PEOPLE IN NEED

Ben Flower and Matt Fortnam

URBANISING DISASTER RISK

VULNERABILITY OF THE URBAN POOR IN CAMBODIA TO FLOODING AND OTHER HAZARDS

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Disclaimer

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Piotr Sasin
Country Director
People in Need
Cambodia
June 2015

People In Need (PIN) - Cambodia,
Address # 33, Street 71, Sangkat Tonle Bassac, Khan Chamkarmon, Phnom Penh

EXECUTIVE SUMMARY

Rapid urbanisation over the past two decades has created new disaster risks in Cambodia, already one of the most disaster prone countries in the world. The urban poor tend to inhabit areas most at risk of hazards, yet little is known about their disaster vulnerability or resilience. This study seeks to address this knowledge gap by assessing the hazards facing Cambodia's urban poor populations, their sensitivity to such hazards and their capacity to deal with them. It does so by conducting Participatory Hazard, Vulnerability and Capacity Assessments (PHVCAs) of six urban poor settlements in the cities of Phnom Penh and Kampong Cham.

The urban poor are exposed to a variety of hazards. Every year, the wet season results in flooding of lowland areas, where the poorest typically reside, which is compounded by periodic river flooding – most recently in 2011 and 2013. Floodwaters contaminated with sewage can remain for up to 8 months of the year, triggering waterborne disease outbreaks. Climate change is expected to exacerbate flooding in the future. Other urban hazards include landslides, storm damage and fires, which spread easily amongst tightly built houses. For some urban poor communities, however, the threat of government-sanctioned eviction was considered to be the most severe hazard they faced.

The socioeconomic attributes of Cambodia's urban poor settlements, which are linked with high levels of poverty, result in the impacts of hazards being severe. Such attributes include, high population densities, the presence of vulnerable groups, the insecure livelihood strategies of residents, low WASH coverage and poor quality housing. These factors have important implications for vulnerability across and within urban poor settlements.

Rapid, unplanned urbanisation has increased the vulnerability to of the urban poor, development-induced flooding in particular. The growth of Cambodia's urban centres has occurred in a context of weak institutional oversight and frequently involves the filling and sealing of lakes and wetlands by private developers. This process deprives urban areas of natural wastewater reservoirs and increases surface run-off, which exacerbates flood risk for urban poor communities living in the remaining undeveloped, low-lying areas. Development-induced flooding is most severe in peri-urban areas where land use change is most rapid, urban poor populations are concentrated, and supporting infrastructure, such as drainage, has least capacity. In addition, peri-urban areas lack the flood defences afforded to more central urban areas.

Urban poor communities cope with annual flooding by adopting an array of strategies, from build-

ing temporary floating walkways to temporarily relocating their houses to higher ground. Over time, many households have upgraded their homes with stilts to raise them above high water levels. Some of the communities studied also attempted to increase their resilience by building flood defences and raising the level of nearby roads to provide a safe zone to relocate houses during floods. The financial costs associated with such strategies have increased household debt with microfinance institutions (MFIs), and the resilience of households to hazards is severely constrained by endemic poverty, with many households, especially those headed by women and the elderly, unable to adapt to the increasing flood risk. Despite such issues, many have adapted to the extent that they prefer living with floods rather than relocating far from their livelihoods.

The findings of this study suggest that urban poor settlements are vulnerable to a potential mega flood disaster. It is thought that even the recent 2011 flood was not on the scale of a 100-year flood event. If such an event were to occur, low-capacity flood protection in peri-urban areas may be breached and the poor located in lowland areas could be severely affected.

Government Disaster Risk Reduction (DRR) policies are focused on preventing and responding to specific hazards, particularly river flooding, rather than complex and emerging hazards, such as development-induced threats.

The study proposes a number of policy options for the Urban Poor Poverty Reduction Working Group (led by Phnom Penh Municipality and UNICEF) and Joint Action Group for DRR to consider:

- Mainstream DRR into urban planning so that urban development does not increase the vulnerability of urban poor populations;
- Implement regulations that limit the negative environmental impacts of rapid urban development, including the rigorous application and enforcement of Environmental Impact Assessments (EIAs);
- Increase the capacity of hard infrastructure, such as piped water coverage and drainage systems, and/or rehabilitate ecosystems such as wetlands to attenuate flood waters in peri-urban areas;
- Mainstream community-based WASH into DRR programmes, so that flood waters are not contaminated with human waste in areas not serviced by sewerage systems and
- Develop appropriate DRR interventions through participatory processes that recognise the specific context of hazards, vulnerabilities and capacities related to urban poor settlements.

ACRONYMS

CCDM	Capital Committee for Disaster Management
CDF	Community Development Fund
CDRI	Cambodia Development Resource Institute
DIPECHO	The European Commission's Disaster Preparedness Programme
DRR	Disaster Risk Reduction
EIA	Environmental Impact Assessment
IPCC	Intergovernmental Panel on Climate Change
JICA	Japan International Cooperation Agency
KCDM	Khan Committee for Disaster Management
MFI	Microfinance Institution
NCDM	National Committee for Disaster Management
NGO	Non-Governmental Organisation
PHVCA	Participatory Hazard Vulnerability and Capacities Assessment
PIN	People in Need
PPM	Phnom Penh Municipality
PPWSA	Phnom Penh Water Supply Authority
STT	Sahmakum Teang Tnaut
SCDM	Sangkat Committee for Disaster Management
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction

GLOSSARY

ADAPTATION	The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
CAPACITY	The combination of all the strengths, attributes and resources available within a community, society or organisation that can be used to achieve agreed goals.
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.
DISASTER RISK REDUCTION	The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to 11 hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.
EXPOSURE	People, property, systems or other elements present in hazard zones that are thereby subject to potential losses.
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.
RESILIENCE	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate 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.
SENSITIVITY	The physical predisposition of human beings, infrastructure, and environment to be affected by a dangerous phenomenon due to lack of resistance and predisposition of society and ecosystems to suffer harm as a consequence of intrinsic and context conditions.
VULNERABILITY	The propensity of exposed elements such as human beings, their livelihoods, and assets to suffer adverse effects when impacted by hazard events.

Note: Definitions from UNISDR (2009) and IPCC (2012)

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01 INTRODUCTION

Cambodia is one of the most disaster prone countries in the world, ranked 8th in the United Nations University's most recent World Risk Index (UNU-EHS, 2013: 46) and 1st in Standard and Poor's index of countries vulnerable to the impacts of climate change (S&P 2014: 6). It is also a country that is rapidly urbanising. For the period 1990-2013, the country's rate of urbanisation was amongst the highest in the region, averaging around 3.5% per year (WDI, 2015). Among Cambodia's neighbours, only Lao PDR experienced faster urban population growth during this period.

Rapid urbanisation over the past two decades has brought new disaster risks to Cambodia's population and presents new challenges for Disaster Risk Reduction (DRR) programmes. The severity of these risks is increasingly recognised by government officials and civil society. The government's recent National Action Plan 2014-2018 for DRR (NAP-DRR) identifies urban areas as key sites of vulnerability to disasters, such as floods, typhoons, fires and industrial accidents (RGC, 2014). Climate change is expected to exacerbate hazard vulnerability in the future *(Ibid)*.

Poor urban dwellers are particularly vulnerable because they often live in peripheral, hazard prone areas. Recent studies of Phnom Penh found that 42% of urban poor residents were affected by flooding from polluted bodies of water (STT 2014: 31), and 23% lived on the banks of rivers (PPM 2012: 10). Poor quality housing, a lack of sanitation facilities and high rates of poverty are also characteristics of urban poor areas that increase their vulnerability to disasters (PIN, 2014). Officials estimate that about 250,000 urban poor people live in Phnom Penh alone (PPM, 2012: 5); outside of the capital little reliable data exists.

Despite the significant risks facing urban poor populations, the NAP-DRR acknowledges that 'urban disasters [are the] least recognised and understood future risk [facing Cambodia]' (RGC, 2014: 15). To address this information deficit, People in Need (PIN) commissioned research to assess the vulnerability of Cambodia's urban poor population to disasters as part of the European Commission (DIPECHO) funded 'Building Disaster Resilient Communities in Cambodia 2' project. The research explores:

- Exposure to hazards – the main hazards that affect urban poor populations (e.g. river floods, rain floods, fires, storms);
- Sensitivity to hazards – the attributes of the urban poor that make them vulnerable to hazards (e.g. poverty, insecure tenure); and
- Resilience to hazards – how vulnerable communities cope with hazards and reduce their risk (e.g. strengthening their houses to withstand floods), and how government, civil society and other stakeholders support them.

02 METHODOLOGY

This research uses a multi-level approach – from local to national – to assess vulnerability, but is primarily centred on a community-level analysis using data from six urban poor communities located in the cities of Phnom Penh and Kampong Cham.

