 29/03/2021).

**Figure 30. Challenges in accessing distance learning modalities** (Source: REACH 29/03/2021)



More than half of teachers in camps have identified 'access to appropriate space to work at home' as the main barrier for remote learning, 'lack of caregiver support' was also scored highly. The large proportion of teachers reporting barriers related to workspace at home can be linked to the increased number of home visits. According to 71% of surveyed Rohingya teachers they have daily contact with students. It is important to note that caregivers reported much lower frequencies of contact, only 17% of caregivers agree that teachers have daily contact with the students ([REACH 29/03/2021](#)).

### **The fire which broke out on 22 March destroyed 176 learning facilities, and some of the remaining functional facilities are being used as shelters for people affected by the fire**

The fire has caused a significant impact on learning facilities in the affected camps, destroying 176 facilities including learning centers, community-based learning facilities, and cross-sectoral shared learning facilities. According to the joint rapid assessment, 88% of KI reported that all or most of the educational facilities in the affected camps were damaged ([ISCG 25/03/2021](#)). Educational materials and books were also destroyed in the fire. Aid agencies delivering education support in the camp have estimated that over 14,000 children are out of reach of education due to the fire ([ISCG 31/03/2021](#)).

As of the end of March, some 66 learning centers which were not affected by the fire are being used as temporary shelters ([ISCG 31/03/2021](#)), at the same time aid agencies estimate that recovery from the fire in terms of the education sector will take more than three months ([Save](#)

[the Children 30/03/2021](#)). The limited number of available educational facilities due to destruction or temporary use as shelter is likely to have an impact on children's access to education. According to the minister of education, schools are scheduled to open on 23 May but the limited space available highlights the importance of quickly re-establishing education facilities and shelter before re-opening ([UNB 30/03/2021](#), [Dhaka Tribune 25/03/2021](#), [ACAPS 25/03/2021](#)).

### **The prolonged closure of schools continue to increase protection issues and affect future prospects of children**

Multiple reports have indicated a perception increase in the rate of children dropping out of school and from other learning opportunities as a result of the prolonged closure of schools and learning centres. Higher rates of dropout have an implication on increased risk of child, early, and forced marriage. Missing out on learning opportunities also have long-term implications on child and youth growth and skills development and in turn will impact future prospects and earnings ([Citizen's Platform for SDGs 01/01/2021](#)).

An Increase in daily infection rate and a surge in deaths has pushed back the re-opening date of schools to 23 May ([UNB 30/03/2021](#)). As school closures keep getting extended for over a year now, the risk of more children dropping out, and the increase in associated risks continue to be a concern. However, it is still unclear how much learning those who continued distance learning actually had ([REACH 29/03/2021](#)). The actual impact of school closures on dropout rates will only be known after schools reopen.

### Information sources and gaps

Data on protection issues and concerns following the fire on 22 March is covered by the initial rapid assessment by ISCG. Some of the challenges and needs in the response are provided by the [Child Protection Sub Sector \(CPSS\)](#). The Anti-Trafficking [Dashboard](#) by the Protection Working Group provides monthly reported cases of human trafficking, the most latest published one covers January 2021. Information about the extent to which protection services have resumed as of February 2021 remains limited.

### The massive fire on 22nd March 2021, damaged a substantial number of child and women-friendly spaces in the camps and exacerbated protection concerns for refugee women and children and the risk of GBV

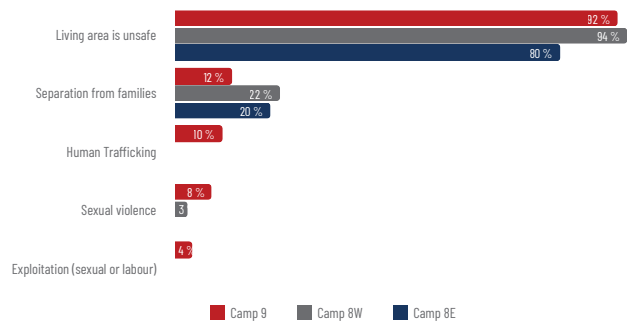
According to findings from the Inter-Sector Coordination Group (ISCG) Rapid Joint Needs Assessment conducted immediately following the fire, 77% of the site management KI's reported that all or most child-friendly spaces in the most affected camps (9, 8W, and 8E) are damaged, slightly less site management KIs (75%) reported damage to all or most women-friendly spaces in the camps ([ISCG 25/03/2021](#)). Many of the remaining functioning ones are being used as temporary shelter. These facilities provide healthcare and counselling, as well as professional case management for survivors of violence and people at risk of child marriage or trafficking ([CARE 14/09/2020](#)).

