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# WHAT IS THE IMPACT OF URBANISATION ON RISK OF, AND VULNERABILITY TO, NATURAL DISASTERS? WHAT ARE THE EFFECTIVE APPROACHES FOR REDUCING EXPOSURE OF URBAN POPULATION TO DISASTER RISKS?

PROTOCOL FOR STAGE 1

**Submitted on: 07/02/2016**

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# 1. BACKGROUND

## 1.1 AIMS AND RATIONALE FOR REVIEW

In 2014, there were 980 natural disasters (Loss events) worldwide, 92% of which were weather-related (meteorological and hydrological) disasters (Munich Re 2015). Overall costs were estimated at US$110 billion and insured losses at $31 billion (Munich Re 2015). Among disasters in 2014, 41% were meteorological (storms), 42% were hydrological (floods), 9% were climatological (heat waves, cold waves, droughts, wildfires) and 8% were geophysical events (earthquakes and volcanic eruptions). Between 1980 and 2014 geophysical events accounted for 11% of all natural catastrophes. From 1980 to 2014 the number of natural disasters more than doubled from fewer than 400 to 980. The extent of financial loss (in $) also increased substantially (Munich Re 2015).

The most recent major natural disaster occurred in Nepal on 25 April 2015 and 12 May 2015 where earthquakes led to 8891 deaths, more than 605,000 houses destroyed and more than 289,000 damaged (USAID 2015). An estimated 5,632,110 people were somehow affected and the economic damage was estimated to be around 3,860 Million USD (CRED 2015).

Bangladesh is exposed to natural hazards, such as, floods, river erosion, cyclones, droughts, tornadoes, cold waves, earthquakes, drainage congestion/water logging, arsenic contamination, and salinity intrusion. Climate change adds a new dimension to community risks and vulnerabilities. Floods occur annually affecting 20% of the country and increase to 68% in extreme years (GoB 2008 and GoB 2010). The floods of 1988, 1998, 2004 and 2007 were particularly catastrophic, resulting in large-scale destruction and loss of lives. Bangladesh is one of the worst sufferers of all tropical cyclones from the Bay of Bengal accompanied by storm floods. On average 1.3 cyclones per annum hit the Bangladesh coast. The most damaging cyclones were those of 1970 and 1991 causing the deaths of approximately 438,882 people together. Annually, the country loses about 8,700 hectares of land due to river erosion displacing around 180-200 thousand people. Predictions of sea level rises and an increase in extreme weather events will pose increased risks to the population. Bangladesh remains in one of the most seismically active regions of the world although there were no large scale earthquakes experienced in the last hundred years (GoB 2008 and GoB 2010).

In recent decades the rate and extent of urbanisation has increased. In 2014, the majority of the world's population (54%) resided in urban areas (UN, 2014). GIven the current pace of growth, by 2050, it is anticipated that 66% of the world's population will be living in urban areas with rapid urbanisation greater in low income countries (LMIC) than developed countries (UN 2014). Commonly, urbanisation is conceptualized as a "change in size, density, and heterogeneity of cities" (Vlahov and Galea 2002). These changes, however, are not limited to population size and density, but emcompass many other processes that alter the way societies organize and interact. Rural-urban migration is one of the major factors behind rapid urbanisation with rural population

migrating to urban areas for employment, education and other livelihood opportunities. Given that the majority of the world's population now resides in urban areas, a focus on disasters and their relationship with urbanisation is overdue.

A natural disaster can cause loss of life and/or property and infrastructure damage, and typically leaves substantial economic costs in its wake. The extent of these impacts depends on a range of factors including the magnitude of the event, the degree of preparedness, the affected population's resilience, the support available, and other factors. An adverse event will not be classified as a "disaster" if it occurs in an area without vulnerable populations (Bankoff et al. 2004). In vulnerable areas, however, an earthquake can have disastrous consequences and result in lasting damage, requiring years to repair, even in countries that are relatively better off (Borcherdt and Gibbs 1976). The San Francisco earthquake in 1906 or the more recent tsunami in Japan are cases in point.

The nature and form of urbanisation also influence "risk of" and "vulnerability to" natural disasters in a number of ways. These include increasing environmental degradation, risk of extreme weather and geological events due to increased population vulnerability and concentration, and, at times, reduced resilience (Lankao and Qin 2011) and through the underpinning complex interactions among physical, socio-cultural, economic, and institutional conditions (Gencer 2013). While the increasing concentration of people, expansion of slums, deforestation, blocking of natural derange, soil erosion, and rising sea levels – all increase risk, at the same time, resilience may decline due to a reduced sense of community, poor preparedness, inadequate governance, and the inappropriate use of resources. Worldwide around 500 million people live in cities which are vulnerable to volcanic ash deposits following an eruption from as far away as 200 km. In developing countries, urban population are vulnerable to natural disasters due to unplanned growth of cities with a large population density. In addition, vulnerability is aggravated by other risk factors among poor urban populations which include poverty, inadequate nutrition, illiteracy, and low quality of water and sanitation.

One of the important characteristics of vulnerability due to urbanisation results from construction that does not meet building and industry standards. The materials used for building and industry construction may produce gas, liquid, or solids that place those living in their vicinity at risk – from explosions, collapse, and impact on the environment. In turn, these may change the climate and precipitate storms, earthquakes, floods, wild fires and other forms of disaster. These primary disasters also may exacerbate other crises such as those related to ground failure (eg; landslides, land erosion) fires, flash floods, tsunamis and hazardous materials releases (Table 1).

### *Table 1: Natural disaster and sequel of events*

| Primary Hazard | Secondary Hazards |
|---|---|
| Severe storms | Floods, tornadoes, landslides |
| Extreme summer weather | Wildfires |
| Tornadoes | Toxic chemical or radiological materials releases |
| Hurricane wind | Toxic chemical or radiological materials releases |
| Wild fires | Landslides (on hillsides in later rains) |
| Floods | Toxic chemical or radiological materials releases |
| Storm surges | Toxic chemical or radiological materials releases |
| Tsunamis | Toxic chemical or radiological materials releases |
| Volcanic eruptions | Floods, wildfires, tsunamis, hazardous materials release |
| Earthquakes | Fires, floods (dam failures), tsunami, landslides, toxic chemical or radiological materials releases |
| Landslides | Tsunami |

Humans are vulnerable to environmental extremes of temperature, pressure, and chemical exposures. Death, injury and illness might happen for hazardous agents such as water, wind, ionizing radiation, toxic chemicals, and infectious agents. The human consequences of natural disaster, however, may depend on the magnitude of the agents, the extent of population exposure and coping capacities. Moreover, vulnerabilities can be experienced in physical, social, psychological and other domains. Nepal's structural vulnerability, for example, arises, in part, from buildings constructed using designs and materials that are incapable of resisting extreme stresses such as high winds, hydraulic pressures, and instability or shaking. While building codes are often in place they are poorly enforced leaving structures vulnerable. Social vulnerability results from physical disability on which may be layers of psychological distress after a natural hazard.

Urbanisation is based on human activities and therefore cumulates the exposure of people to natural hazards and hence to physical and psychological insecurities. These consequences can be prevented by strengthening people's "capacity to anticipate, cope with, resist and recover from the impacts of a natural hazard" (Blaikie et al. 2014). There is room for improvisation in risk management in urban areas given their role as national economic drivers and hubs of intellectual, business and financial activities (UNDP 2010). Improvisation is achievable through the proximity of risk-reducing infrastructure and services, such as provision for sanitation, drainage, waste collection, health care and emergency services.

Documented interventions include raising awareness, enhancing resilience, facilitating preparedness, and planning for more effective responses. The range of stakeholders with important roles to play include government (global, national, local), civil society (local and international), and the private sector. Building awareness brings recognition of risk and enhances the potential for behaviour and policy change. Public availability and effective communication

of data enhances upstream planning and preparedness. Reducing risk through enhancing resilience requires an integrated planning process to make sure that structures are resilient to current and future hazards. Financial preparedness is crucial but challenging and involves decisions at the macro level with concomitant political commitment. Traditional insurance using risk-based pricing free from political intervention may facilitate faster recovery and reconstruction. Alternative preparedness measures include microinsurance; "catastrophe bonds" to provide liquidity in times of crisis; and country level funds to help reduce public sector liability.

The proposed systematic review will synthesize what is known about effective means of addressing proneness to and impact of disasters in urban environments and open out discussion to contextualize these insights to the South Asian region. This SR though can benefit from earlier work undertaken by members of our team (Zwi et al, 2013) and will draw upon it methodologically and practically. In addition the SR will further explore the temporal relations between urbanisation and the risk of natural hazards, which has been little investigated to date. Making interventions affordable may require additional support from other stakeholders or through disaster risk reduction and post-disaster funding mechanisms. What works to reduce and mitigate risks and impact is often unclear, as is the evidence base of effective interventions. This systematic review, and the processes of consultation and dissemination around it, aims to bring together available knowledge and evidence to inform future programming, policy and practice.

## 1.2 DEFINITIONAL AND CONCEPTUAL ISSUES

Urbanisation: Urbanisation is the process by which large numbers of people become permanently concentrated in relatively small areas, forming cities (Gencer EA 2013, Klimeš and Escobar 2010). An urban area can be defined by one or more of the following: administrative criteria or political boundaries (e.g., area within the jurisdiction of a municipality or town committee), a threshold population size (where the minimum for an urban settlement is typically in the region of 2,000 people, although this varies globally between 200 and 50,000), population density, economic function (e.g., where a significant majority of the population is not primarily engaged in agriculture, or where there is surplus employment) or the presence of urban characteristics (e.g., paved streets, electric lighting, sewerage).