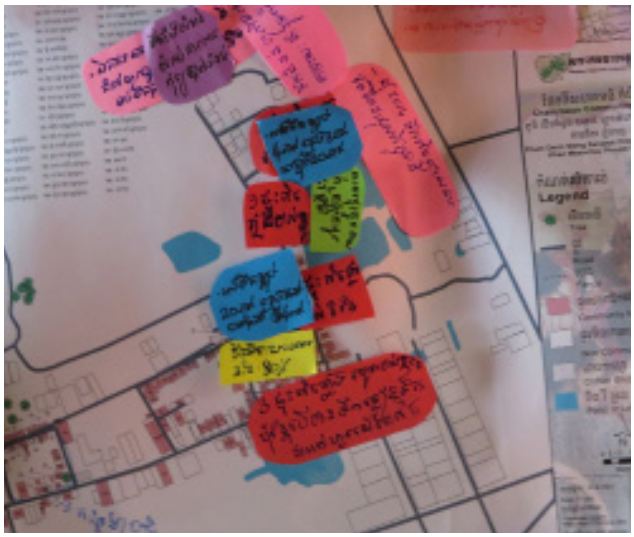
It was beyond the scope of this study to provide a quantitative assessment of nation- and city-wide trends of hazard vulnerability. Instead, the research team relied on qualitative data, such as secondary sources and interviews with key informants from government and civil society, to identify the key hazards and vulnerabilities of Cambodia's urban poor at the national and city levels. Against this background, the study used a participatory approach to provide detailed case studies of hazard vulnerabilities and capacities at the community level. In doing so, this report provides the first in-depth review of key urban DRR issues at the local-level in Cambodia.

The primary methodology used in this research was the Participatory Hazard, Vulnerability and Capacities Assessment (PHVCA). The PHVCA is a widely used methodological toolkit in DRR programming. Its goal is to facilitate a 'participatory analysis of past patterns of hazards and present threats at the community level (hazard assessment), combined with an understanding of the underlying causes of why hazards become disasters (vulnerability assessment) and of the available resources an affected community uses to cope with the adverse effects (capacity assessment)' (ADPC 2015).

PHVCAs have been an integral part of DRR programming in rural Cambodia as part of the DIPECHO funded 'Building Disasters Resilient Communities in Cambodia 2' and related projects. Development partners have tailored the PHVCA to the Cambodian context so that studies have methodological consistency and generate comparable data.

For this study, the research team modified the PHVCA model implemented in rural Cambodia to fit the urban context. PHVCAs were conducted with focus groups of ten community members, including individuals belonging to vulnerable population sub-groups, such as the disabled, elderly and youth (Figure 1). The team adopted an analytical framework informed by both DRR and climate change adaptation definitions of vulnerability. This was in recognition of the long-term, growing stresses faced by the study communities (such as perennial floodwater levels) in addition to disaster events (such as flash floods). Details of the PHVCA methods used, steps of implementation and issues covered during focus group discussions are detailed in Annex 1.

Figure 1: Urban PHVCA fieldwork



Phnom Penh was selected as a survey city as Cambodia's capital and largest urban area with a population estimated at 1.6 million in 2012, including many urban poor. The city, at the confluence of the rivers Tonle Sap, Bassac and Mekong, is vulnerable to flooding and has experienced many significant flood events in its history. Kampong Cham was selected because it is the largest city in one of Cambodia's most flood prone provinces, and to address an almost complete lack of data relating to disaster vulnerability and/or urban poor communities in the city.

Three disaster prone communities were identified in each of the survey cities to represent the breadth of hazards affecting urban poor communities (Figure 2). Sites were selected in partnership with local NGOs, Urban Poor Women's Development (UPWD) in Phnom Penh and Community Development Fund (CDF) in Kampong Cham, which have extensive experience working with urban poor communities in the respective cities.

Phnom Penh

Selected communities in Phnom Penh were all located in the outer or peri-urban districts of the city. UPWD, other informants and secondary sources suggested that urban poor populations in peri-urban areas of the city were the most vulnerable to hazards. In dialogue with UPWD, the following sites were selected:

- Chamrouen – Located in the outer municipal district of Chbar Ampov. The settlement was established in 1979 and included 231 households. The majority of residents work as informal rubbish collectors.

- Vealsbov – located in the district of Chbar Ampov, established in 1996 and home to 57 households. Like Chamrouen, the majority of residents work as informal rubbish collectors. Out of the 57 households, 32 had been relocated from Chamrouen community in 2009.

- Borei Doemsrol – located on the banks of the Tonle Sap River in the outer municipal district of Russei Keo, established in 1979 and home to 74 households. The majority of

residents are employed in factories or as civil servants.

Kampong Cham

Establishing city-wide trends of hazard vulnerability and survey site selection in Kampong Cham were hampered by the lack of data on urban poor communities there. A total of four communities were identified in the vicinity of the city, two of which were relocation sites for settlements formerly located in central urban areas. Out of the four poor communities identified, three were selected for study in consultation with CDF:

- 42 Knong – located in a peri-urban area of Kampong Siem district and home to 42 households. The community was established in 2006 after being relocated from the riverfront area in central Kampong Cham. Residents work as market porters, factory workers and hawkers, amongst other jobs.

- Niengkong Hing – located on a filled in lake in Kampong Cham town and home to 153 households. The community was established in 2010 and comprises of various urban poor and landless communities relocated from other areas of the city. Like 42 Knong, most residents work as market porters, factory workers, hawkers and in other menial jobs.

- Roka Thom – a peri-urban settlement on the riverbank opposite Kampong Cham town and home to 225 households. The majority of households work as labourers or as farmers.

Figure 2: Location of survey sites (A-Phnom Penh, B-Kampong Cham)

Source: Google Earth

03 EXPOSURE

Exposure refers to the nature and degree to which societies or a system experiences hazards (Adger, 2006). This section explores exposure at the national, city and community level, focusing on floods hazards and their synergies with other hazards, such as forced eviction, disease epidemics and industrial pollution.

3.1 FLOODING AND STORMS

Cambodian flooding: national context

The Mekong, the 10th largest river in the world, enters Cambodia from Laos and flows via Kampong Cham before joining with the Tonle Sap and Bassac rivers at Phnom Penh. It then flows towards Vietnam and the Mekong Delta where it discharges into the South China Sea. As much as 85% of Cambodia's land area resides within the Lower Mekong Basin (Sovann, 2006);

The climate of Cambodia is tropical monsoon, with the southwest wet season from May to November accounting for 75-85% of annual rainfall (EM-DAT, 2006 in ACAPS, 2011). The torrential monsoonal rains and tropical storms cause the Mekong River and Tonle Sap Lake to flood their vast plains in the Lower Mekong Basin south of Kratie (Keskinen et al., 2010). The floodwaters supply nutrients and water to agricultural soils to support rice production, and maintain biodiverse and productive freshwater ecosystems that sustain the livelihoods and sustenance of millions of poor fisherfolk (Davies et al., 2014).

The flooding regime of the Mekong is predictable with the flood season deviating by only 2 weeks from its average start date (ADB, 2014), but

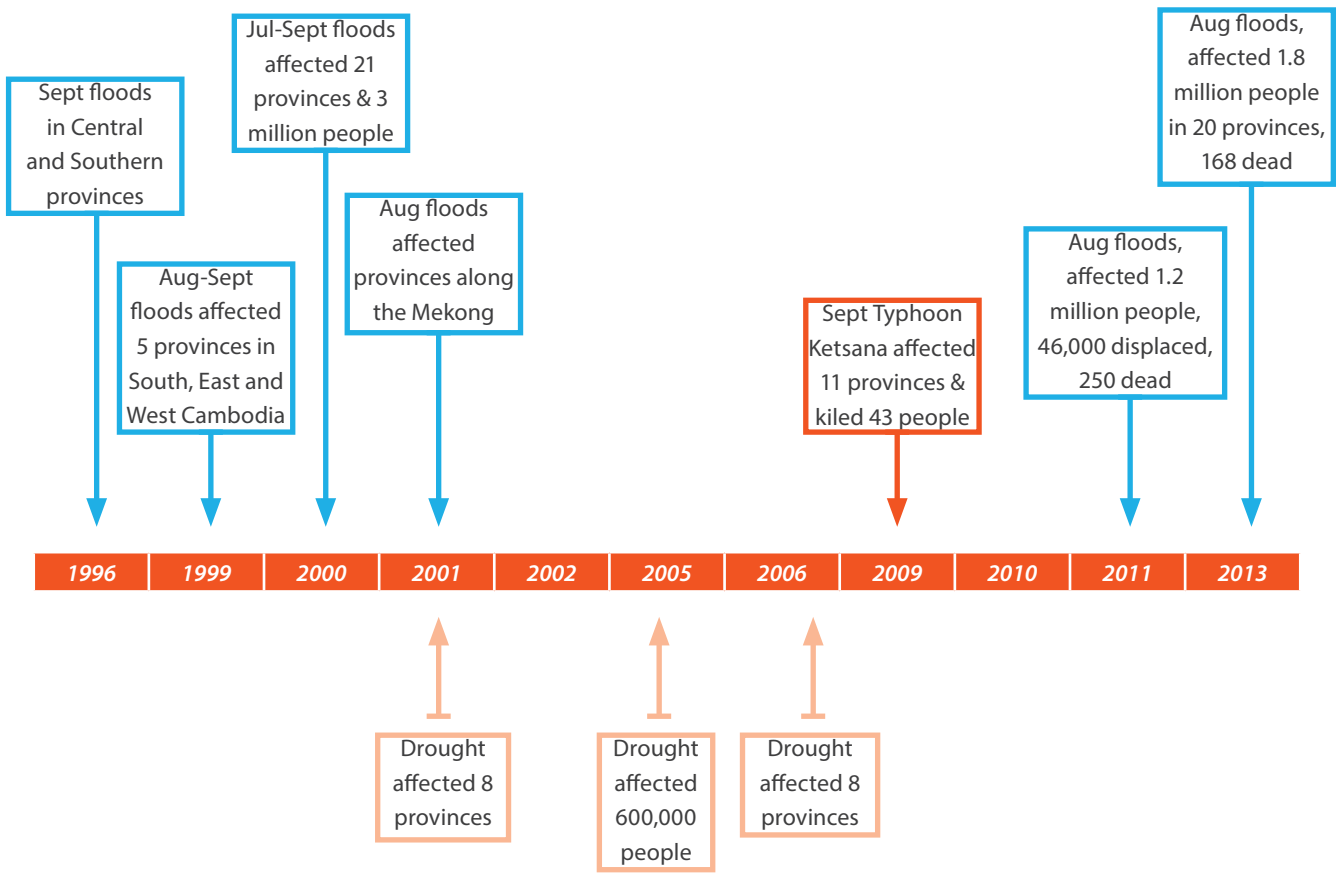
Figure 3: : Map of the Cambodian section of the Mekong River Basin.