Such safe spaces are urgently needed, not only did COVID-19 already increase risks related to gender-based violence (GBV) but also the fire exacerbated existing risks and exposed women and children to additional threats to their personal safety. Many of them are staying in temporary shelters or open spaces with inadequate lighting, and suffering from a lack of water and sanitation facilities, exposing them to the risk of harassment, assault, or violence. This is reflected in the concerns of the affected people, according to the initial rapid assessment, "living area is unsafe" is reported by almost all KI as the main concern for women's safety, followed by sexual harassment and violence ([ISCG 25/03/2021](#)). Elderly and pregnant women have also reported increased difficulties in accessing critical health services ([IRC 23/03/2021](#)).

An unknown number of separated and unaccompanied children were reported in the camps, in addition many caregivers are busy dealing with the aftermath of the fire,

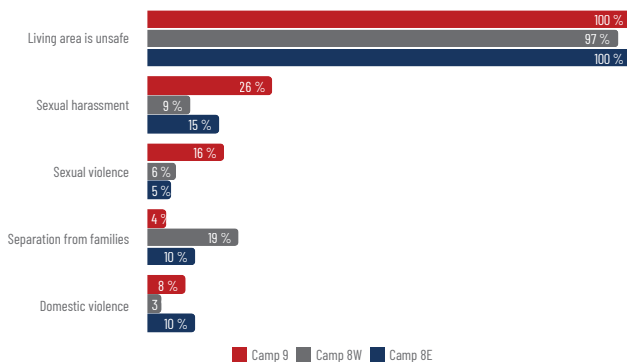
leaving children unsupervised. As a result, children are more vulnerable to protection issues and are at risk of exploitation, trafficking, or injury. Some children were observed collecting and selling items obtained from going through debris for very little money or food. Younger boys were observed cleaning up debris leading to concerns about exploitation ([CPSS 25/03/2021](#)). However, according to the KIs 'living area is unsafe' is also the main concern for children, 'separation from families' was a distant second.

**Figure 31. Safety concern for the children in refugee camps 9, 8 W and 8E** (Source: [ISCG 25/03/2021](#))



However, it is likely that the reduction in protection activities due to COVID-19 restrictions in addition to the destruction of many facilities during the fire will impact protection and reunification efforts to some degree ([CPSS 25/03/2021](#), [PWG 11/2020](#)). According to the Child Protection Sub Sector, the longer children are separated, the less likely reunification and the more burdensome the verification process becomes as children face a higher risk of protection concerns ([CPSS 25/03/2021](#)).

**Figure 32. Safety concern for the women in refugee camps 9, 8 W and 8E** (Source: [ISCG 25/03/2021](#))



Many refugees have also lost their personal documents, such as birth certificates and identity cards. However, humanitarian agencies have exempted the people affected by the fire from providing documentation for food assistance and have already started issuing such documents ([ISCG 31/03/2021](#), [WFP 23/03/2021](#)). It is worth noting that according to [BBC Media Action](#) community feedback, concerns over documentation among the Rohingya community have witnessed a decrease of 9% in the first two months of 2021 in comparison to 2020, but remains a key concern with 28% of feedback related to documentation. This comes after a steady increase in concerns from 2018 to 2020. It remains unclear if the decrease in concerns over documentation will continue throughout the year or not.

**Despite the increased protection risks including risks of trafficking and other forms of abuse and exploitation since the beginning of the pandemic, reported human trafficking cases have decreased in December 2020 and January 2021 compared to previous months.**

According to the Anti-Tracking Dashboard, human trafficking continues to be reported in Cox's Bazar as of January 2021, with 8 cases of trafficking reported throughout the month, all of which are related to forced labor. The restrictions on livelihoods and education and the dwindling resources to meet basic needs are some of the factors that lead refugees to resort to smuggling and place them at risk of trafficking ([UNHCR 17/03/2021](#)).