Hazard: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR 2009).

Disaster: A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences (UNISDR 2009).

Natural disaster: A natural disaster is a major adverse event resulting from natural processes of the Earth; examples include floods, volcanic eruptions, earthquakes, tsunamis, and other geologic processes. A natural disaster can cause loss of life or property damage, and typically leaves some economic damage in its wake, the severity of which depends on the affected population's resilience, or ability to recover. An adverse event will not rise to the level of a disaster if it occurs in an area without vulnerable population (UNISDR 2009).

Disaster risk: Disaster risk is the 'potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period' (UNISDR 2009).

Disaster risk management: Disaster risk management aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness (UNISDR 2009).This is a systematic process of using administrative directives, organisations and operational skills and capacities to implement strategies and policies (UNISDR 2009).

Disaster risk reduction: The concept and practice of reducing disaster risks are systematic efforts to analyse and manage the causal factors of disasters. The efforts include accumulating the proper management of land with improved environment and develop preparedness for managing adverse events, due to disaster. Hence, lessened the vulnerability of people to the exposure of disaster (UNISDR 2009).

Exposure: People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses. Measures of exposure can include the number of people or types of assets in an area (UNISDR 2009).

Preparedness: The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals for anticipation of a hazard event and response to the event, thus achieving the recovery from the impacts of hazard event. (UNISDR 2009).

Resilience: 'The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions' (UNISDR 2009).

Risk assessment: Risk assessment is defined as a methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment (UNISDR 2009).

Socio-natural hazard: The phenomenon of increased occurrence of certain geophysical and hydro meteorological hazard events, such as landslides, flooding, land subsidence, chemical pollution, extreme heat and cold, drought etc. These hazards are consequences of human activity that goes beyond their natural probabilities.

Building code: A set of ordinances or regulations and associated standards intended to control aspects of the design, construction, materials, alteration and occupancy of structures that are necessary to ensure human safety and welfare, including resistance to collapse and damage (UNISDR 2009).

Vulnerability: Vulnerability to disaster depends on the level and nature of individual and societal resources, capacity and coping mechanisms. Vulnerability differentiates between one group and another, such as age, gender, ethnicity and mobility. The extent of vulnerability also depends on the frequency and intensity of natural hazards.

## 1.3 POLICY AND PRACTICE BACKGROUND

With the increasing threat of extreme weather events and other natural disasters, many countries are already taking measures to reduce their vulnerability to various natural disasters. Donors, NGOs, UN agencies, and other international and local organizations have used different approaches in this regard. A wide range of guidelines have already been developed by various organizations to inform the field.

Disaster risk reduction is now firmly on the development agenda; this has most recently been recognized within the Sendai Framework (WHO 2013, Yodmani S 2001, UNISDR 2015). The Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted at the third UN World Conference in Sendai, Japan. The Sendai Framework is the successor instrument to the Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters. The Sendai Framework focuses on how disasters are to be prevented, mitigated and addressed in coming decades.

There has been a paradigm shift in the approach to disaster management, from one of post disaster relief and rehabilitation to pre disaster prevention and preparedness. The SAARC Disaster Management Centre (SDMC) developed twelve SAARC Road Maps for regional cooperation and in process to develop three more roadmaps to deal with regional disaster in a comprehensive ways.

Bangladesh considers disaster risk reduction with climate change adaptation a win-win opportunity. The climate system is fundamental for both issues: 75% of all disasters originate from weather-climate extremes. Disaster risk reduction and adaptation to climate change strategies aim to enhancing sustainability, resilient societies and human security. The government acknowledges the need for pre-disaster mitigation and preparedness of the people, as opposed to responding after a disaster has taken place, as a necessary and cost-effective approach. Thus, priority has been accorded to focus on community level preparedness, response, recovery and rehabilitation. The Draft National Policy on Disaster Management has emphasized strategies to manage of both risks and consequences of disasters by involving the government machinery as well the community; i.e. both structural changes and non-structural engagement (GoB 2010).

The Disaster Management Vision of the Government of Bangladesh is "to reduce the risk of people, especially the poor and the disadvantaged, from the effects of natural, environmental and human induced hazards, to a manageable and acceptable humanitarian level, and to have in place an efficient emergency response system capable of handling large scale disasters". (GoB 2008, GoB 1010). Bangladesh is a signatory of the United Nations Framework Convention on climate change (UNFCCC) and adopted a National Adaptation Action Plan (NAPA) accordingly. Similarly, Bangladesh along with Nepal, India and other countries, advocated these action plans globally and regionally, and developed a regional SAARC Framework for Action (SFA-2006-2015) including all six South East Asian countries (GoB 2010). Nepal is a natural disaster prone country. Nepal's Ministry of Home Affairs developed the National Disaster Response Framework (NDRF) 2013 to provide a comprehensive framework to deliver a more effective and coordinated national response to disasters. The Ministry of Federal Affairs and Local Development have initiated efforts to comply with the Sendai Framework, Goal 2 - *Risk reduction: actions to address and reduce pre-existing disaster risk*. They will support 130 municipalities in the country to prepare the "Local Disaster Risks Management Plan" by 15 July 2016 (GoN 2014). A more detailed investigation of the Nepali policy context will take place as part of the context review for this study.

## 1.4 RESEARCH BACKGROUND

Disaster risk reduction is now firmly on the development agenda; this has most recently been recognized within the Sendai Framework ( WHO 2013, Yodmani S 2001, UNISDR 2015) that frames how disasters are to be prevented, mitigated and addressed in coming decades. The existing literature connecting urbanisation with disaster is often conceptual while the empirical data encompasses two of the elements of the Disaster Risk Management Framework (Baas S 2008) – pre and post-disaster. In relation to the pre-disaster tier, many of the studies we have identified to date describe the vulnerability to hazards in urban areas (Bhattarai and Conway 2010, Lelieveld et al. 2013, Rajbhandari et al. 2002, Yazdi and Neyshabouri 2012, Yodmani S 2001). Risk assessment and planning approaches applying GIS and remote sensing techniques were numerous (Klimeš, Rios E 2010, Taubenböck et al. 2011, Wieland et al. 2012); these fall in the realm of applied sciences. Several studies looked at disaster preparedness, including evaluation of interventions, mostly employing social science principles. A cross-sectional survey in Kuala Lumpur found that level of preparedness varied with socioeconomic indicators; men fared much better than women and higher income and education groups had higher preparedness. Several studies dealt with Nepal: evaluating disaster education in Kathmandu (Shiwaku et al. 2007), evaluating women's empowerment initiatives in disaster risk reduction (Dhungel and Ojha 2012), evaluating mental health aspects of disaster preparedness (Green J 2003, Acharya L et al, 2006), and looking at community perceptions of disaster preparedness.( Jerry Velasquez and Laursen 2015) Only a handful of studies covering post-disaster situations could be identified. Two studies looked at how urban populations cope with disasters: one study in Nepal (Bhandari et al. 2011) and one in Tanzania (Sakijege et al. 2012). A World Bank report conducted social and livelihood impact

assessment of the Yogyakarta earthquake in Indonesia (Narain S 2012) and another proposed a framework for rapid impact assessment (Gilbuena et al. 2013). However, the large bulk of the studies shed light on the causal chain of urban activities and disaster through enhancing environmental stress such as increased pollution (Akpoborie et al. 2015; Pandey, Choudhry 2013) and health hazards (Lelieveld et al. 2013, Gonçalves and Alecrim 2004, Hassanzadeh-Rangi et al. 2014, Kroll et al. 2014). Some studies aimed at creating broad conceptual or statistical frameworks for disaster management. These including a review of disaster management in global cities (Prior and Roth 2013), a policy analysis concerning urban resilience and climate change (Galderisi and Ferrara 2012), and a conceptual framework for urbanisation and disaster risk (Oliver et al. 2008). Another lens to look at the existing literature is the perception and/or involvement of various stakeholders in disaster risk management, as emphasis grows on management capacity. The role of government in building urban resilience is highlighted in some studies from Sri Lanka (Malalgoda et al. 2013), and Nepal (Jones et al. 2013). Garima Jain discusses the role of the private sector in DRR in her paper (Jain 2015), an important issue deserving greater understanding and analysis. Previous systematic reviews have looked at specific aspects of disaster risk management. Members of our team Zwi et al (Zwi et al. 2013) looked at the effect of community based disaster risk management initiatives on social and economic costs arising from disasters. They identified mechanisms which contributed to reducing risk, reducing vulnerability and enhancing resilience. This Review did not have an urban focus but elements of the framework developed and the realist approach may be of value and adaptable to the current review. The Systematic Review (SR) of Health Impacts of Mass Earth movements (Kennedy et al. 2015) reported that mental health impacts, in particular the prevalence of PTSD, may be higher after landslides than other types of disaster (Kennedy et al. 2015). Another SR on health and disaster looks at medication loss due to evacuation (Ochi et al. 2014). These SRs do not have an urban focus and will not answer the question posed here but may contribute useful insights.

## 1.5 OBJECTIVES OF THE SYSTEMATIC REVIEW

The initial review research questions are:

1. What is the impact of urbanisation on risk of, and vulnerability to, natural disasters?
2. What are the effective approaches for reducing exposure of urban population to disaster risks?