Source: Open Development Cambodia

inter-annual rainfall is highly variable, ranging from 1,100 mm to 4,000 mm a year (EM-DAT, 2006 in ACAPS, 2011).. In addition to river floods, monsoon thunderstorms can also cause localised flash floods.

Although flooding is vital for ecosystems and rural economies, disastrous floods are reported to be increasing in frequency and severity. Until the 1990s, major flooding occurred approximately every 5 years, whereas since then floods classified as disasters were recorded in 1991, 1994, 1996, 1999, 2000, 2001, 2002, 2006, 2009, 2010, 2011 and 2013. The floods of 2000 had the largest impact in 70 years – 22 provinces and over 3.4 million people were affected. The flooding in 2011 was also especially devastating, with 18 provinces and 1.6 million people affected. Typhoons tracking from the South China Sea exacerbate flood risk. Typhoon Ketsana crossed Cambodia from 29th September to 5th October 2009, resulting in 43 fatalities, the disruption of the livelihoods of approximately 180,000 people, and about USD $132 million of damages (ADB, 2014). Figure 4 shows a timeline of flood, drought and typhoon events.

Figure 4: : Disasters in Cambodia (1996-2014)

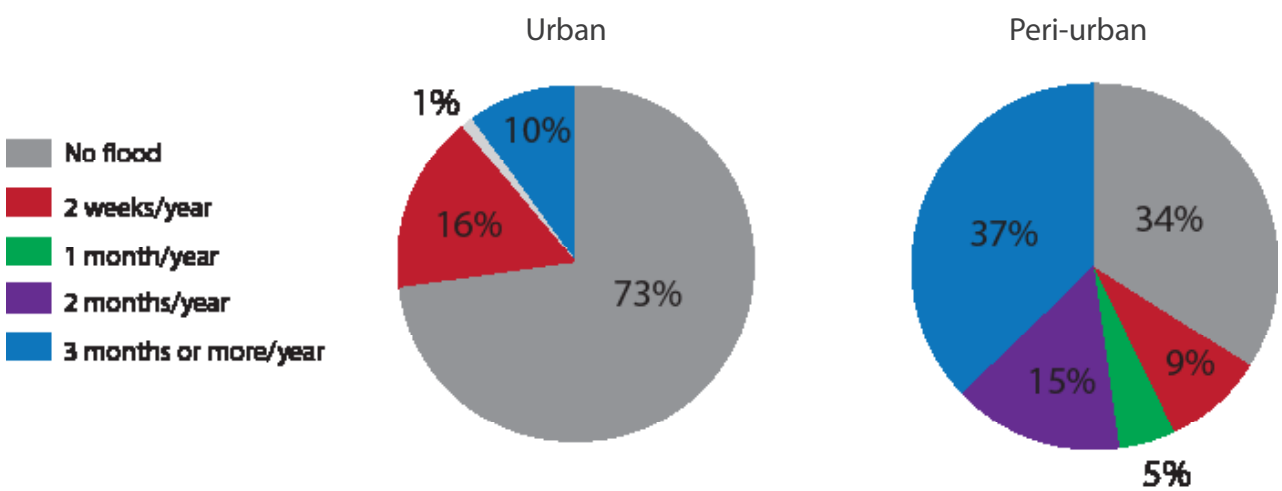


Sources: ACAPS, 2011, Royal Government of Cambodia, 2014

Flooding in Phnom Penh and Kampong Cham

Located on the flood plains of the Mekong, Phnom Penh and Kampong Cham both experience seasonal flooding and flash floods, yet studies of flooding in Cambodia have predominantly focused on rural areas. A lack of data on and mapping of flood risk, especially of the urban and peri-urban poor, presents a major obstacle to fully understanding exposure at the city-scale, particularly outside of Phnom Penh. Secondary sources, community survey data and interviews with public officials point to variable flood risk across urban spaces. According to NCDM officials, peri-urban areas, and the poor located there, are the most vulnerable to flooding. Secondary data from NGO reports supports this assertion. An STT (2009) survey of representatives from over 400 urban poor communities in Phnom Penh found that 66% of survey sites in peri-urban areas experience flooding compared to 27% in urban areas (Figure 5). Importantly, flood duration in peri-urban areas vastly exceeds that of urban areas, with over a third of peri-urban poor communities experiencing flooding for over 3 months every year. In contrast, 80% of flooding in urban areas lasts for less than a day. The increased exposure to flooding in peri-urban communities is also reflected in a forthcoming PIN study, which included PHVCAs with officials and other stakeholders from all of Phnom Penh's 98 Sangkats (commune). The survey found that across the city's Sangkats flooding was the most severe hazard, gaining a hazard score of 258 from the 98 PHVCAs (almost double that of fire, the second most severe hazard). Out of the 258 points attributed to floods, 249 (97%) were reported in Phnom Penh's peri-urban districts (PIN, forthcoming).

Figure 5: Flooding duration in Phnom Penh's Sangkats



Source: data from STT, 2009

In Kampong Cham there is a severe lack of data or understanding of flood risk at the city-scale. Nevertheless, research participants and NGO partners painted a similar picture to that in Phnom Penh. During the 2011 floods, rainfall was 24% higher than the September average, and by October the Mekong and Tonle Sap rivers were in flood (ACAPS, 2011). Kampong Cham was one of the worst affected provinces, with 33,436 households affected (9%) and 47 causalities. In Phnom Penh, most of the city avoided flooding but 10,000 families were evacuated, before 14,570 homes and 22 school buildings were inundated (ACAPS, 2011). According to Murphy et al. (2013) 'It is quite possible that neither the 2000 nor the 2011 floods were the scale of a potential 100-year flood, i.e. without any consideration of impending changes, the potential for more serious future flooding exists'. Climate change is expected to increase the intensity and duration of these flood events, which is likely to exacerbate the impact of flooding on urban areas in Cambodia in the future.

Table 1: Flood affected households in Phnom Penh

Year	Affected/ damaged houses	Affected households
2001	2051	2051
2003	145	150
2006	5109	5119
2011	14570	17150
2013	7460	2700

Source: PPM (PIN, Forthcoming)

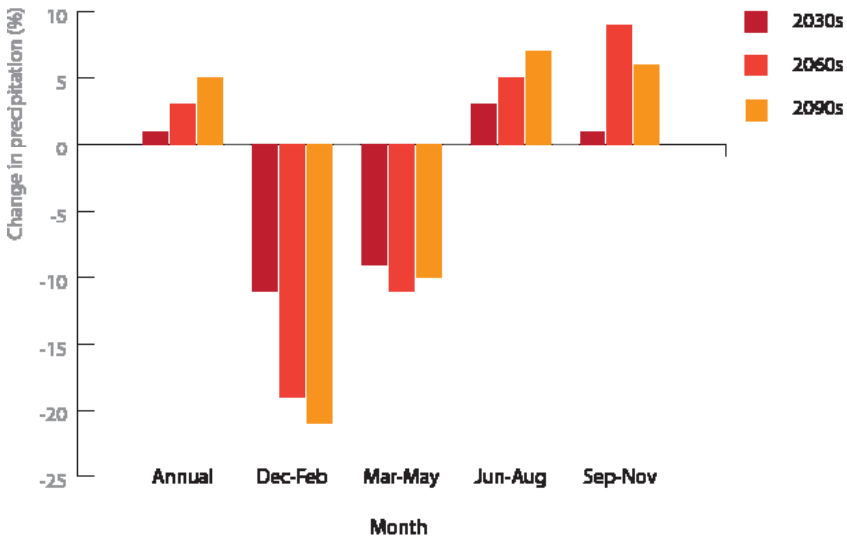
Climate change and hydropower development influences

The hydrological regime of the Mekong river basin is undergoing substantial change. In a Climate Change Vulnerability Index, Cambodia is ranked eighth out of 193 countries, which considers exposure, sensitivity and adaptive capacity (Maplecroft, 2014). Other mapping studies ranks it as the most vulnerable in Southeast Asia, alongside the Philippines, to climate change due to 'its exposure to floods and droughts; sensitivity through reliance on agriculture and lack of adaptive capacity through a combination of low levels of income, skill and infrastructure' (Fee et al., 2012: 3). Although over 20% of Cambodia's population is urban (UN Statistics, 2014), studies of climate change have only focused on its rural implications (Fee et al., 2012).