However, reported cases have decreased in December 2020 and January 2021 compared to previous months ([UNHCR 17/03/2021](#), [UNHCR 14/02/2021](#)), but this decrease does not necessarily mean an improved security situation. In fact, overwhelming evidence suggests that COVID-19 related containment measures have exacerbated pre-existing protection risks such as child labor, child marriage, kidnapping, and human trafficking ([CARE International 14/10/2020](#), [PWG 11/2020](#)). The closure of schools has also compounded these risks ([UNHCR 14/02/2021](#)). Therefore, the decrease may just reflect a decrease in reported cases due to movement restrictions and reduced activity of protection services and authorities.

# ABOUT THIS REPORT

IMMAP and DFS currently implement the OFDA COVID-19 support project in six countries: DRC, Burkina Faso, Nigeria, Bangladesh, Syria, and Colombia. The project duration is twelve months and aims at strengthening assessment and analysis capacities in countries affected by humanitarian crises and the COVID-19 pandemic. The project's main deliverables are monthly country-level situation analysis, including an analysis of main concerns, unmet needs, and information gaps within and across humanitarian sectors.

The first phase of the project (August–November 2020) focuses on building a comprehensive repository of available secondary data in the DEEP platform, building country networks, and providing a regular analysis of unmet needs and the operational environment in which humanitarian actors operate. As the repository builds up, the analysis provided each month will become more complete and robust.

**Coordinating Sectors and Agencies:** ISCG, IOM, UNICEF, ACF, CwCWG, TWG, Food Security and Livelihood Sector, Nutrition Sector, Child Protection Sector, Shelter & NFI Sector.

**Methodology.** To guide data collation and analysis, IMMAP and DFS designed a comprehensive Analytical Framework to address specific strategic information needs of UN agencies, INGOs, LNGOs, clusters, and HCTs at the country level. It is essentially a methodological toolbox used by IMMAP/DFS Analysts and Information Management Officers during the monthly analysis cycle. The Analytical Framework:

- Provides the entire suite of tools required to develop and derive quality and credible situation analysis;
- Integrates the best practices and analytical standards developed in recent years for humanitarian analysis;
- Offers end-users with an audit trail on the amount of evidence available, how data was processed, and conclusions reached;

The two most important tools used throughout the process are the Secondary Data Analysis Framework (SDAF) and the Analysis Workflow.

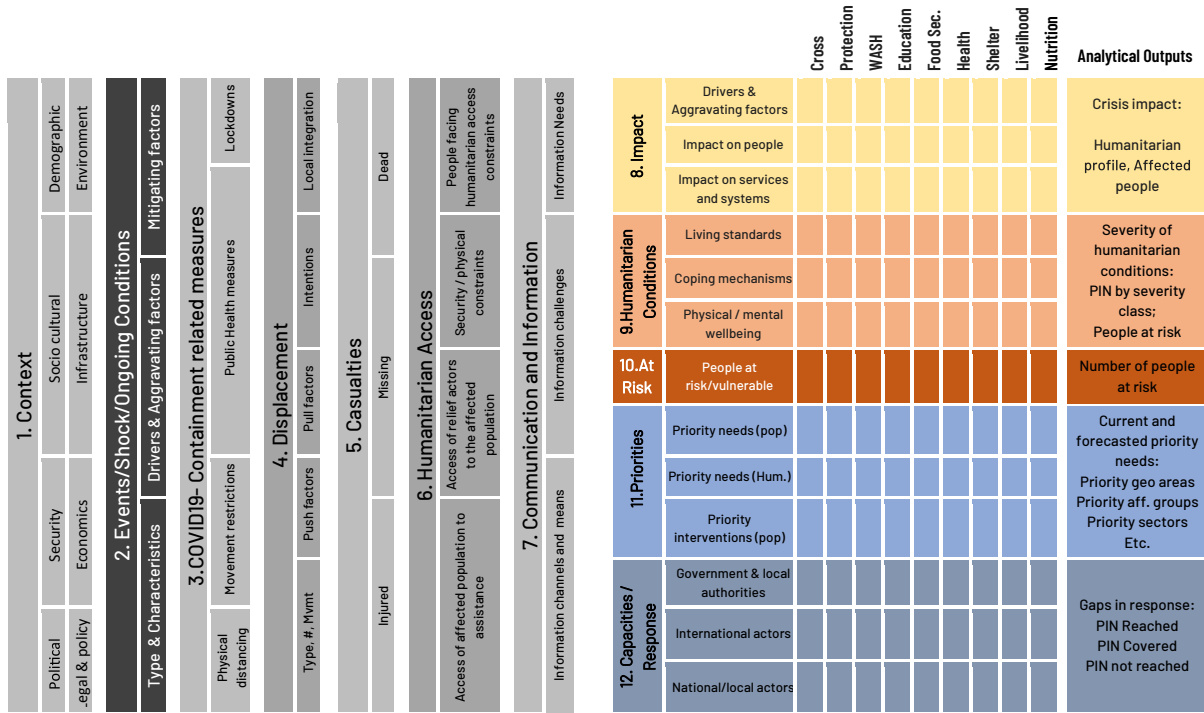
**The Secondary Data Analysis Framework** was designed to