The review will adopt a mixed systematic review process. A wide range of literatures from diverse disciplinary perspectives and databases will be sought. The Review team will also draw on the grey literature from key agencies and their websites. This will be a two stage review with Stage I reviewing and mapping the scope of the literature on impact of urbanisation on risk of, and vulnerability to, natural disasters and will aim to try to describe and conceptualise what is known of their interactions and relationships. The second stage review will be most be guided by the outcomes of stage I review to assess and identifying the effective approaches to reducing the risks and vulnerability to risks.

## 1.6 CONCEPTUAL FRAMEWORK

This proposed SR though can benefit from the earlier works undertaken by members of our team and can draw upon it methodologically and practicality. However, the research objectives identified a lack of evidence in key areas under investigation. For example, the identification of vulnerable communities and the factors contributing to vulnerability are crucial for effective disaster risk management and significant advances have been made in the study of community vulnerability over the past two decades. However, we still know little about the local spatial and temporal factors influencing the risks to natural disasters and also to vulnerability and how these can be reduced or mitigated.

While understanding vulnerability is a core concept in many disaster management measures in many parts of the world, vulnerability is rarely not well defined (Zhou et al. 2014). Similarly, risk itself remains more a derived concept, often confused with vulnerability. The classical pressure and release (PAR) model explained the risk as a direct relation between R (risk)= H (Hazard/disaster) x V (Vulnerability) which was probably derived from the interaction of society and disaster and its consequences. We feel the relation is not as linear as depicted, particularly when we consider natural disaster, and most of our reviewers feel that it is difficult to model something so complex and capture all of its characteristics. UNISDR defines disaster risk as the 'potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period'. A hazard is a "dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage" (ISDR). Risks are constructs that we use to calculate potential harm, impact or consequences of future disasters. Hazards are real world phenomena that exist but that could possibly interact with social structures, processes and the built environment to produce future disasters. Not all human societies are equally exposed to different types of hazards even if they have similar vulnerabilities arising out of, say, urbanisation.

There are many unclear areas in understating how urbanisation increases the risk of natural disaster. Does urbanisation directly influence the occurrence of natural disasters or does it operate through particular mediators or modifiers? Do urban characteristics such as the pace of growth and subsequent changes drive the risks of, and vulnerability to, natural disasters or directly induce some of the natural events? Urbanisation influences the risk of exposure of populations to certain kinds of hazards and, potentially, to certain kinds of disaster, however, there are also mitigating factors arising out of urbanisation such as the potential for preparedness and engagement with communities in understanding vulnerabilities and addressing them earlier on.

At this stage, the void in effectiveness studies of interventions is notable. There are more action plans and reports than empirical studies except for modeling and theoretical constructs that explained or put forward evidence

supporting earlier theories. This review will seek to identify, map, and synthesize aspects of the available literature, and in Stage 2, focus in more detail on an agreed component of this literature.

The proposed conceptual framework seeks to represent the interplay among the domains under investigation in which some relation are unidirectional and straightforward and some are yet not well explained. This framework should able to capture the interaction complexities of the domains under review as well as guide the search to capture relevant publications for the review. The framework should also be simple enough to narrate the relations among the domains and connect the environment information to knowledge that facilitates an assessment of the vulnerability of the urban areas and its systems and to identify effective programmatic implications, implementations and scaling strategies. This review proposed and adopted the framework proposed by Mehrota (Mehrota et al, 2009). While Mehrotra and others defined risk from a capacity-based approach and influence of external conditions, we modified the domains by including risk reduction (e.g. resilience etc.) dimension in it (Figure 1)

Alternately we may propose this model. (Figure 1)

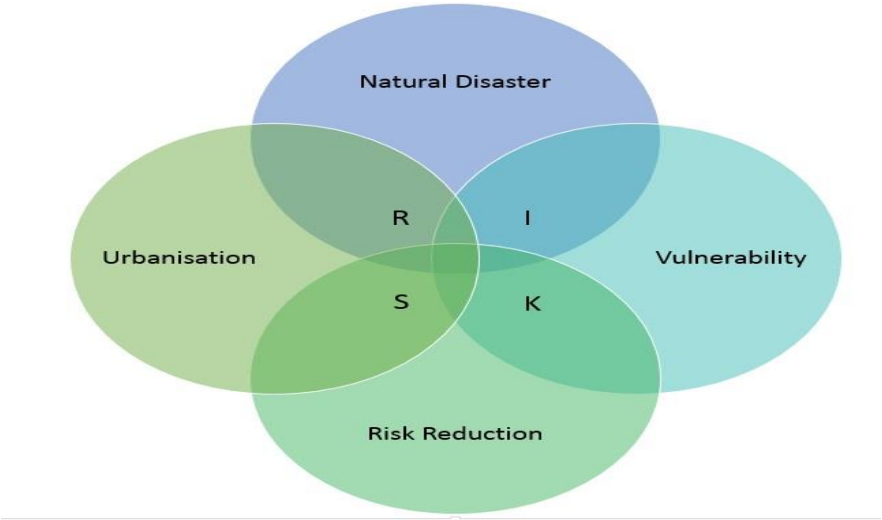


***Figure 1: Conceptual Framework***

This framework will guide the initial approach to the search strategy acting as a sensitizing construct, however, the approach will also allow for other concepts to emerge from the data extracted. Here the assumption is risk is the interface of four vectors; urbanization, natural disaster, vulnerability and risk reduction. The impact of approaches to effect or modify the exposure of urban population to disaster risks will therefore vary on all these four vectors, may be differentially.

This SR will try to explore and understand and explain these issues and if necessary, redefine their relations.

## 1.7 AUTHORS AND FUNDERS OF THE REVIEW

This systematic review is enabled by financial support from DFID, awarded through a call for proposal on pre-defined themes and managed through PwC, India.

Dr. Shahed Hossain (SH) will be the lead PI for this Systematic Review, and will provide content area expertise and review experience, participate in the development of the protocol and drafting of the final review. He will serve as a third party decider of any disagreement over inclusion/exclusion of studies for the review. He will lead the development of the protocol, oversee the search and participate in the subsequent screening of abstracts and studies, data extraction, conduct analysis/synthesis and lead the drafting of the first draft of the full review and dissemination activities.

Prof Anthony B. Zwi (AZ), a Co-PI of this systematic review and is the lead researcher from UNSW. He will provide additional content area expertise to the development of the protocol and to the drafting of the final review. He will play a leading role in systematic review methodology. He will participate in the development of the protocol, external reviews and search process, participate in the subsequent screening of abstracts and studies, conduct analysis/synthesis and contribute to drafting and reviewing the report, published papers and dissemination activities.

Dr. Rubana Islam (RI) participates in the development of the protocol and will play a leading role literature screening. She will also conduct analysis/synthesis and contribute to drafting of the first draft of the full review.

Dr. Nafisa Huq (NH), participates in the development of the protocol and will play a leading role for literature screening, she will also conduct analysis/synthesis and contribute to drafting of the first draft of the full review.

Razib Mamun (RM), participate in the development of the protocol and will assist SH for literature screening, retrieval from the grey literature, drafting of the first draft of the full review.

Dr. Alayne M. Adams (AA) will assist qualitative synthesis, methods and theory of change analysis, urban context areas. She will also assist SH for the drafting of the review and addressing comments on review.

Dr. Rukhsana Gazi (RG) will Assist SH for this Systematic Review, and will provide content area expertise and review experience, participate in the development of the protocol, analysis and drafting of the final review.

Prof. Shariful Islam (SI) will work on Statistical analysis or other relevant method of data analysis (if required). He will write the method part of the review.

Dr. A.T.M. Iqbal Anwar (IA) will work on Statistical analysis or other relevant method of data analysis (if required). He will write the method part of the review. He will also give input in urban context and policy analysis section of the review.

Dr Kim Suprway (KSp) will play a leading role literature screening, assist the team for drafting of the first draft of the full review.

Dr Krishna Shrestha (KSh) will play a leading role in contextualization and policy analysis of this systematic review. He will bring in conceptual approaches to understanding urbanisation and its social justice implications in South Asia.

Dr Hemant Ojha (HO), will play a leading role in contextualization and policy analysis, climate change and urbanisation issues of this systematic review. He brings particular expertise in community development and local governance as well as a strong interest in policy processes and the value of evidence.

Jacqui Bonnitcha (JB) will assist the for literature screening, drafting of the first draft of the full review. She will also conduct analysis/synthesis and contribute to review drafting and dissemination activities. She brings in broader insights regarding urbanisation and risk.

Dr. Hari Dhungana (HD), will play a leading role in contextualization and policy analysis, climate change and urbanisation issues of this systematic review.

Kamal Devkota (KD), will play a leading role in contextualization and policy analysis, climate change and urbanisation issues of this systematic review.

Dr Ngamindra Dahal (ND) will lead the SIAS team, be a member of the overarching project management team, and will contribute to the contextualization and policy analysis, with an emphasis on Nepal and its policy context.

# 2. METHODS OF THE REVIEW

## 2.1 REVIEW APPROACH AND COMPONENTS

The purpose of this review is to explore and understand the complex relationships between urbanisation, natural disasters and vulnerability, the three (3) main domains of this review. While examining their complex interplay, the review will seek to identify those efforts and processes that address this complexity and contribute to mitigating the risks of natural disaster. **The review will adopt a mixed systematic review process and will be undertaken in two stages.** In Stage I the focus will be on understanding conceptually and empirically the links between urbanisation processes and disasters and their impacts. In association with this work we will seek to identify existing models and conceptual frameworks which underpin urbanisation – disaster links, and will seek to identify, adapt or develop one that can inform our review and context analyses.