Country level assessments project that total annual rainfall will increase in the Lower Mekong Basin by an average of 162 mm by 2050, but in peak years this figure could be as much as 933 mm (ADB, 2014). This increase is expected to be concentrated in the wet season with more intense rainfall events, while the dry season is predicted to have lower rainfall than today (Fee et al., 2012). Thus, climate change is likely to increase the magnitude and volume of flooding during the August and September pulse and increase the duration of the floods in the Lower Mekong Basin (Figure 6) (ADB, 2014; Keskinen et al., 2010).

An understanding of the potential impacts of climate change is complicated by large-scale hydropower development in the Mekong Basin. As many as 126 hydropower projects with a capacity of 107.8 trillion cubic metres are under consideration by the five nations sharing the Mekong Basin (ADB, 2014). In addition to climate change, this development will be a major driver of changes in the hydrological cycle of the Mekong Basin (Keskinen et al., 2010), potentially altering flooding patterns. Moreover, the effects of large scale de-forestation and conversion into agricultural land is reducing the water retention capacity of ecosystems and increasing run-off into rivers.

Figure 6: Predicted annual and monthly precipitation change (%) in Cambodia. Data based on an intermediate climate scenario (A1B scenario). Source: (McSweeny et al., 2010)



Source: McSweeny et al., 2010

Community-level exposure to flooding and storms

The community level analysis revealed significant local-level risk of and impact from flooding. All the assessed communities, except one, identified flooding as likely or very likely, and as having severe to critical impacts. Three types of flood were reported by the communities in Phnom Penh and Kampong Cham: river flash floods; slow onset rain and run-off related flooding; and government released flood overflow waters. The type of flood the communities face depends on their location, local topography and surrounding land use.

Flash river floods were predominantly a concern for Borei Doemsrol (Phnom Penh) and Roka Thom (Kampong Cham), which are both located on the riverbanks of the Bassac and Mekong, respectively. In the former, the worst river flooding occurred in 1984 and 2000 when water levels were up to twice as high as the average season high waterline. The floods occur rapidly, over a matter of days, leaving little time for residents to prepare. Chamrouen was previously susceptible to river flooding but the construction of dykes has prevented recent river flooding.

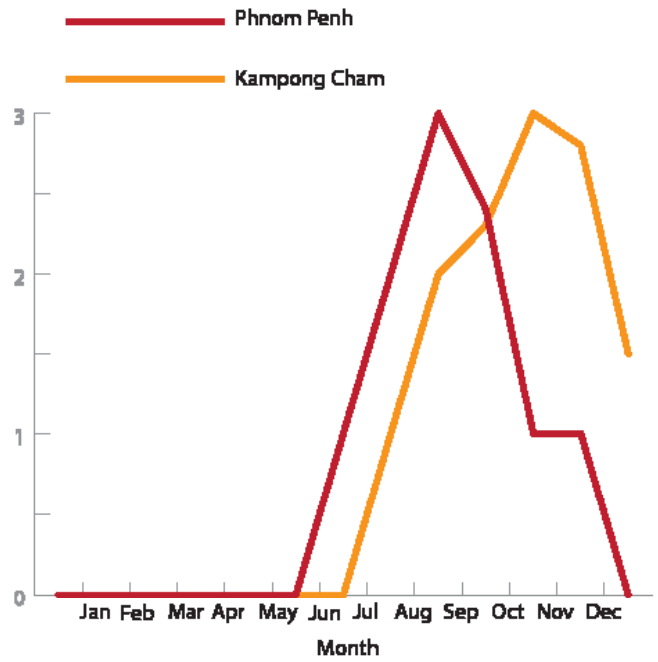
Vealsbov and Chamrouen (Phnom Penh) are situated in lowland, rapidly urbanising peri-urban areas. Nearby development is contributing to their flood exposure due to increased run-off from hard surfaces and the loss of local green space, such as marshland, and its associated flood attenuation capacity (see Section 4, Sensitivity). Consequently, rainwater collects in poorly drained

lowland areas where the urban poor reside. So while Chamrouen is less exposed to river floods as a consequence of the dyke, rain and run-off related flooding remains a major concern.

In Niengkong Hing and Vealsbov, flooding is controlled by a system of dykes. However, during peak flows, water is released from the Mekong and the Bassac, respectively, into nearby overflow channels, and combines with run-off from nearby developments to inflict localised flooding. In Vealsbov, the overflow water fills a nearby lake by 10-20 cm a day to eventually inundate the community. Controlling water levels for downstream communities thus occurs at the expense of informal settlements near the banks of the rivers. Figure 7 presents the flood seasons for Phnom Penh and Kampong Cham, as perceived by the study communities. The duration of the flood season appears to be longer in Phnom Penh, where that floodwaters take between 4 and 8 months to recede as a consequence of poor drainage. Thus, while the flood events typically occur during the monsoon season between July and October, the impacts of flooding extends beyond this time to December. In Kampong Cham the floodwaters recede before December which, speculatively, may reflect the less urbanised context (less run-off), the dominance of river flooding, and better natural drainage compared with areas assessed in Phnom Penh.

Storm and typhoon events, which track across Cambodia every year, compound flooding and cause wind damage to houses. In 2004, a storm caused a large ship to break anchor before damaging three houses in Borei Doemsrol; in 2001, five houses were damaged by a storm in Chamrouen; and in 2013 and 2014, storms destroyed 14 and 23 houses each year, respectively, in Vealsbov. Storms were also considered a likely and severe hazard risk to Roka Thom. The community remembered how three houses had been destroyed in 1998, and how one house collapsed following a storm in 2013.

Figure 7: Participant seasonal calendar of perceived flood severity in Phnom Penh and Kampong Cham. Scores (0-3) represent average of the study communities in each city where flooding was reported.



Source: Focus Group Discussions

Flooding and disease

Nationally, flooding hazards are known to affect the prevalence of water-borne diseases, especially diarrhoeal diseases such as viral and bacterial gastroenteritis, dysentery and cholera (Davies et al., 2014). According to WaterAid (2015), an estimated 10,000 children die each year from diarrhoea in Cambodia, and a study by Davies et al. (2014) found 'incidence and risk of water-borne diseases appears to increase with flooding, particularly in the most flood-affected provinces'. Likely factors for these increases include the inaccessibility of health services, the disruption of power supply for boiling or treating water, and the contamination of water resources during floods.

The link between flooding and disease is likely to be less acute in urban areas because of access to better sanitation, sewage and drainage infrastructure. Nevertheless, participants in the study communities, where such public services are lacking, reported that the flood season brought increased incidences of disease, including dengue fever, skin diseases, eye infections, chest infections and typhoid.

Sewage systems frequently fail during flash floods and slow-onset rain flooding eventually exceeds their capacities, resulting in increased rates of open defecation and disease. Stagnant water provides breeding ground for dengue infected mosquitoes which carry dengue; in Chamrouen, for example, dengue fever affects 20-30 children each month during the raining reason, and killed 5 children between 2010 and 2015. When the floodwaters recede they leave residues that the participants believed were the cause of conjunctivitis. Inundation by flood waters also causes the settlements to be infested with snakes which bite residents.

3.2 FIRE

Fire is a constant risk for poor urban residents. Between 2001 and 2009, an estimated 5,270 urban families lost their homes because of fires (according to Phnom Penh municipal authorities; in PIN, forthcoming). Housing constructed from temporary, fire prone materials (Sotharith, 2006) combined with unsafe, poorly maintained electrical equipment and open flame cooking (Figure 8), provide the triggers for fire events in informal settlements (PIN, forth-

Figure 8: Cooking with an open flame (Chamrouen, Phnom Penh)

coming). Rooftop settlements, comprised of wooden huts built on top of existing buildings, provide well-ventilated and light accommodation but are highly vulnerable to fires since fire hoses are unable to reach them (Khemro and Payne, 2004).

Past major fires have devastated whole communities. In 2001, two of Phnom Penh's largest informal settlements were destroyed by a fire outbreak. In the Tonle Bassac area, the fire left 1,853 families homeless (Sotharith, 2006; URC, 2002). Fires are often followed by the eviction and resettlement of residents. The fire disasters of 2001, for instance, resulted in the Municipality of Phnom Penh relocating fire victims to new undeveloped resettlement sites, which lacked basic services such as water supply, sanitation or drainage (Sotharith, 2006). Later, many residents returned to the Tonle Bassac area.

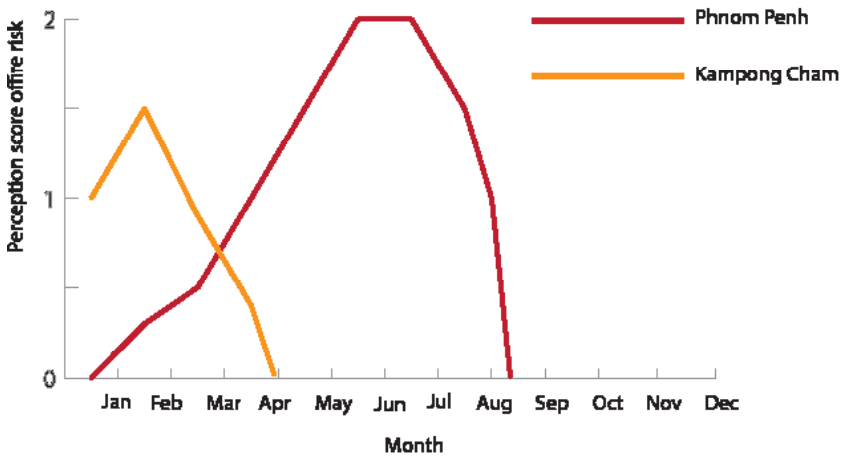
Phnom Penh.