be compatible with other needs assessment frameworks currently in use in humanitarian crises (Colombia, Nigeria, Bangladesh) or developed at the global level (JIAF, GIMAC, MIRA). It focuses on assessing critical dimensions of a humanitarian crisis and facilitates an understanding of both unmet needs, their consequences, and the overall context within which humanitarian needs have developed, and humanitarian actors are intervening. A graphic representation of the SDAF is available in figure 19.

On a daily basis, IMMAP/DFS Analysts and Information Management Officers collate and structure available information in the DEEP Platform. Each piece of information is tagged based on the pillars and sub-pillars of the SDAF. In addition, all the captured information receives additional tags, allowing to break down further results based on different categories of interest, as follows:

1. Source publisher and author(s) of the information;
2. Date of publication/data collection of the information and URL (if available);
3. Pillar/sub-pillar of the analysis framework the information belongs to;
4. Sector/sub-sectors the information relates to;
5. Exact location or geographical area the information refers to;
6. Affected group the information relates to (based on the country humanitarian profile, e.g., IDPs, returnees, migrants, etc.);
7. Demographic group the information relates to;
8. The group with specific needs the information relates to, e.g., female-headed household, people with disabilities, people with chronic diseases, LGBTI, etc.;
9. Reliability rating of the source of information;
10. Severity rating of humanitarian conditions reported;
11. Confidentiality level (protected/unprotected)

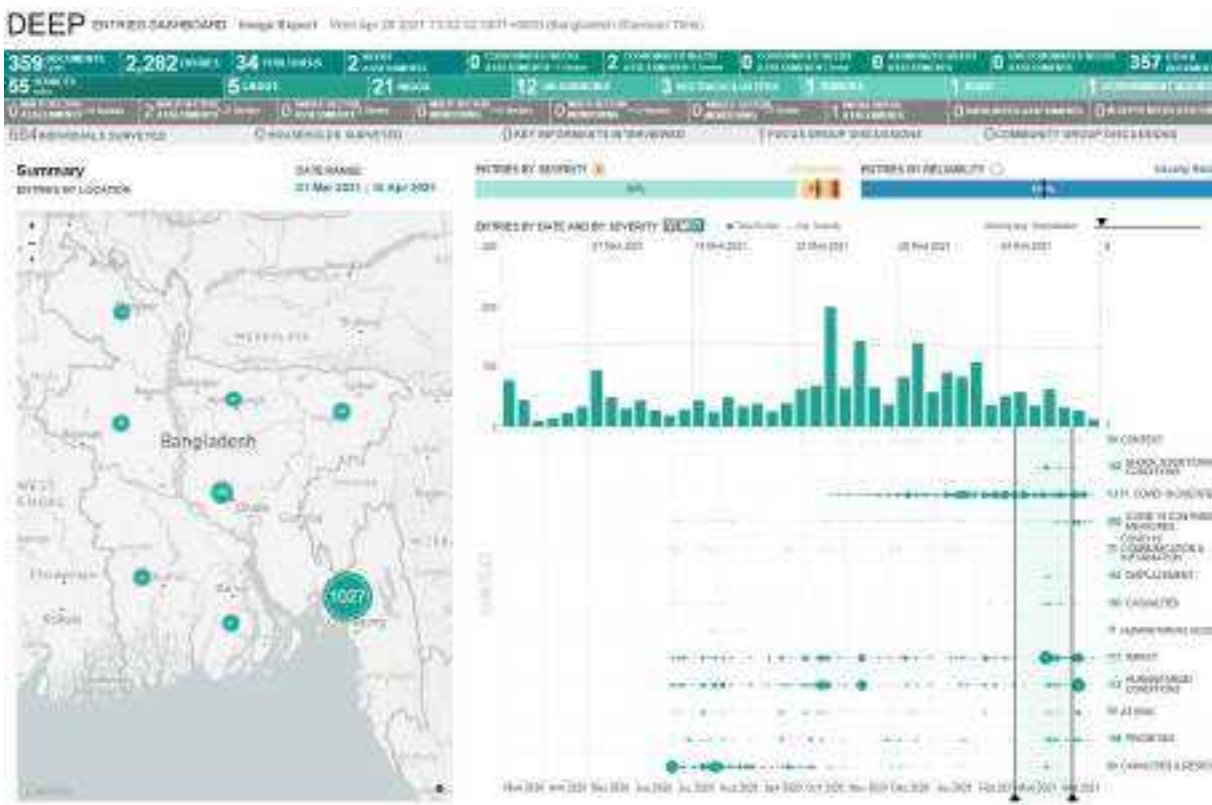
**Figure 33.** IMMAP/DFS Secondary Data Analysis Framework