Stage 1 consitutes a scoping or mapping review which will aim to assess the nature and extent of the available literature and evidence addressing the research questions. The scoping will help to refine the research questions and to judge which areas of the disaster - urbanisation interface and associated literature should form the basis for the Stage 2 review. Stage 1 will also assist in identifying the quality of available studies. This will be an iterative process and lead from one stage to the other, having identified patterns within the literature, gaps in the evidence, and engaged the Commissioning organisations in determining which aspects of the review are of most relevance to their programming, policy, and practice.

The Stage 2 of the review will follow the outputs of Stage 1 and synthesize evidence of relationships, impact of interventions and outcomes**. At this stage we will try to relate disaster specific risks and vulnerability in a particular context, with emphasis to South Asian countries, particularly Nepal.** This will also help in deciding on the range of risk mitigating interventions that have been evaluated and may affect the success or failure of a program or offer lessons about their applicability to different contexts, especially those of South Asia.

## 2.2 USER INVOLVEMENT

Our engagement plan is central to achieving the aims of the review. Based on principles of dialogue, interaction, and active listening, we see communications, dissemination and engagement as critical to both successful communication and enhancing research uptake. Thus our strategy is to incorporate a variety of activities aimed at both ensuring that the review findings are responsive to beneficiary needs/objectives, and have maximum impact on policy processes. SIAS and UNSW will play an important part in engaging policy makers and practitioners in

Nepal, while icddr,b will do so in Bangladesh. The full team will examine potential opportunities to engage a broader range of stakeholders in their countries, South Asia, and rest of the world.

We will engage and communicate with stakeholders at all levels and take advice from the Commissioning body as well as the Reference/Advisory Group. The advisory group is planned to include representatives from the review commissioners agency, academia and experts from policy and implantation levels. The review team will seek inputs from the advisory group as the review progresses and decisions regarding more detailed analysis, grouping or splitting research focus or judgments on approaches or interventions are required.

The review team will seek input at several key stages of the review. It is anticipated that the advisory group will provide input into the progress of the review at five key points:

1) Protocol: we will seek input and feedback from the Advisory Group while developing the conceptual framework, search strategy and draft inclusion and exclusion criteria;

2) Searching: We will ask our Advisory Group members to identify any research or ongoing projects and organisations that are especially relevant;

3) Interim findings: Advisory group members will be asked to comment on drafts of the review and the synthesis of initial findings for both the Stage 1 and Stage 2 draft reports. Feedback and recommendations from the advisory group will be incorporated into the final report.

4) Dissemination: We will enlist the support of the advisory group in disseminating the review findings and engaging actors and organisations that may find it of value.

We seek to promote impact at multiple levels – researchers and policy analysts, civil society (including think tanks), policy makers and donors involved in urban disaster risk management. We will use a variety of approaches to communicate and engage with policy influencers, including informal and formal consultations. The team will draw on established networks to convene and interact with relevant stakeholders and groups engaged in disaster management. We will use a variety of media for engagement and planned dissemination with methods of engagement, dissemination and communication tailored to the relevant stakeholder groups. The Consortium has excellent links and networks across a variety of fields and will draw on these early in the project to inform those potentially interested in the Review being undertaken and to establish mechanisms for communicating with those most interested at a number of key points in the project. The Consortium will utilize its existing networks and channels of communication; these include formal and informal consultations and feedback, policy briefs, public and closed meetings, peer-reviewed publications in Open Access journals, and social media where relevant. All Consortium partners have websites and followers through social media; these channels too will be used to invite engagement, solicit information, or engage with key policy stakeholders. In addition, we will engage with the academic community globally through publication in high quality, peer-reviewed journals. In addition, we will

disseminate the review findings at various international forum, including conferences and workshops aligned with the review goals.

## 2.3 IDENTIFYING AND DESCRIBING STUDIES

A systematic approach will be adopted to search for and identify relevant literature. The relevant studies will be searched in specific and related databases using a variety of search terms. A limitation of the review, however, is that searches by necessity will be carried out in English to find studies published in countries where English may not be the main language. Hand searches of local journals in Bangla and Nepalese will attempt to reduce this at least in Bangladesh and Nepal. The database searches will be supplemented by searching grey literature (including grey net) which includes a number of working papers, technical documents and policy reports. The grey literature search will also be reviewed using the same key wording tools which we will identify through screening relevant websites and contacting authors if necessary (See appendix 2 for search strategy). The resulting list of studies will be screened using inclusion and exclusion criteria relevant for the review (See Inclusion criteria section below and Exclusion Criteria listed in appendix 5). Synthesis of study findings when necessary will follow standard EPPI-Centre guidelines data abstraction tools and coding tools focusing on context (Types of urbanisation, progress etc.), disaster and risk and their impacts and outcomes. The review will use Framework Analysis for in-depth thematic narrative analysis – Framework Analysis is discussed in more detail in the 'Analysis' section of this protocol.

**Identification of potential studies: The major data sources are:**

1. Electronic Bibliographic databases (please see the search sources in the appendix for details)
2. Hand search of the following key journals in the fields of disaster, natural disasters, urbanisation and, Public health in Disasters and Natural Disasters, PLoS Disaster papers
3. Internet searches will be carried out using Google and Google Scholar search engines.
4. Targeted search of websites such as World Bank, UN Habitat, WHO, ADB, ALNAP, UNISDR, DFID and International NGOs, Munich Re.
5. Additional references to consider for inclusion will be sought from members of the Reference Group and the commissioning body.
6. Grey literature will be searched through relevant websites, key informants/ experts in the field suggested by members of the Reference Group and contacting key authors for their advice.

### INCLUSION CRITERIA

This review will use the PICO (Population-Intervention-Comparisons-Outcomes) framework to organise inclusion criteria as follows:

Population:

Urban and peri-urban populations of low and middle income countries (LMIC- as per World Bank 2016 definition) inclusive of age, sex, and socio-economic groups. Poor, marginalized, slum-dwellers, displaced populations, migrants and others at raised risk will receive particular attention. In addition, local and national government plus other relevant agencies and municipalities will be considered.

Disaster:

Natural disasters include natural hazards, environmental emergencies, avalanche, earthquake, fire, flood, landslide, tsunami, tidal wave, volcano, catastrophe, cyclone, hurricane, typhoon, coastal hazard, lahars, blizzard, hailstorm, storm, tropical storm, heat wave, tornado, wildfire or bushfire, mudflow, extreme weather event, environmental emergency, climate related hazard etc.

Language of the review:

The review will be focus mainly on English language literature. We anticipate getting the vast majority of literature on urbanisation and natural disaster in English, particularity arising from LMICs in South Asia. However, hand searches of local journals in Bangla and Nepalese will be also performed at least in Bangladesh and Nepal.

Time of the review: The major searchable databases in this connection are also in English. We will limit our search to the period from 1980 to date (end of 2015) as most of the databases and related reporting were not widely available before this. Digitized information gradually started to became available after 1980.

Study design:

All study designs will be included and are most likely to include qualitative and mixed methods research studies. Studies assessing impact such as randomized controlled trials or quasi-experimental studies (unlikely in this case) designs, controlled before and after studies, and interrupted time series will be considered potentially suitable for assessing effects of intervention for investigating implementation including case studies and process or impact evaluations. Observational studies such as surveys, cohort studies, case-controlled studies and case studies (with or without economic or equity analyses) assessing harm or causation will be considered potentially suitable for assessing reach, implementation and converge of disaster and interventions. By nature, the realist approach to searching literature is iterative; however attempts will be made to describe the process that will be followed.

**Intervention:** The focus of the first stage of the review will be on broadly understanding urban propensity to natural disasters; and in the second stage on the kinds of interventions that reduce risk and vulnerability. Inclusion criteria may require fine-tuning after the scoping study (Stage 1) to focus in on particular types of disasters, interventions or contexts of particular interest and to ensure the review is feasible and meaningful to the policy community, in the time available. This systematic review will cover all programmes and interventions implemented by governments, NGOs, international organisations or donor agencies to manage environmental effects of

urbanisation. For the first stage of the review, any intervention along the continuum of Disaster Risk Management i.e. pre-disaster, disaster response, and post-disaster- will be included but the emphasis will be on understanding the link between urbanisation and risk and vulnerability to disasters (and their effects). In the second stage, interventions that aim to manage the environmental impact of urbanisation will be included for further analysis - examples include environment management techniques concerning improved land use and watershed management, preparedness programs as well as those entailing extensive community engagement and participation, and urban risk assessments.

The strategic goals of the Hyogo framework (UNISDR 2010) and more recently the Sendai Framework for Disaster Risk Reduction (UNISRD 2015) will be used to guide the search for interventions at policy and practice levels. Particular effort will consider integration of Disaster Risk Reduction (DRR) into sustainable development policies and planning; development and strengthening of institutions, mechanisms and capacities to build resilience to hazards; and the systematic incorporation of risk reduction approaches emergency preparedness, response and recovery programmes.

**Comparisons:** The phenomena under investigation are natural hazard occurrences and their interface with human settlements, urbanisation and related activities. It is unlikely that we will identify experimental or quasi-experimental studies to allow for comparative assessment of interventions. The initial Stage 1 search will aim to cover all forms of study and intervention.