Fire was identified as very unlikely but as having critical impacts in Borei Doemsrol (Phnom Penh). The community lost seven houses to a fire in 2000 that was caused by an electrical failure in a wooden house. Although a fire in 2011 destroyed three houses, fires were considered as, again, very unlikely and as having minor impacts in Chamrouen. In contrast, participants from Vealsbov perceived fire to be a likely hazard with the potential to have critical impacts. A bush fire in 2013, caused by the use of smoke to collect honey from hives, destroyed four houses. The perception of fire risk is attributed to the inaccessibility of the village by public fire services (see Section 4, Sensitivity).

In Kampong Cham, there is little available data on fire hazards. For Roka Thom, fire was not reported as a hazard, but in Niengkong Hing it was considered to be a likely and critical hazard risk since when it occurs it 'destroys everything'. Here, open flame cooking causes fires that spread easily amongst tightly built wooden housing. Similarly, in 42 Knong, fires were regarded as very likely and as having severe consequences, even though fires have so far not affected the community. Bush fires used to clear land and fertilise soils for small-scale crop production, and children playing with fire, were perceived as potential causes of fire events.

In Phnom Penh, fires tend to occur towards the end of the hottest months of March-June when temperatures average between 28 and 35^{oC}, but can easily reach over 40^{oC} in April. In Kampong Cham, where fire is perceived to be a less significant risk, January and February were regarded as the most likely months to experience fire (Figure 9).

Figure 9: Participant seasonal calendar of perceived fire risk in Phnom Penh and Kampong Cham. Scores (0-3) represent average perceived risk from the 3 study communities in each city.



Source: Focus Group Discussions

3.3 LANDSLIDES

In Phnom Penh a landslide in 2008 damaged the properties of 61 families in Russei Keo, and a landslide affected four families in 2009. DRR agencies estimate that about one thousand properties situated near to the Mekong riverbanks in Phnom Penh are at risk of landslides (PIN, forthcoming). Landslides have also occurred in Kampong Cham along the riverbanks of the Mekong (Figure 10). In Roka Thom, erosion of the riverbanks occurs during the flood season and again when the flooding subsides and leaves water-logged soils. Landslides associated with this erosion resulted in two houses collapsing in 1998/1999. During the 2011 floods, a 320m x 37m plot of land by the river was washed into the river, taking with it 28 dwellings and a section of road. In total, 79 out of 225 households have been made landless by the landslides and forced to resettle in a nearby conservation area or rent. The community

Figure 10: Road destroyed by landslide in Roka Thom, Kampong Cham, being rebuilt by local authorities.

estimate that they have lost 2.5 km^2 of land between 1988 and 2015 due to landslides, based on possession documents issued at that time; only 7 plots remain in their original location.

In Roka Thom, residents associated landslides with the dredging of the Mekong, which, they believed, increased the rate of riverbank erosion. Dredging rivers for sand to be used in the construction industry is widespread in Cambodia, and has been blamed for landslides that have resulted in loss of life and property (RFA, 2015). Because of the adverse impacts of the practice, the government recently stopped issuing new licences to sand dredging companies while the social and environmental effects of dredging are investigated. However, it is thought that many dredging companies operate illegally and may therefore not be affected by the licensing moratorium *(Ibid)*.

3.4. EVICTIONS

Tenure insecurity and evictions of urban poor communities are endemic in Cambodia. As the urban economy has grown, property prices have increased and competition for urban land has become intense. In this context, the urban poor have frequently been evicted from central urban areas to make way for redevelopment projects (Khemro and Payne, 2004). Although there are no definitive figures, it is estimated that tens of thousands of urban poor families have been evicted over the past two decades (URC, 2002; STT, 2011). Since 2001, the government's systematic land titling programme has aimed to reduce tenure insecurity across urban areas. However, poor communities have often been excluded from titling and remain vulnerable to evictions (Grimsditch and Henderson, 2009).

Eviction was considered to be a hazard by Borei Doemsrol and Vealsbov communities because of the potential negative consequences of relocation on their livelihood opportunities and access to social support networks. In Borei Doemsrol, tenure insecurity was viewed as the biggest hazard the community faced – bigger even than flooding from the Tonle Sap River. The community had been told by authorities that their land possession was illegal because they inhabit land classed as riverbank which belongs to the state. They believed that eviction was a strong possibility and, in the words of one participant, we 'live with fear in our hearts every day'.

04 SENSITIVITY

Sensitivity refers to the social and environmental attributes of urban poor communities and settlements that increase their vulnerability to hazards. This section, first, highlights the socioeconomic characteristics of urban poor communities that result in the impacts of disasters being severe; and second, assesses how the rapidly changing urban environment renders the urban poor increasingly hazard-prone.

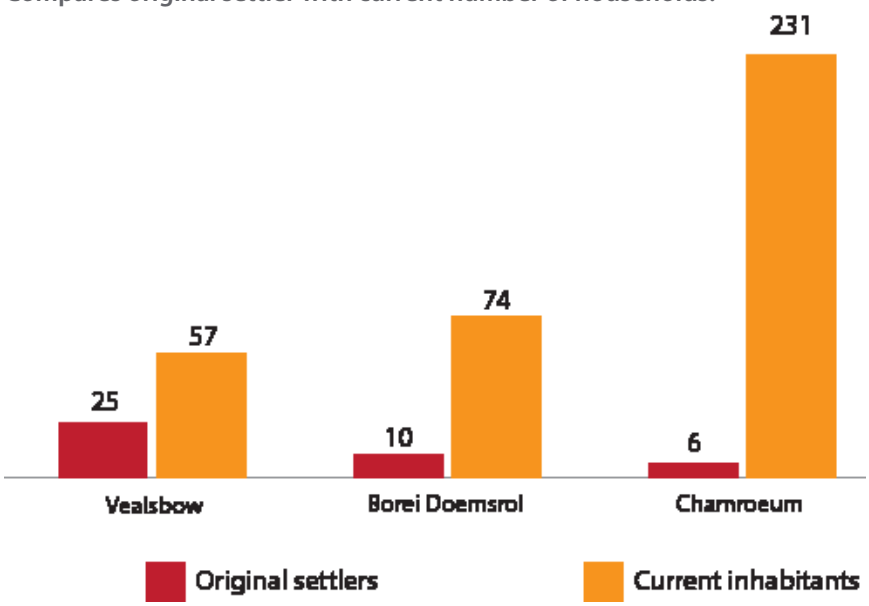
4.1. SOCIAL AND ECONOMIC CHARACTERISTICS OF THE URBAN POOR

At the city-level, there are various social and economic factors that contribute to urban poor vulnerability, which are rooted in the poverty that many low-income communities suffer. Such factors include high population density, the distribution of vulnerable groups within communities, insecure livelihood strategies, low WASH coverage, and housing and tenure issues. The city-wide patterns of urban poor vulnerability were observed in the survey communities. It should be noted that – in contrast to Phnom Penh – there is no available secondary data on the socioeconomic characteristics of urban poor communities in Kampong Cham.

Increases in population density increases vulnerability

In Phnom Penh the available information suggests increases in urban poor populations could be significant, particularly in peri-urban areas. CDRI estimated the urban poor population of Phnom Penh in 2001 as around 175,000 (So et al. 2001:47); by 2012, Phnom Penh Municipality put the figure at 250,000 (PPM 2012: 5) – an increase of 75,000 in a decade. Most of this growth has occurred in peri-urban areas. STT (2014: 8) estimates that the number of urban poor communities doubled in peri-urban Phnom Penh between 1997 and 2015. Though little urban poor

Figure 11: Number of households in study settlements in Phnom Penh. Compares original settler with current number of households.



Source: Focus group discussions

data exists for Kampong Cham, the city's low rate of urbanisation suggests that the growth of the city's urban poor population has been far less rapid than in Phnom Penh.

The nation-wide trend of rapid urbanisation has been represented in population increases in the Phnom Penh survey sites (Figure 11). Population increase in Chamrouen has been especially steep, from seven households establishing the community in 1983 to 231 in 2015. Urban growth has not yet affected Kampong Cham, where the population of the survey sites changed little over time.

Spatial constraints result in urban population growth increasing population density. Rapid increases in population density can increase vulnerability by putting additional pressures on the environment and infrastructure of urban poor communities. In Chamrouen, rapid population growth occurred in the context of low capacity sanitation systems. Around 70% of households used latrines while others simply defecated in plastic bags, which were then tossed into open space. In addition, with no rubbish collection serving the community, other household waste was also discarded in open space close to dwellings. During times of flood, pit latrines overflow and mix with other rubbish and faeces. Contact with the contaminated water causes diarrhoea, skin diseases and other ailments.

Increases in population also changed the dynamics of vulnerability within settlements. In Borei Doemsrol, original residents had sub-divided their plots to sell to incoming migrants. Migrants tended to be better off than original residents and purchased land further away from the river that is less exposed to floods. After repeated subdivisions, many original residents lived in very small plots on the riverbank, which are vulnerable to river flooding and suffer high tenure insecurity because riverbank land is considered property of the state.