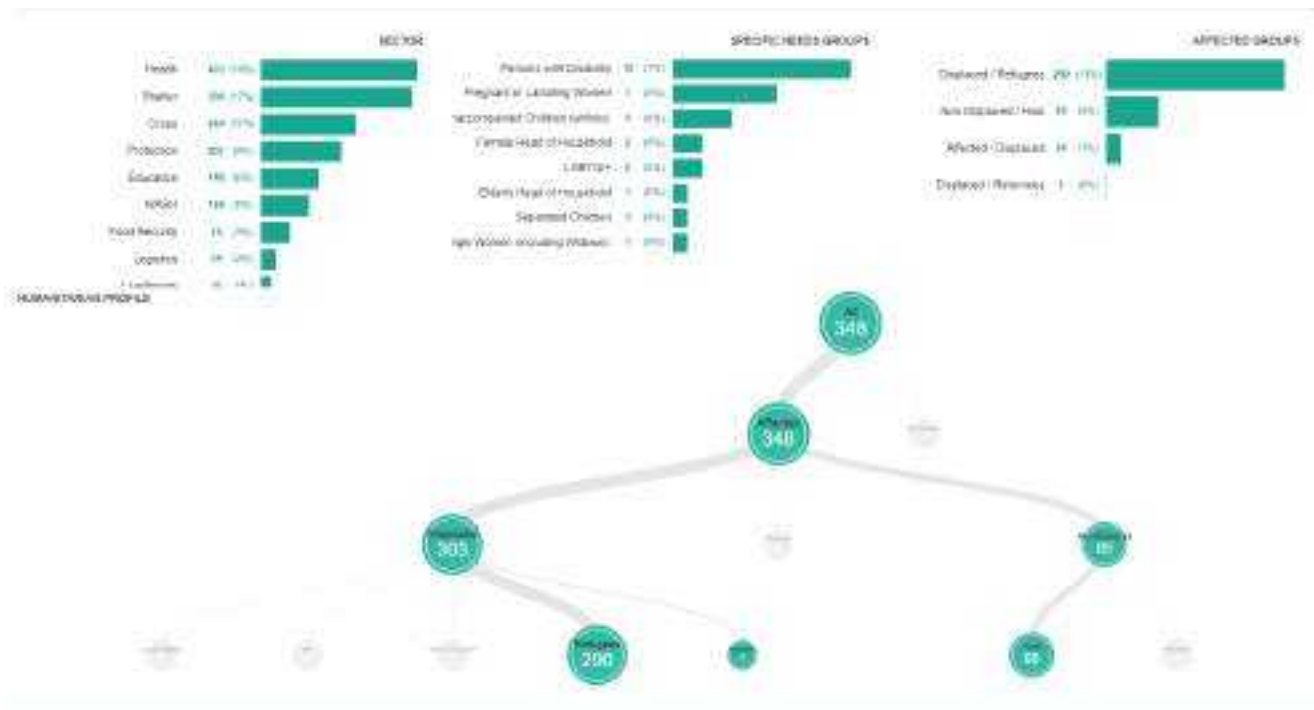
The DEEP structured and searchable information repository forms the basis of the monthly analysis. Details

of the information captured for the Bangladesh Cox's Bazar report are available below (publicly available documents primarily from 01 March to 04 April 2021 were used).