**Outcome(s):** "Risk of" and "vulnerability to" natural disasters will be two broad outcome indicators. We will map the literature to determine what other measures of outcome and impact may be present – not only the impact of urbanisation on risk and vulnerability, but importantly, potential area to intervene effectively. Studies of interest are likely to include terms such as "resilience", "preparedness", "disaster planning", and may include improvements to risk assessment, slum avoidance, and enforcement of safer land use for human habitation and of building codes (Please see the appendix for details of search strategy). The range of interventions will be identified in the initial mapping and then more detailed systematic review of interventions undertaken. "Risk of" natural disaster due to urbanisation is defined as the production/reduction/control of environmental stressors that may induce hazardous events. A good example of this is the ways in which urban governments manage public infrastructure such as flood controls and levies: more impoverished areas are often left behind with inadequate infrastructure resulting in an increased vulnerability to flooding. "Vulnerability" to natural disaster is better gauged through the presence or absence of adaptive capacities including preparedness indicators, immediate response indicators, reconstruction of settlements, and rehabilitation and recovery. Special attention will be given to the cross cutting themes of gender and socio-economic inequity addressed by or arising out of the DRR processes.

## 2.4 DERIVING CONCLUSIONS AND IMPLICATIONS

### DATA COLLECTION AND DATA MANAGEMENT

Quality assurance will be maintained through the dual application of the inclusion and exclusion criteria. Titles and abstracts identified by the search strategy will be screened by two reviewers to remove citations which are not relevant to the review. The review authors will determine independently if studies meet the inclusion criteria. Full reports will be obtained for those studies that meet the criteria or relevant to the review. For the full reports which do not meet initial criteria, the inclusion and exclusion criteria will be re-applied again. Disagreements will be resolved through discussion with a third reviewer, and with the review group, if required.

Data management: Coding will be conducted by pairs of team members working independently and then comparing their decisions. Any occasion of disagreement will be resolved via discussions with the third reviewer or among the review authors. Software available through EPPI Centre (EPPI reviewer 4.0) will be used to manage and classify the searches, sources of information and categorization of data. Data extraction categories (**Appendix 4**) definitions and criteria will be developed by the Team for Stage 1 and refined before Stage 2. Attempts will be made to contact study authors to obtain any missing information. We will extract data relating to the following items from all included studies.

1. Participants: all types of affected persons/victims/patients/consumers/care givers of services around relevant interventions. Information about all providers of health care around disaster management.
2. Study design and the key features of studies.
3. Intervention (types of community needs identified, nature of community support systems, specific training, awareness building, ongoing monitoring systems, affiliation, community groups, resources, standardization of supplies and services including any services linked with disaster management or prevention.
4. Cost-effectiveness, where considered in the included studies.
5. Socioeconomic position: we will describe study populations according to components of socioeconomic position that are applicable to different settings.
6. Outcomes: health outcomes on select indicators due to disaster
7. Policy, regulations and plans on disaster management or risk reduction / mitigation activities

### QUALITY ASSESSMENT OF STUDIES INCLUDED IN THE REVIEW

For assessment of any risk of bias in included studies, two independent review authors will assess the quality of all included studies using the methodological quality criteria in the Cochrane Effective Practice and Organization of Care (EPOC) Group's quality checklists if feasible. Disagreements will be discussed and resolved by consensus

between the review authors. We will summarize risk of bias for outcomes across studies as follows: both quantitative and qualitative studies will be examined in this review and appropriate quality appraisal tools will be utilized. Quantitative studies will be appraised by adapting the Critical Appraisal Skills Programs (CASP). In relation to qualitative studies, it has been suggested that different structured approaches to reviewing qualitative research do not produce consistent results in assessing whether to include studies in a systematic review. (Dixon-Woods et al. 2007). A key issue in such studies is to determine the appropriateness of the qualitative approach utilized in specific studies and whether sufficient information is provided to contextualize the insights derived. Qualitative studies are often conducted when researchers are interested in "understanding insiders' views", "identifying" variables for further quantitative study, or “to gain a deeper understanding of how things work” rather than "measuring" variables. (Green 2003, Peters 2009; Varkevisser et al. 1993) Therefore, a Quality in Qualitative Evaluation - A Framework for Assessing Research Evidence (QF) will be adopted to evaluate the quality of research undertaken(Spencer et al. 2003). In sync with this, the ConQual approach should help us to establish confidence in the evidence produced. (Munn et al. 2014). As with work undertaken previously by the UNSW team, an effort will also be made to establish whether the study in question is offering new empirical insights (of particular interest) or merely revisiting and commenting on what could or should be or has been reported before.

## ANALYSIS

Two reviewers will extract data from all included studies using a standardized form of EPPI Reviewer software to manage and analyze review information. Framework analysis is our method of choice for synthesizing qualitative and quantitative research with the aim of learning about effecting change. Framework analysis allows the combination of issues important to policy makers, practitioners and service users, is sufficiently flexible to allow amendments to the analysis in light of the emerging literature, and leads to learning specifically linked to explicit principles driving activities and their contexts (Spencer et al. 2003).

Measures of effect for quantitative data will depend on the availability of datasets, their types, and presentation. Standard statistical methods will be applied to estimate the impact size (risk measures, mean difference with dispersion- Standard Deviation or Confidence Interval- as applicable). For dichotomous data, for example, we will present the results using risk ratio (RR) with 95% confidence intervals (CI). We will estimate the pooled treatment effect using the Mantel-Haenszel random-effects method. Similarly for continuous data, we will present mean difference (MD) (with 95% CI) and will consider using the standardized mean difference (SMD) (with 95% CI) in case the same outcomes are measured on different scales. Depending on what the full search reveals, we may propose to do an indicative measure of effects in particular areas/cities based on time trend of loss, direct and indirect (World Bank 2005), from disaster and take stock of the specific interventions documented for that city and try to establish a quantitative correlation.

## SUBGROUP ANALYSIS AND INVESTIGATION OF HETEROGENEITY

We expect variations in the study findings due to the various sources of heterogeneity, such as differences in the level of intervention, types of activities within the intervention, and outcome measurements. There may be variations in study setting, the socioeconomic status (e.g. income quintiles), and the cultural and health service environment of the country in which the study was conducted. We will try to explore possible heterogeneity due to the above mentioned variables using meta-regression analysis if feasible. If sufficient studies are not identified, we will explore heterogeneity via different techniques, either visually via bubble plots or via box plots (displaying medians and ranges). We will consider equity across selected outcomes in the review (i.e. if the poorest and least poor achieve the same benefit, similarly whether poor and ultra-poor groups obtain same benefit). If there are sufficient included studies, we will carry out subgroup analysis to determine whether the interventions work in the disadvantaged. We will group studies according to the characteristics of intervention (i.e. focus on prevention or management; initiated by community members or outsiders, socioeconomic position).

The review results based on study quality, and contribution to establishing conceptual framework will be discussed in an ongoing way among the review authors and the advisory group members. This will enable the reviewer to track and follow up any emerging findings or themes from the review as well set out directions needs to advance the review in a meaning manner.

## CONTEXTUALISATION

Although the review will draw evidence primarily from all low and middle income countries, the relevance of the findings will be considered for South Asia and particularly for Nepal. The April 25th and May 12th earthquakes have accelerated debate and decision-making about policy and planning changes required, and have reinforced the urgency of addressing concerns with enforcing building codes and planning cities to deal with mass disasters. The Nepal earthquakes have generated considerable debate and engagement with urbanisation and disaster planning as well as have intensified efforts around how to promote resilience and reduce vulnerability. The Nepal Risk Reduction Consortium (NRRC) is a key partnership in Nepal that includes government, civil society and international actors – we aim to engage with the NRRC, UNDP and Government of Nepal, as well as with academics and civil society via the coordinator of the NRRC who has agreed to join the Reference Group as well as via SIAS and the Nepal Policy Network. The NRRC has identified urban disaster-related issues as a major gap.

The Review will enhance understanding of the issues, causal chain and successful program designs in similar settings. We will seek to invite those with experience from India, Pakistan, Myanmar and Afghanistan to comment on the emerging findings and their relevance to those setting. icddr,b is well placed to do so as the team examine the literature, and Nepali insights will also be sought along the way. At the commencement of the Review we will also identify specific contextual issues of relevance to each of the countries and consider these as the review is

undertaken. A desk-based context review will be undertaken re patterns of disasters by country, current disaster planning and relevant structures, role of local government, specific other issues (such as conflict and instability in Afghanistan and Pakistan), and key international agencies and donors supporting the country. When synthesizing data from individual studies we will apply a "Policy significance" which has been developed and will be refined for this project. When producing the report a sub-set of studies relevant to particular countries will be identified.

## REPORT WRITING

Report writing will be undertaken in an ongoing way with clear responsibilities within the team and the PI and co-PI taking responsibility for maintaining standards and performance according to the agreed protocol and timetable. AA, RG and RI will draft the introductory sections for comments and feedback by team members at UNSW (AZ, KSp, JB). RG, AA, and SI will write the methods section. SH, AA, AZ, KSp, and will write the synthesis and analysis section with input from SI, KSh, HD, KD, HO as needed. SH, IA, AZ, KSh, HO, JB, HD, & KD will work on the discussion and contextualization parts of the report. The report will be designed per the EPPI reviewer format.

The report will contain an Executive Summary; a short summary of findings which can "stand alone" as well as the required Presentation will also be prepared. SIAS (HD, KD) and those with insights regarding context and policy of urbanisation (and response in Nepal and Bangladesh (AA, JB, KSh, HO) will take the lead in preparing the conxtualisation document, along with AZ. Funds permitting, some additional activities and presentations of the Stage 1 and draft Stage 2 reports will be presented in Nepal for discussion, debate and feed-in by relevant agencies. These have not been costed to date and will supplement the scheduled activities in Dhaka. Other paper based communication materials to be considered include review output briefs (e.g. output from Phase 1 Mapping), policy briefs (highlighting implications for policy and practice consideration) and peer- reviewed journal articles which might take the form of research articles, commentaries and policy debates.