Vulnerable groups within the community are most at risk

Focus group discussions revealed that communities included many sub-groups that were especially vulnerable to hazards. Children, the elderly and disabled residents are considered the most at risk because they are unable to ensure their own personal safety. The majority of flood-related deaths in the survey areas related to drowned children, typically after falling from an elevated walk way into flood waters. In all three Phnom Penh survey sites and one Kampong Cham site children had drowned in this way. The elderly were viewed as a vulnerable demographic, particularly in relation to flooding, because they are unable to swim. Similarly, those with disabilities, ailments and pregnantwoman are more vulnerable because they are less able to cope with difficult living conditions. In Vealsbov, for example, pregnant women found it hard to reach the hospital because of flooding, and some gave birth en route. One pregnant woman miscarried when she fell while wading through flood waters.

Capacity to cope with hazards was also related to variations in poverty suffered by residents. The poorest tend to live in dwellings made of low quality material, usually wood, which are less able to withstand floods, fires and storms. Poverty was associated with certain groups, including female-headed households, and the elderly and disabled without family support networks. These groups often lived in the poorest quality housing because they could not afford durable construction materials. The cumulative effects of

poverty and reduced mobility were particularly acute for residents in flood prone areas which necessitated the moving of their homes to safe areas each year (see Section 5 Resilience)

Those in informal employment are most at risk of income shocks

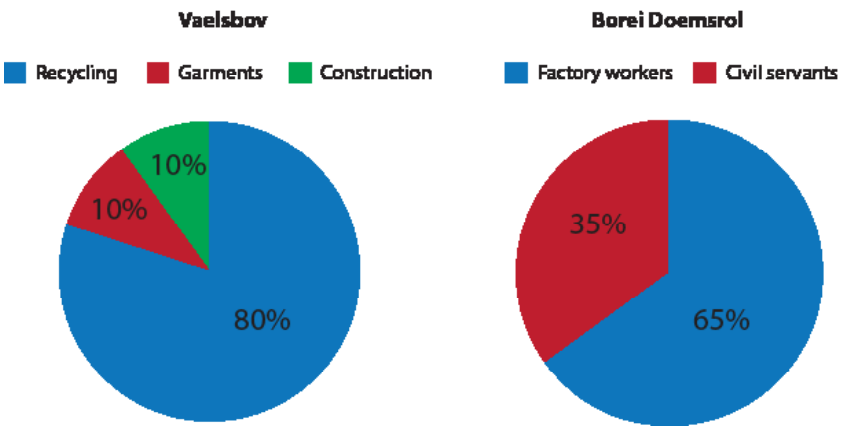
A large proportion of urban poor residents live precariously as self-employed informal workers. This demographic does not have a guaranteed income and their income is liable to seasonal fluctuations. The on-set of disasters can adversely affect informal livelihood strategies because work is often street-based, home-based and/or reliant on assets that may be damaged by disasters, such as food carts or motorbikes. Informal workers account for a significant proportion of the urban poor workforce. A recent survey found that around 20% of all surveyed income generating household members worked as informal motorbike taxi drivers, and over 7% derived a living from informal recycling (PIN, 2014: 29).

At the community level, it was found that the urban poor who relied on informal livelihood strategies were particularly vulnerable to income loss during times of disaster. In Chamrouen and Vealsbov, these effects were particularly acute because the majority of households are very low income echai collectors. Echai workers trawl the streets with a push- or motor-cart collecting recyclables, including plastic bottles, cans and other material. They then sell this material to recycling companies, who pay echai workers by the kilo of material collected. During flood periods, echai workers could not access roads to collect recyclables. The resultant loss of income coincided with periods of high flood-related expenditure, such as healthcare costscausing significant economic hardship.

Households whose members were in wage-labour did not suffer income shocks to the same extent as those reliant on casual labour, but still reported some issues. Factory workers and civil servants were able to work during floods, but reported losing income due to higher transport costs and not being able to work over-time because of longer commuting times.

Informal and formal workers were unevenly distributed across settlements (Figure 12). Settlements with a high proportion of informal workers, like Vealsbov, suffered the greatest hazard-induced income shocks.

Figure 12: Contrasting livelihood strategies in two sites



Source: Focus group discussions

Households that derived income from home-based economic activities were also sensitive to hazards. In most sites, few residents derived income from on-site economic activities. In the semi-rural location of Roka Thom, however, most residents' primary economic activity was farming their own land. Flooding events meant that their crops were destroyed yearly, and landslides meant that many lost farm land, resulting in lost income and assets.

Low WASH coverage contributes to health problems

Access to Water, Sanitation and Hygiene (WASH) varies across urban poor communities. At the city level, WASH coverage varies widely in Phnom Penh between peri-urban and urban areas. In peri-urban Phnom Penh, STT (2014: 28) found that 58% of surveyed settlements did not have sewage systems for human waste; in comparison, only 6% of settlements in urban areas had no system. Regarding access to water, 30% of peri-urban settlements did not have access to a piped water source, as opposed to 10% of urban settlements. Rubbish collections were also much less frequent in peri-urban area.

WASH trends at the city-wide level were broadly represented at the community level. However, complex intra-community dynamics meant that access to WASH infrastructure varied markedly across and within communities.

In Phnom Penh many residents could access piped, good quality water provided by Phnom Penh Water Supply Authority (PPWSA). In Chamrouen and Borei Doemsrol, between 85% and 90% households are connected to piped water directly from PPWSA. The quality of piped water in Phnom Penh was high, and it was not considered dangerous to drink in times of need. Residents in both sites, therefore, could access safe drinking water during times of flood. In Kampong Cham, 90% of households in Niengkong Hing could also access piped water. However, piped water in Kampong Cham was not safe to drink and diarrhoea was a common occurrence from consumption. In each of the three sites with piped water connections, the minority who were not connected purchased water from their neighbours.

In the remaining three communities, the absence of piped water was linked to negative health effects resulting from the consumption of unsafe water. In Vealsbov, while some better off residents had a piped water connection, most bought water at a cost of 500 riel (US$ 0.13) for 3 buckets of water, equating to around 6,500 riel (US$ 1.63) per cubic metre. High water costs in Roka Thom meant that only 50% purchased drinking water; those who could not afford treated water drank straight from the river. Of the 50% that drink river water, only about half boil water prior to consumption. Drinking river water was identified as a major cause of diarrhoea.

The only community to rely on well water, 42 Knong in Kampong Cham, suffer water shortages in times of drought. The wells in the community are only 30 metres deep – effective wells in the area are usually 70 metres – and often run dry. Even when available, residents claim that well water is not safe to drink and can only be used for washing. In addition, the wells do not provide enough water for the community – two out of the three wells in the settlement are non-functioning. Residents are forced to buy water from a neighbouring well owner at an inflated cost. The high price of water constituts a major expenditure

for residents, particularly in times of drought.

Low capacity sanitation infrastructure is a feature of the majority of the survey sites, contributing to a variety of health issues in communities, particularly during floods. As noted earlier, the issue is particularly severe in Chamrouen because of the high population density and inadequate sanitation systems. Of all the survey sites, only Borei Doemsrol residents have piped sewage. In Niengkong Hing, authorities plan to install drainage, though this has not yet occurred. The lowest capacity sanitation systems are in Vealsbov, 42 Knong and Roka Thom. Only 7 out of 57 households have access to latrines in Vealsbov community and 10 out of 33 in 42 Knong. In both communities, those without latrines go into scrubland to defecate – a practice that reportedly put residents at risk of snake bites. In Roka Thom there are no improved sanitation facilities. However, given the semi-rural, low density environment, unimproved sanitation was not reported to lead to adverse health impacts.

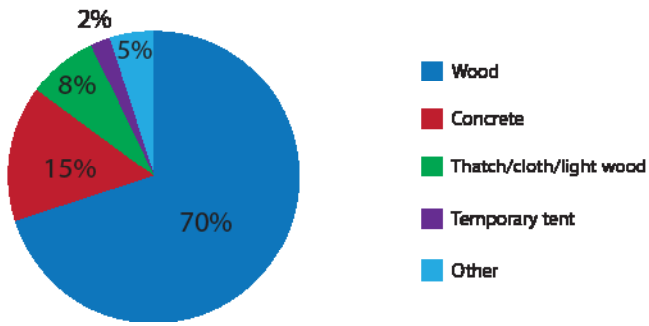
Floods compromise sanitation systems in all affected communities. Even in Roka Thom, toilets connected to sewers are located below the water-line and so are inaccessible during floods – residents deposit human waste directly into flood waters. Pit latrines frequently leak during floods. The pollution is most severe in areas where water is stagnant and remains for months.

In addition, surveyed communities (except Borei Doemsrol) do not have rubbish collections because their sites are inaccessible to rubbish trucks. In the absence of rubbish collections, residents either burnt their rubbish or deposit it on open land. In times of flood, waters are further contaminated by this household waste.

Poor quality housing increases severity of disaster impact

Housing quality in urban poor areas is low. According to Phnom Penh Municipality only 15% of urban poor dwellers live in concrete or brick dwellings; the majority live in lower-quality structures made from wood or other light materials (Figure 13). At the community level, housing quality was considered by residents as one of the most important fdeterminants of vulnerability. The poorest live in low-quality structures made of light materials with living spaces at ground level. Such structures are highly susceptible to flood and storm damage. As noted in Section 3, residents in Vealsbov reported that 37 low-quality dwellings were completely destroyed by strong winds in 2013-2014. Houses made from wood are particularly vulnerable to fires – in Borei Doemsrol, eight wooden houses burnt down with the loss of all property. Better off families adapted their property to better withstand hazards (see Section 5, Resilience).