**Figure 34.** Documents by Location, Timeline, and Primary Categories (Analytical Framework)



**Figure 35.** Figure 35. Documents and Entries by Sector and Affected Group



**Figure 36.** Entries by Sector and sub-Categories (Analytical Framework)

ANALYTICAL FRAMEWORK	IMPACTS	HUMANITARIAN CONDITIONS	AT RISK	PRIORITY	CAPACITIES & RESPONSE	LEADS	FOOD SECURITY LIVELIHOODS	HEALTH	NUTRITION	WASH	PROTECTION	EDUCATION	PROTECTION	AGRICULTURE	TOTAL	
IMACTS	Drivers/Aggravating Factors	Impact on People	Number of People Affected	Living Standards	Physical & Mental Wellbeing	244	18	28	167	23	124	256	142	287	2	23
HUMANITARIAN CONDITIONS	Number of People at Risk / Vulnerable	People at Risk / Vulnerable	Priority Needs (Food)	Priority Needs (Shelter)	Priority Interventions (Food)											
AT RISK	Government & Local Authorities	Natural & Local Actors														

**Analysis Workflow.** IMMAP/DFS analysis workflow builds on a series of activities and analytical questions specifically tailored to mitigate the impact and influence of cognitive biases on the quality of the conclusions. The IMMAP/DFS workflow includes 50 steps. As the project is kicking off, it is acknowledged that the implementation of all the steps will be progressive. For this round of analysis, several structured analytical techniques were implemented throughout the process to ensure quality results.

- The ACAPS Analysis Canvas was used to design and plan for the September product. The Canvas support Analysts in tailoring their analytical

approach and products to specific information needs, research questions or information needs.

- The Analysis Framework was piloted, and definitions and instructions set to guide the selection of relevant information as well as the accuracy of the tagging. A review workshop was organized in October 2020 to review pillars and sub pillars and adapt if necessary.

An adapted interpretation sheet was designed to process the available information for each SDAF's pillar and sub pillar in a systematic and transparent way.

The Interpretation sheet is a tool designed so IMMAP/DFS analysts can bring all the available evidence on a particular topic together, judge the amount and quality of data available and derive analytical judgments and main findings in a transparent and auditable way.

Information gaps and limitations (either in the data or the analysis) were identified. Strategies have been designed to address those gaps in the next round of analysis.

The analysis workflow is provided overleaf (Figure 37).

**Figure 37.** IMMAP/DFS Analysis Workflow

<b>IMMAP/DFS Analysis Workflow</b>					
	<b>1.Design &amp; Planning</b>	<b>2.Data collation &amp; collection</b>	<b>3.Exploration &amp; Preparation of Data</b>	<b>4. Analysis &amp; Sense Making</b>	<b>Sharing &amp; Learning</b>
<b>Main activities</b>	Definitions of audience, objectives and scope of the analysis	Identification of relevant documents (articles, reports)	Categorization of the available secondary data	Description (summary of evidence by pillar / sub pillar of the framework)	Report drafting, charting and mapping
	Key questions to be answered, analysis context, Analysis Framework	Identification of relevant needs assessments	Assessment registry	Explanations (identification of contributing factors)	Editing and graphic design
	Definition of collaboration needs, confidentiality and sharing agreements	Data protection & safety measures, storage	Additional tags	Interpretation (priority setting, uncertainty, analytical writing)	Dissemination and sharing
	Agreement on end product(s), mock-up and templates, dissemination of products	Interviews with key stakeholders	Information gaps identification	Information gaps & limitations	Lessons learnt workshop, recommendations for next round
<b>Tools</b>	<ul style="list-style-type: none"> <li>Analysis Framework</li> <li>Analysis Canvas</li> <li>Data sharing agreements</li> <li>Report template</li> </ul>	<ul style="list-style-type: none"> <li>SDR folder</li> <li>Naming convention</li> </ul>	<ul style="list-style-type: none"> <li>DEEP (SDAF)</li> <li>DEEP (Assessment registry)</li> <li>Coding scheme</li> </ul>	<ul style="list-style-type: none"> <li>Interpretation sheet</li> </ul>	<ul style="list-style-type: none"> <li>Revised report template</li> <li>Analytical writing guidance</li> <li>Lessons learnt template</li> </ul>



**THANK YOU.**



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**Contact**

**Bangladesh Focal Point**

**Alex Nwoko**

Email: [anwoko@immap.org](mailto:anwoko@immap.org)

**Global Project Manager**

**Benjamin Gaudin**

Email: [bgaudin@immap.org](mailto:bgaudin@immap.org)

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