## POSSIBLE LIMITATIONS AND GENERALISABILITY

As urban areas grow across low and middle income countries that lack resources to mitigate and manage risks and aftermath of disaster, the potential of short and long term loss from acute events of nature become more striking. Beyond the obvious aspects of human concentration and localization, the understanding of modalities through which urban activities intensify "risk of" and "vulnerability to" natural disasters can contribute to disaster risk reduction measures. A comprehensive analysis of approaches and what is known of their effectiveness can inform high-risk areas to adopt tested methods and save valuable resources and lives. Some major constraints are however expected after the initial scoping of literature, limiting such an attempt. Much of the empirical research on urbanisation and vulnerability to disaster risk expounds on methods and techniques and rarely their effectiveness beyond simulations and in vitro modeling. Case studies and cross-sectional surveys were the most commonly reported study designs in this domain, leaving a gap in more rigorous study types. The technological approaches to risk assessment may pose difficulties in their assimilation and generalization due to the different

origins of natural hazards vis. geological, hydro-meteorological, and climatic. The plethora of literature focuses mostly on floods, landslides, and earthquakes, in that order, and this is expected to make their assimilation manageable. Despite all these limitations, we anticipate valuable insight from this SR into trend of evidence on this subject and assess contextual variations where applicable.

## SUGGESTIONS ON RESEARCH QUESTION:

Most natural disasters do not fit within man-made political and administrative boundaries, particularly the impacts of climatic or environmental hazards which often extend beyond such limits of "urban" or "rural". We anticipate that the measures taken to mitigate disasters also follow suit. Therefore the literature may follow the same pattern and may focus on urban as well as other areas in concert. To single out urban specific interventions and their impact evaluation will therefore prove to be challenging. Considering the available data, an initial scoping review is suitable to define the nature and type of disasters and vulnerabilities related to the processes and patterns of urbanisation (RQ #1). Initial search yielded that most of the literature are descriptive or case study type, only a few studies reported multiple points of measurement over the time and may impose limitation on understand the intervention impacts. Hence RQ# 2 should focus not on more deeply understanding the relationship between urbanisation and natural disaster risks and vulnerability, but on potential areas in which to intervene. It is these clues that policy-makers and donors are seeking and searching for. In assessing available evidence regarding interventions, the SR will also identify the gaps which require investment in primary research to assess outcomes and impact of different forms of intervention

**Potential policy impact** – Evidence and research do not drive policy, but they certainly can and should inform it. Our approach to evidence-informed policy is to ensure understanding of context, of the actors and organisations involved in making or shaping policy, and of their interests, power and influence in relation to differing interventions and policy objectives, and to use enhanced processes to ensure that deliberation is informed by those affected as well as the most rigorous evidence available. We seek to promote impact at multiple levels – researchers and policy analysts, civil society (including think tanks), policy makers and donors involved in urban disaster risk management. Our core objective is to inform users about the impact of urbanisation on disasters and to identify the range of approaches to reducing risk and vulnerability, and enhancing resilience that are based on evidence. Some stakeholders will be engaged with a view to incorporating emerging evidence into their own preparedness and planning whereas researchers might be challenged to address the weaknesses in available evidence. We will use a variety of approaches to communicating and engaging with policy influencers, including informal and formal consultations as explained in C. It is hoped that such engagement will facilitate enhancements to policy content and processes, as well as to feed into initiatives promoting more effective implementation. Initial stakeholder mapping of policy stakeholders will include government at different levels, multilateral and bilateral agencies, the private sector, and indeed communities and civil society organisations. The policy impact cannot, however, be prejudged: it depends on what the Review and the evidence reveals and who has the power and

influence to take forward effective interventions. The earlier UNSW CBDRM Review highlighted the importance of effective community-based organisation and management, working with other agencies such as local government, and utilizing technologies and insights to promote transformative change. SIAS work in Nepal highlights the importance of democratic local government if decisions are to be made which reduce risk and vulnerability and are responsive to the poorest. The team will draw on established networks to convene and engage with relevant stakeholders and will establish a Reference Group to enhance reach and scope for sourcing other insights. The UNSW and SIAS teams have extensive networks within Nepal while icddr,b is actively engaged with informing and influencing policy in Bangladesh. All Consortium members also have links with a range of NGOs, policy-makers and other actors in Burma, Afghanistan, Pakistan and India – this will facilitate cross- national engagement and feed-in to policy discussion and dissemination forums. Our Consortium is willing to place considerable effort on such activities should these also be funded on completion of the Report.

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## APPENDIX 1: AUTHORSHIP OF THIS REPORT

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Conflicts of interest:
None

Acknowledgement

Professor Sandy Oliver and colleagues (Dr Mukdarut Bangpan; Claire Stansfield; Jeff Brunton) at EPPI- Centre, Department of Social Science, UCL Institute of Education, UK; Professor Shariful Islam (BSSMU, Bangladesh) for advice and feedback. We also acknowledge PwC India for programme management and DFID South Asia Research Hub (SARH) for financial support.

## APPENDIX 2: SEARCH STRATEGY

The search strategy will target the major domains under conceptual framework. The domains include i. Urbanization, ii. Natural disaster, iii. Risk and risk reduction and iv. Vulnerability. Search will constitute a mixture of keywords, index terms as appropriate with targeted databases. Searches will be adopted based on this basic search strategy covering the domains of the review.

(Search will include the following fields: title, abstract, other abstract, MeSH, other index terms, but **NOT** place of publication). Searches will be combined using Boolean operators whenever possible and depending on the yields of the search.

**# 1 Search: Population terms:**

urbanicity OR urbanisation [tiab] OR urbanisation [tw] OR "Urban Population/classification"[Majr] OR "Urban Population/organization and administration"[Majr] OR "Urban Population/statistics and numerical data"[Majr] OR "Urban Population/trends"[Majr] OR "Urbanisation [Mesh] OR urban* OR metropol* OR city OR town* OR "(local AND government) OR "local authority" OR "Vulnerable Populations/classification"[Mesh] OR "Vulnerable Populations/epidemiology"[Mesh] OR "Vulnerable Populations/statistics and numerical data"[Mesh]

AND

**# 2 Search: Disaster or disaster related terms:**

Search #: "natural disaster*" OR "environmental emergenc*" OR "natural hazard" OR avalanche* OR earthquake* OR fire* OR flood* OR landslide* OR tsunami* OR volcan* OR catastroph* OR cyclon*OR "tidal wave*" OR tsunami* OR "coastal hazard*" OR lahar OR blizzard OR hailstorm OR hail OR storm OR "heat wave" OR heatwave OR landslide OR hurricane OR typhoon OR tornado* OR wildfire OR "wild fire" OR "wildland fire" OR "bush fire" OR bushfire OR"extreme weather event" OR "Disasters/economics"[Majr] OR "Disasters/epidemiology"[Majr] OR "Disasters/mortality"[Majr] OR "Disasters/organization and administration"[Majr] OR "Disasters/prevention and control"[Majr] OR "Disasters/statistics and numerical data"[Majr] OR "Disasters/supply and distribution"[Majr] OR "Disasters/utilization"[Majr]

# NOT ('toxic combustion' OR 'toxic incident' OR 'chemical incident' OR 'chemical fire' OR 'simulated disaster' OR 'chemical release' OR 'chemical spill' OR 'hazardous incident' OR 'environmental contamination' OR 'environmental disasters' )

AND

**# Search 3 Vulnerability and impact related**

*Search:* vulnerabilit* OR Injur* OR displace* OR refuge*OR homeless OR wounded OR wound* OR death* OR mortalit* OR casualt* OR killed OR died OR fatalit* OR poverty* OR "poverty reduction" OR microinsurance OR

“micro-insurance” OR “safety net*” OR microfinance OR externalities OR “multiplier effect*” OR “opportunity cost” OR “cost benefit analysis” OR livelihood OR resilien* OR vulnerabl*

AND

**# 4 Risks and risk reduction related:**

Search: “disaster risk reduction” OR “risk reduction” OR “disaster risk management” OR “disaster preparedness” OR “disaster recovery”OR “disaster relief” OR “disaster mitigation” OR “disaster management” OR “disaster prevention” OR “disaster preparedness” OR “disaster planning” OR “disaster response” OR "Environmental Restoration and Remediation/adverse effects"[Majr] OR "Environmental Restoration and Remediation/classification"[Majr] OR "Environmental Restoration and Remediation/organization and administration"[Majr] OR "Environmental Restoration and Remediation/statistics and numerical data"[Majr] ) OR “Hyogo Framework for Action” OR resilien* OR “risk planning” OR “risk analysis” OR “risk assessment” OR “risk management” OR “disaster resilience” OR “disaster loss*” OR “economic aspect*” OR “social risk management” OR “social vulnerability” OR capacity OR “coping capacity” OR “capacity development” OR “capacity building” OR “social protection” OR “indigenous coping” OR “traditional coping strateg*” OR “social capital” OR “indigenous knowledge” OR “local knowledge” OR “traditional knowledge” OR empowerment OR “public participation” OR “community planning” OR “local government” OR “local authority” OR “local leader*” OR municipalit* OR “village leader*” OR “local council” OR “town* council” OR “district council” OR “community-based disaster risk management” OR “community based disaster risk management” OR “community based disaster risk reduction” OR “community-based disaster risk reduction” OR "Risk Reduction Behavior/statistics and numerical data"[Majr]