Figure 13: Housing structures in Phnom Penh's urban poor communities



Source: Adapted from PPM 2012: 11

4.2 RAPIDLY CHANGING URBAN ENVIRONMENT

Rapid urbanisation is changing Cambodian cities. The location of urban populations in relation to areas of rapid land use change and hazard risks render them increasingly vulnerable to disasters.

The severity of natural hazards threatening urban poor communities has been exacerbated by environmental changes resulting from rapid urban development. Of particular concern, in both Phnom Penh and Kampong Cham, is the rapid pace at which developers are filling in urban lakes and wetlands to create land to build on. In Kampong Cham, for example, a large lake in the vicinity of the city has been filled (Figure 14), while in Phnom Penh swathes of wetlands surrounding the city have been reclaimed for residential, commercial and industrial developments. This pattern of urban development brings new sources of flood risk by depriving cities of their natural waste water reservoirs, increasing surface run-off and overwhelming underdeveloped drainage systems.

Figure 14: A lake in Kampong Cham city in 2003 (top) filled with sand for development by 2013 (bottom)

source: Google Earth

Fast-paced land use change has occurred in a context of weak regulation that has failed to prevent development that degrades urban ecosystems (Box 1). Urban poor communities, who often live in wetland areas or close to filled in lakes, bear the brunt of the flooding that such land use changes cause. A report examining the flooding impacts of a Phnom Penh redevelopment project, found that those living close to the filled-in Boeung Kak lake began to suffer severe wet season flooding events during and after the completion of lake filling (BABSEA 2011).

Urban poor in peri-urban areas are most vulnerable

Land use changes associated with urban growth have been most pronounced in peri-urban areas. In Phnom Penh, it has been in peri-urban areas where most of the city's urban growth has taken place over the past two decades. According to the most recent census data, between 1998 and 2008, the total peri-urban population grew by more than 300,000, whereas the population of urban areas grew by just 1,000 (Figure 15). Absorbing this growth, wetlands and lakes have been reclaimed both to facilitate large residential developments and

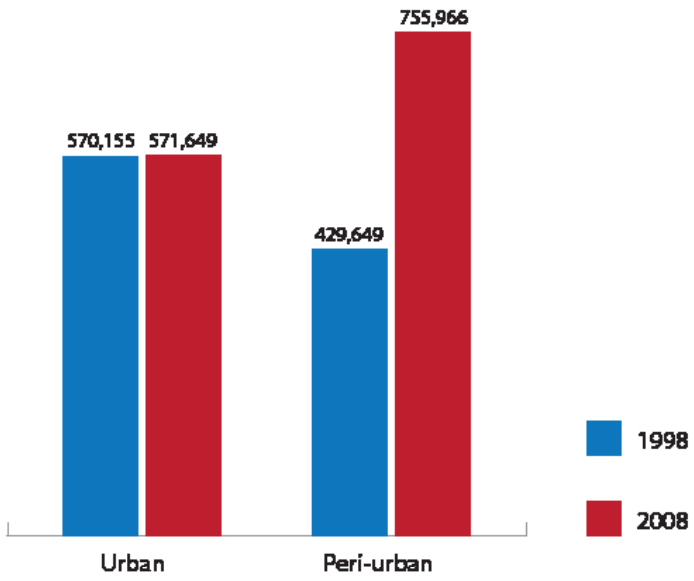
Box 1: Urban planning and hazards in Cambodia

Increased urban hazards at the city-wide level have resulted from rapid urban transition in a context of low-capacity urban planning mechanisms. There is currently no implemented Phnom Penh master plan or zoning regulations coordinating urban land use and infrastructure development. Instead, urban growth is private sector-led and uncoordinated. The primary regulatory framework to assess the environmental impacts of development projects is the Environmental Impact Assessment (EIA). However, companies contracted by developers conduct the assessments, raising questions over their veracity. The EIAs are then approved by the Ministry of Environment who will, if applicable, monitor the project to ensure guidelines are followed. It is feared that EIA companies contracted by developers may lack objectivity and suffer conflicts of interests in their assessments. Further, there are concerns that government institutions tasked with monitoring and enforcing EIAs do not have the required capacity to do so effectively.

In the case of the Boeung Kak lake reclamation, for example, an EIA provided by the developer claimed that the project would not result in increased flooding in the surrounding project area. A local NGO then commissioned its own EIA, which rejected the scientific rigour of the first, and found that localised flooding would increase as a result of the project.

To address deficiencies in the EIA process, the government is currently consulting key stakeholders for a draft EIA law. It is hoped that this law will streamline EIA procedures and strengthen the capacity of implementing institutions.

Figure 15: Population growth in urban and peri-urban Phnom Penh districts



Source: Cambodia census data 1998 and 2008 (RGC 1998; 2008)

factories and small-scale private development.

Despite rapid population growth, there has been a lack of supporting hard infrastructure development in peri-urban areas. The most significant flood control and drainage project in the country, which is supported by the Japanese government agency, JICA, mainly targets the inner, urban districts. In contrast, peri-urban areas lack flood controls, such as effective dykes, drainage systems, and riverbank defences.

In the absence of urban planning mechanisms and adequate drainage infrastructure, developers have focused on protecting their own land from floods by increasing the elevation of the ground and building dykes. Unintentionally, this process increases the severity of flooding of nearby lowlands. As more land is filled in, waste water and surface run-off is concentrated in ever diminishing lowland areas. It is in such remaining lowland areas that the poorest, who cannot afford to build up their land above the flood waters, are located. The cumulative effect of low capacity flood protection infrastructure and rapid, unplanned urban development results in many peri-urban poor communities experiencing floods with greater frequency and severity than their urban counterparts (see Section 3, Exposure).

Peri-urban areas are especially hazard prone because, increasingly, they are sites associated with poverty. In Phnom Penh alone, it is estimated that 30,000 poor households (approximately 150,000 people) were removed from urban districts and relocated to peri-urban sites in the period 1990-2011 (STT, 2011). Further population increases have been driven by recent urban migrants, who settle in peri-urban localities to avoid the strict enforcement of laws on legal land possession in urban areas.

Changing urban environments increase hazard risk at the local level

The city-wide trend of increasing vulnerability of urban poor in peri-urban areas is mirrored in community level PHVCAs. The location of five of the six survey communities rendered them vulnerable to flooding and, in the case of one community, the associated risk of riverbank collapse.

Surveyed riverside communities do not have the flood defences often afforded to urban populations. In Borei Doemsrol, for example, there are no flood defences on the riverbank to prevent river flooding. The community reported being inundated most recently in 2011; five kilometres downstream in central Phnom Penh, the flood defences were not breached. Unprotected river-banks also present the risk of landslides in Roka Thom in Kampong Cham (See Section 3 Exposure).

Rapid land use change in the locales of survey sites has been associated with emerging flood hazards, and even, in some survey sites, a shift in hazard from river flooding to development-induced flooding. Three communities – Chamrouen and Vealsbov in Phnom Penh, and Niengkong Hing in Kampong Cham – are located in wetlands areas where landfilling for redevelopment is taking place. Chamrouen provides a clear example of the changing threat of flood hazards. The community's location in a lowland area next to a small river meant residents had historically been vulnerable to flash river flooding. Such floods occurred in 1996, 2000, 2001, 2010, and 2011. As the area urbanised, the government built a dyke to block the flow of the river, which removed this risk from 2012 onwards. However, while the natural flood hazards have been

reduced, rapid urban development and filling of marshland has meant that development-induced flooding has increased.

Development-induced flooding in Chamrouen has been the result of significant land use change close to the community. Figure 16 shows the community surrounded by marshland and green space on all sides in 2005. By 2015, much of this land has been or is in the process of being developed. The most significant land use change in the area is the loss of marshland just to the north of the community, marked as 'A', which has been filled with sand and elevated to a higher aspect. This topographical change of the landscape was identified by residents as a cause of increased surface runoff and flooding. The only remaining wetland area, marked as 'B', is currently for sale – a 'for sale' sign and phone number is visible in the photograph. It is expected that, once sold, this wetland area too will be filled.

The reclaiming of wetlands for development has caused the severity of floods to increase in affected ur-

Figure 16: Map on the left shows Chamrouen in 2005 and right 2015;

Source: Maps from Google Earth; Pictures by authors.

ban poor areas. Vealsbov residents, for example, regarded the progressive filling of nearby marsh for a large residential development as the source of their flood hazard. Since filling began, flooding in their community has become progressively more severe each wet-season. Residents noted that flooding during the 2014 wet season was the worst they had experienced. The on-set of the disaster was much quicker than in previous years. Typically flood waters would rise slowly over a period of days or weeks, but in 2014 dwellings were flooded over the course of one night and residents had to evacuate in darkness, losing their possessions to the waters.