We will limit the search to only low and middle income countries as defined by World Bank recent list of 2016 of LMIC. We will use Cochrane/EPOC LMIC PubMed Filter and modify it accordingly**.** *(Available at http://epoc.cochrane.org/lmic-filters , accessed on December 23, 2015.*

## APPENDIX 3: SEARCH SOURCES

**Bibliographic databases:**
**Health:** Global Health, Medline, PsychINFO
**Political/Sociological:** PAIS, Scopus, ASSIA, British Humanities Index (BHI), Sociological Abstracts, Informit Humanities and Social Sciences and Health Collection
**Environment:** GEOBASE, CAB Abstracts, OARE, Collaboration for Environmental Science
**Economics:** Econlit
**Disaster/ Development:** IBSS: International Bibliography of the Social Sciences, IPSA (International Political Science Abstract),

QUAKELINE Database: http://mceer.buffalo.edu/utilities/quakeline.asp

**Systematic Review Data Bases:**
EBM Reviews: Cochrane Database of Systematic Reviews
Johanna Briggs systematic reviews, EPPI-Centre systematic reviews database, Campbell Collaboration database, Collaboration for environmental evidence, 3ie database of systematic reviews

**Key journals:**
**Hand search of the following key journals:** Int. Journal of Disaster Risk Reduction, Disasters, Public Health in Disasters and Natural Disasters, PLoS Disasters
World Bank Economic Review
Journal of Disaster Risk Studies (South Africa)
African Journals Online: http://www.ajol.info/
Asia Journals Online: http://www.asiajol.info/
Latin American Journals online: http://www.lamjol.info/

**International Organisation databases:**
Prevention Web (lists documents from a wide range of DRR/DRM, organisations), British Library for Development Studies, Eldis, HRH Global Resource Center Secretariat of the Pacific Community, World Bank (incl. GFDRR, Poverty Impact Evaluations Database), International Committee of the Red Cross, International Federation of Red Cross and Red Crescent, African Development Bank, Asian Development Bank, Inter-American Development Bank

**Websites:**
Asian Disaster Preparedness Center (ADPC), Global Facility for Disaster Reduction and Recovery, Pacific Disaster Net, SOPAC, International Development Research Centre, (http://publicwebsite.idrc.ca/EN/Pages/default/aspx), Public Policy Pointers (http://www.policypointers.org/), British Library Development Studies catalogue, Active Learning Network for Accountability and Performance in Humanitarian, Action (ALNAP), Overseas Development Institute, ProVention Consortium, Relief Web, IRIN, EU, OECD, Institute of Development Studies, Evidence and Lessons from Latin America (http://ella.practicalaction.org/), Centre for Global Development (http://www.cgdev.org/page/list-impact-evaluation-databases), International Development Research Centre (IDRC: http://www.idrc.ca/EN/Pages/default.aspx)

**Bilateral Aid Agencies:**
DFAT (formerly AusAID), DFID, USAID, JICA, SIDA, DANIDA, NORAD, CIDA, GIZ (previously GTZ)

**United Nations:**
WHO, UNEP, UNCRD, UNDP, UNFPA, UNISDR, UNICEF, UNESCAP, UNHABITAT
UNU, FAO, OCHA, IOM, IFAD, WMO

**INGOs:**
OXFAM, Plan, World Vision, Action Aid, Save the Children, Care, Caritas, IFRC, Concern Worldwide, Practical Action, HelpAge International, Cordaid, MercyCorps, Islamic Relief, Tearfund, International Alert

**Other organisations:**
Bangladesh Directorate of Disaster management (http://www.ddm.gov.bd/)
ACCRA – African Climate Change Resilience Alliance
CENESTA – Centre for Sustainable Development, Iran
CECI - Centre for International Studies and Cooperation
ICIMOD - The International Centre for Integrated Mountain Development
ICHARM – The International Centre for Water Hazard and Risk Management
IIED - The International Institute for Environment and Development
ISET - Institute for Social and Environmental Transition
IUCN - International Union for Conservation of Nature

## APPENDIX 4: DATA EXTRACTION SHEET

Data extraction sheet for Stage 1 review

| Sl. | Categories | Sub-categories/Description |
|---|---|---|
| | Type of document (select one) | -Journal article<br>- NGO report<br>- World Bank report<br>- Donor report<br>- Independent research report<br>- Master or doctoral thesis<br>- Other [describe briefly] |
| | Region (select one) | Africa; East Asia & pacific; Europe & Central Asia; Latin America & Caribbean: Middle East & North Africa; South Asia |
| | Country (select one or more) | Name or LMIC |
| | Discipline | Environment, Health, Social, Economic, |
| | Study type(select one) | -Theoretical/conceptual overviews (no outcomes).<br>-Systematic reviews and general secondary data analysis<br>-Descriptive studies<br>-Theory-practice studies (e.g. a case study used to illustrate concepts)<br>-Primary data collection which may include interviews, surveys, case studies, content analyses, that examine participants' behaviour, beliefs, perceptions, cognitive or affective processes concerning the program/intervention/practices studied)<br>-Outcome evaluations (or Effectiveness Study or Intervention Study) (explicit outcomes)<br>-Other/None of the above [describe briefly] |
| | Research design(select one) | -Qualitative |

| | | |
|---|---|---|
| | | - Quantitative<br>- Mixed<br>- Other<br>- n/a |
| | Type of disaster addressed (select one or more) | Avalanche, earthquake, fire, flood, landslide, tsunami, volcanic eruption, typhoon, cyclone, tidal wave, tsunami, coastal hazard, lahar, blizzard, hailstorm, storm, heat wave, hurricane, tornado, wildfire/bushfire, mudflow, extreme weather event, natural disaster, environmental emergency, natural hazard, catastrophe, climate related hazard, various/multiple or other. |
| | Relation between urbanisation and disaster (select one or more) | -Intermediate processes<br>-risk<br>-vulnerability |
| | Specific urban population group (select one or more) | -Poor<br>-Children<br>-Elderly<br>-Female<br>-Migrants<br>-Slum<br>-Non slum<br>-Disabled<br>-N/a |

Data extraction sheet for Stage II review

| Sl. | Categories | Sub-categories/Description |
|---|---|---|
| | Type of document | -Journal article |

| | | |
|---|---|---|
| | | - NGO report<br>- World Bank report<br>- Donor report<br>- Independent research report<br>- Master or doctoral thesis<br>- Other [describe briefly] |
| | Region (select one) | Africa; East Asia & pacific; Europe & Central Asia; Latin America &<br>Caribbean: Middle East & North Africa; South Asia |
| | Country (select one or more) | Name of LMIC |
| | Discipline (select one or more) | Environment, Health, Social, Economic, other [describe briefly] |
| | Intervention type (select one) | Theoretical/simulation, social, infrastructural, educational, other [describe briefly] |
| | Intervention mode | Practice, policy |
| | Elements of intervention (select one or more) | Capacity building, early warning systems and networks, risk communication, community awareness and disaster education<br>Programs, Pre disaster preparedness or preparation programs, Disaster response programs, Disaster recovery programs, Long-term disaster mitigation programs, other [describe briefly] |
| | Stakeholders involvement (select one or more) | Community, school, private companies, NGOs, policy makers, civil society, other[describe briefly] |
| | Effectiveness analysis | Yes, No |
| | Outcomes evaluated (select one or more) | Morbiditiy, mortality, social, mental, economical, cost, law, policy, governance |

| | | |
|---|---|---|
| | Disaster stage addressed (select one or more) | Pre, post, disaster |
| | Type of disaster addressed (select one or more) | Avalanche, earthquake, fire, flood, landslide, tsunami, volcanic eruption, typhoon, cyclone, tidal wave, tsunami, coastal hazard, lahar, blizzard, hailstorm, storm, heat wave, hurricane, tornado, wildfire/bushfire, mudflow, extreme weather event, natural disaster, environmental emergency, natural hazard, catastrophe, climate related hazard, various/multiple or other. |
| | Relation between urbanisation and disaster (select one or more) | Intermediate process, risk, vulnerability |
| | Specific urban population group (select one or more) | -Poor<br>-Children<br>-Elderly<br>-Female<br>-Migrants<br>-Slum<br>-Non slum<br>-Disabled<br>-N/a |

## APPENDIX 5: EXCLUSION CRITERIA

| | | EXCLUDE IF.... | EXPLANATION/COMMENTS |
|---|---|---|---|
| Exclude on country | 1 | Not LMIC. | ***Exclude*** if not on World Bank List of low and middle-income countries. World Bank recent list of LMIC will be adopted. |
| Exclude on language | 2 | Language is not English | ***Exclude*** if study titles and abstracts are not in English. However, hand searches of local journals in Bangla and Nepalese will be performed at least in Bangladesh and Nepal. |
| Exclude on publication type | 3 | News article, editorial, comment, periodical, update, speech, book review, fiction, film, symposia, write up of workshops | ***Exclude*** if study is news article, editorial, comment, periodical, update, speech, book review, fiction, film, symposia, write up of workshops. |
| Exclude on publication date | 4 | Publication before 1st January 1980. | ***Exclude*** all studies published prior to 1st January 1980. |
| Exclude on disaster type | 5 | Not natural disaster. | ***Exclude*** if any condition is ***not*** related to a natural disaster as identified by the author/s in title & abstract.<br>Natural disasters include natural hazards, environmental emergencies, avalanche, earthquake, fire, flood, landslide, tsunami, tidal wave, volcano, catastrophe, cyclone, hurricane, typhoon, coastal hazard, lahar, blizzard, hailstorm, storm, tropical storm, heat wave, tornado, wildfire or bushfire.<br><br>The rapid onset climate change hazards (like epidemic, medical conditions) and slow onset hazards (like famine, draught etc) will be excluded. |

## APPENDIX 6: GUIDELINE FOR ASSESSING QUALITY OF STUDIES

**Quality assessment:** The quality of studies will be assessed through the application of criteria previously piloted in systematic reviews published by EPPI centre ( Harden et al., 2001, Spangaro J,et al. 2013, Zwi A, et al. 2013) as well as EPPI centre's standardized key wording strategy tool (EPPI Centre: Reviewers Guideline, Pawson et al. 2005: 22). The principal focus of quality judgment with respect to each source will be made in terms of rigour and relevance and the conceptual framework of the review to guide: "whether a particular inference drawn by the original researcher has sufficient weight to make a methodological credible contribution to the test of a particular intervention theory" (Pawson et al 2005).

The framework for quality assessment will include criteria:

1. Explicit account of theoretical framework and/ or inclusion of a literature review;

2. Clearly stated aims and objectives;

3. A clear description of context;

4. A clear description of sample and sampling methods;

5. A clear description of methodology, including data collection and data analysis methods;

6. Evidence of attempts made to establish the reliability and validity of data analysis; a clear description of the sample and the context; data saturation and attempts of triangulations; adequate presentation of data in terms of numerators and denominators with the dispersions and appropriate measurements;

7. The inclusion of sufficient original data to mediate between data and interpretation.

## APPENDIX 7: FRAMEWORK ANALYSIS

**Frame work analysis:** This analysis will include summarizing and comparing case-based data through the use of data displays and summaries. This is common practice within systematic reviews: using matrices, tabulation and conceptual mapping to describe and analyse data according to thematic and conceptual categories that emerge during data extraction (Dixon-Woods et al 2005; Evans 2002; Gough, Oliver and Thomas 2012; Miles and Huberman 1994).Given the review's focus on understanding the complex interactions of urbanisation and natural disaster and their interrelation with risk and vulnerability and subsequent identifying interventions that could impact in risk reduction or ameliorate the situation or exposure to risk, initial matrices will focus on summarizing the selected published papers in terms of how the interrelations of urbanisation and disaster was assessed; how the risk and vulnerability changed with urbanisation and hazards, what best practices the interventions identified and utilized, and or scaled; perceived successes as described by the authors; and the study's challenges and limitations.

Based on this analysis, and keeping the major five dimensions (e.g., i. urbanisation, ii. natural disaster, iii. vulnerability, iv. risk and v. risk reduction) in focus, the review will pick up other emerging sub-dimensions (Like programme impact or human resilience etc.) to organize further analysis. The review will try to map all possible related issues of these dimensions and sub-dimension and related interventions: population needs and priorities; an enabling environment in the form of local governance, infrastructure and policies; systems integration; partnership; implementation and implementers; and, finally, users. All the major dimensions we anticipate are to be influenced by catalysts, eg, external push or promotion / influencing factors that lie outside the local response system. Subsequent matrices will explore specific features associated with each of these dimensions. Certain studies may contribute insight and experience on each dimension holistically, while others may focus on one dimension in particular. Separate review matrices may be prepared for intervention studies and reviews using Microsoft Excel 2013.

## APPENDIX 7: WORKPLAN

| Tasks | Description | Start date | End date | Duration (days) | Remarks |
|---|---|---|---|---|---|
| Title Registration | Selected teams will register their reviews with the EPPI- Centre. The team is allowed around 2 weeks to complete the process after contract signing. | 1-Nov-15 | 14-Nov-15 | 13 | |
| Preparation of Preliminary Protocol | Preliminary Protocol preparation will start simultaneously with title registration. Preliminary protocol will include- (1) Background, (2) Aims and rationale for review, (3) Definitional and conceptual issues, (4) Objectives of the SR; (5) Conceptual Framework; (6) Methods of the review (Review approach, identifying potential studies, inclusion-exclusion criteria, data collection and management, analysis, contextualisation, report writing etc.); (7) References<br><br>Key inputs in preliminary protocol will be (1) determining the scope of the review and defining the inclusion - exclusion criteria and (2) developing a search strategy which includes determining which databases and other sources to search, which search terms to use; date(s) for including studies etc. Teams will consult advisory group members while preparing the preliminary protocol and / or will take their feedback on the draft preliminary protocol before submitting it for review. | 15-Nov-15 | 31-Dec-15 | 46 | On time submission |
| Protocol review and revision | Protocol review will involve 2 stage review- first stage review by QAT and second stage review by DFID Teams will revise protocol for QAT's and DFID's comments. | 10-Jan-16 | Feb-16 | | Received QAT's feedback on 22 Jan 16, team has revised protocol for QAT's comments; |

| Tasks | Description | Start date | End date | Duration | Remarks |
|---|---|---|---|---|---|
| Stage I: Streamlining review scope based on availability of existing evidence | This stage will include:<br>(1) Search - Based on inclusion-exclusion criteria and key search terms agreed during preliminary protocol stage, relevant databases, websites and journals will be searched to identify and retrieve relevant primary studies.<br>(2) Screening - Studies identified by the search are then checked (screened) to exclude those that do not meet the inclusion criteria. Screening will be carried out for titles, abstracts and full text.<br>(3) Coding - Details of the selected studies are coded to understand characteristics of existing evidence.<br>(4) Scoping: Based on coding of studies, existing evidence will be mapped by various domains- type of intervention, type of studies, geographical coverage etc. to understand scope of existing research for the theme. | 1-Jan-16 | 11-Mar-16 | 70 | |
| Preparation of stage II protocol | Teams will add following sections in preliminary protocol to prepare stage II protocol:<br>(1) results of searching and scoping exercise;<br>(2) proposed modifications in scope of research (research question, population, interventions, outcomes, types of studies, geographical coverage etc.) based on search and scoping and;<br>(3) approach for contextualisation.<br>Teams will consult advisory group members while preparing stage II protocol and / or will take feedback from advisory group on draft stage II protocol before submitting it for review. | 11-Mar-16 | 31-Mar-16 | 20 | |
| Stage II Protocol Review & revision | Stage II protocol will be reviewed by QAT (2 weeks) and DFID (1 week); Teams will revise protocol for QAT's comments in 2 weeks and for DFID's comments in 1 week. | 1-Apr-16 | 13-May-16 | 42 | Submission date was 01 March 2016 as per original work plan |

| Tasks | Description | Start date | End date | Duration | Remarks |
|---|---|---|---|---|---|
| Presentation of stage II protocol | Teams will make a presentation on the finding of searching and scoping exercise as well refined scope of research to SR consortium, DFID and advisory group. PPT should be organised after 1 week of submitting stage II protocol. | 11-Apr-16 | 11-Apr-16 | | Tentative |
| Stage II start: Data extraction | Relevant data and information will be extracted from selected studies using data extraction sheets; | 16-Apr-16 | 16-May- 16 | 30 | Assuming DFID will approve revised scope of work within 15 days of receiving stage II protocol |
| Appraisal | Appraisal determines how much weight is placed on the evidence of each study included in the final synthesis. The three key components to critical appraisal are (1) the study's relevance to the review question, (2) the appropriateness of its methods in the context of the review, and (3) the quality of the execution of these methods. | 16-May-16 | 15-Jun-16 | 30 | |
| Synthesise | It is the process of integrating the findings from the included studies to answer the review question. It involves examining the available data, looking for patterns and interpreting them. Synthesis may involve qualitative or quantitative analysis or both. At this stage, team will draw key findings and conclusions. | 15-Jun-16 | 15-Jul-16 | 30 | |
| Contextualisatio n | The team will contextualise the findings to South Asia and specific countries mentioned in the RfP. | 15-Jul-16 | 12-Aug-16 | 28 | |
| Preparation of draft report and summary | The report will include (1) Structured abstract (background, methods, results, conclusions); (2) Executive summary; (3) Background; (4) Objectives; (5) Methods; (6) Search results; (7) Details of included studies; (8) Synthesis results; (9) Limitations; (10) Conclusions and recommendations; (11) References (included studies and studies excluded when inspecting full | 12-Aug-16 | 1-Sep-16 | 20 | |

| Tasks | Description | Start date | End date | Duration | Remarks |
|---|---|---|---|---|---|
| | reports). The systematic review report will also include a section on contextualisation and policy relevant implications of findings.<br>Teams will consult advisory group members while preparing the SR report and / or will take feedback from advisory group on draft report and summary before submitting it for review. | | | | |
| Review and revision of draft SR report with contextualisation and SR summary | Draft report will be reviewed by first by QAT (4 weeks) and then by DFID (2 weeks); Teams will revise report for QAT's comments in 3 weeks and for DFID's comments in 1 week | 1-Sep-16 | 10-Nov- 16 | 70 | Same as in the contract |
| Dissemination | Organising dissemination workshop, stakeholder engagement | 10-Nov-16 | 15-Dec-16 | 35 | |
| Finalising SR report | Incorporating feedback received during dissemination in the final report. | 15-Dec-16 | 31-Dec-16 | 16 | |
| | | | Total duration of SR (Days) | 426 | |
| | | | Total duration of SR (Months) | 14 | |