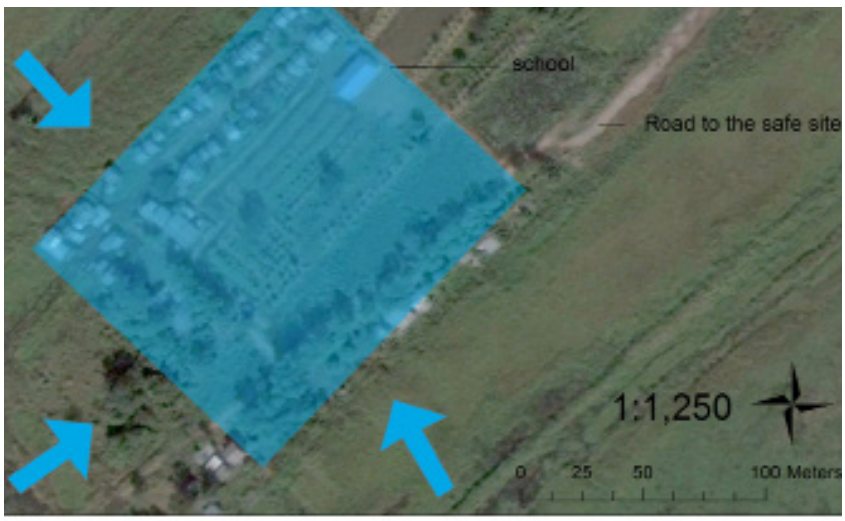
The 2014 flood-waters also remained in the area for far longer than previous years. The community would normally evacuate themselves and their dwellings to a safe area in July or August and return when the flood-waters receded in November or December. After the 2014 floods, residents only began to return in January 2015. Many were still living in the safe area when the survey team visited the site in February 2015. Residents expressed concern that planned new developments would make flooding in the area worse, increasing the time they would have to stay in temporary accommodation in the safe area.

Residents in all three sites affected by urban redevelopments noted that the quality of development-induced floodwaters were worse than river flood-waters. A key reason for this is the underdeveloped or non-existent sewage systems in peri-urban sites. As one participant in Chamrouen noted 'when we were flooded by the river, the water was clean. Now water comes from the higher land built up all around, and also from the ground. The water from the ground is brown and warm, I think it is the waste tanks from all the surrounding developments overflowing.'

The issue of water quality was linked to industrial development by residents in Vealsbov. They asserted that the quality of the water has become progressively worse over the years because of an increase in the number of nearby factories. Community members believe that wastewater from these factories ends up in their area and describe the water as being different colours: 'red, green, blue'.

Development-induced flooding combines with the other types of flood (see Section 3, Exposure) to result in more severe flood events in affected communities. Figure 17 shows the cumulative flood risks present in the Vealsbov area.

Figure 17: Flooding in Vealsbov



source: Google Earth

05 RESILIENCE

Resilience refers to 'the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience' (100 Resilient Cities, 2015). To understand this capacity in our study communities, we review their coping responses and the adaptations they have made over the years to reduce disaster risk. We set these responses within their city-wide and national DRR policy context, and reveal what actors do what when responding to hazards, with a particular focus on building resilience to flooding.

The communities have demonstrated a remarkable ability to learn to live with hazards by adopting many small-scale innovations, such as makeshift ferries, raised gangways and even temporarily relocating their settlements during floods. However, their capacity to cope and adapt faces several challenging constraints. Along with Lao PDR, Cambodia is considered to have the lowest adaptive capacity in Southeast Asia (Yusuf and Francisco, 2010). Moreover, responses by the communities and external actors can produce secondary effects that can potentially increase rather than reduce vulnerability to flooding and other hazards – for example, by increasing household debt.

We explore the coping and adaptive capacity of Phnom Penh and Kampong Cham at the household, community and institutional (city-wide and national) levels.

5.1. COMMUNITY-BASED COPING STRATEGIES

Household coping strategies

The study communities in Phnom Penh and Kampong Cham adopted a variety of strategies to cope with seasonal and flash flooding. Households prepare for the flood season by stockpiling food, purchasing wood and bamboo to build protective fences around their houses, and protecting their living spaces from snake infestation by spreading a lime mixture. Some households also use mosquito nets to prevent debris from entering living rooms. In Niengkong Hing (Kampong Cham), the community fill in depressions in the land that collect still water in order to minimise mosquito breeding and thus dengue fever during the rainy season.

In all communities, livelihoods can be severely disrupted during floods due to reduced transportation and or damage to agricultural areas (in some peri-urban sites in Kampong Cham). One strategy for coping with loss of income during the rainy season is to borrow money from moneylenders to purchase food and pay for school fees. In Roka Thom, agricultural workers cope by travelling further afield to cassava farms unaffected by the floods. During severe floods (e.g. 1996 and 2001), however, the Roka Thom community is evacuated to a district 9 km away for up to

3 months. Here, 90% are unable to work, with the rest seeking employment as labourers locally or fishing for sustenance. Conversely, the residents of 42 Knong recalled how, before resettlement, when they lived in a flood prone area, their incomes were actually higher during the floods because they took advantage of passing boats by selling them products or finding employment as crew.

Community coping strategies

At the community level, temporary, floating wooden walkways are constructed between buildings using oil drums for buoyancy in Borei Doemsrol, inner tubes ferry adults, at a cost of 500 riel per trip, and wash basins transport babies and infants over the flood-waters. In this way, the residents remain mobile during the flood season. Furthermore, sand bags, provided by the Sangkat, are placed on the road to prevent flood-waters entering houses further from the river, thus limiting the number of households affected by flooding.

In Chamrouen and Vealsbov, the communities are forced to resort to more radical responses to flooding. Households without stilts move their houses to, or build temporary accommodation on, higher ground, such as roads, in order to escape the floodwaters (Figure 17). Similarly in Kampong Cham, the residents of 42 Knong, before resettlement, moved their houses to a nearby road during the flooding season and remained there for 3 months. They said that this was made possible because their houses were small and wooden and thus easy to transport. They also recalled the importance of their social support network during the floods. Everyone helped each other move the houses to the safe zone, and shared food during times of shortage. Likewise, in Chamrouen, families with better capacity to deal with the floods often shelter the worst affected community members.

Figure 18: Temporary housing in safe area during flood season (Vealsbov, Phnom Penh)

5.2. COMMUNITY-BASED ADAPTATION STRATEGIES

Household adaptation

Households have made several adaptations to lessen the impact of flooding. In all the study communities, many households have rebuilt their houses damaged by floods or fires to better resist seasonal flash and rain floods. Adaptations to houses have included raising the height of homes above the high water-line with stilts. The height and material (wood or concrete) of the stilts varies according to the wealth of the households with some still not sufficiently high enough to escape inundation (Figures 18 and 19; Table 2). In Vealsbov, it was the older residents that had installed stilts, whereas the homes of recent migrants to the area (since 2009) were still without stilts because of financial constraints and high levels of insecure land tenure.

Further household adaptations have included the reinforcement of houses with concrete foundations, and the construction of platforms in living areas and/or structures on rooftops to escape flood levels. In Borei Doemsrol, water pipes were extended to reach the new rooftop structures, and electricity lines were raised above the highest flood-water levels.

Figure 19: Earth/mud foundations in Chamrouen. Sediments on structure mark flood-water levels

Figure 20: Strengthening of houses with concrete foundations and building materials in Borei Doemsrol

Community-level adaptation

Community-level adaptations have focused on engineered solutions. The Sangkat of Chamrouen, for example, constructed a dyke to protect the community against river flash floods (Figure 20). To date, this has prevented further flash floods, although rain flooding still remains an issue. In 2014, the Sangkat authorities, in partnership with local NGOs and the community, also raised the height of the road and surrounding ground by 1.7 metres so it would be less susceptible to floods. This has had several effects. First, by increasing the level of the road, floodwaters in the improved road areas were only ankle deep in 2014, compared to several metres' deep before, reducing the threat of drowning. Second, the floods no longer damage the road, which used to create large submerged holes that people, especially children, would fall into during the rainy season. Third, the investment by the Sangkat has given wealthier households the impetus to invest in building up their land with concrete foundations to the same height of the road (by 1.7m). Around 50% of housing in Chamrouen has or is being upgraded in this way. As one women said 'people used to say, why do you live here when it floods every year and it's so dangerous? However, the road upgrading and the installation of the dyke has made the area safer and now we think that it is worth making more permanent investments here'. In Vealsbov (Phnom Penh) and Roka Thom (Kampong Cham) new and strengthened roads above flood levels are also planned with the intention that families can build temporary dwellings there during the flood season.

Figure 21: Dyke built by Sangkat in Chamrouen, Phnom Penh

Small-scale community engineering solutions have involved the building of concrete raised walkways in Borei Doemsrol to address the issue of dangerous temporary wooden walkways, which children frequently fall from and injure themselves (Figure 21).

Given the synergies between flooding and diarrhoeal disease incidences (see Section 3, Exposure), WASH related initiatives should be considered as DRR interventions (Box 2). In Vealsbov, for example, 40 latrines are being installed by PIN and Wetlands Work! that are designed to digest sewage and filter water using plants. The aim of the project is to improve water quality and reduce diarrhoeal diseases during the flood season.

In addition to these hard and soft-engineered solutions, community organisations play a key role in reducing disaster risk by providing education to residents on hygiene and disease. In Chamrouen, community education projects have reduced the number of dengue deaths as mothers now know the warning signs and take their children to hospital. The organisation has also increased awareness of sewage and latrine use – coverage has increased

Figure 22: Replacing temporary elevated wooden walkways with concrete elevated walkways (Borei Doemsrol, Phnom Penh)

Before: wooden raised walkways

Today: concrete walkways

from 0% in 2004 to 70% of all households in 2015 (the 30% who do not use latrines are renters whose landlords have not allowed them to be installed).

Community organisations also play a key role in accessing resources from the government, the private sector and civil society. For example, in Borei Doemsrol, PPWSA initially refused to extend piped water connections to the community because they believed residents were soon to be evicted. After residents, supported by an NGO, organised as a community, they were in a stronger

Box 2: Mainstreaming WASH into DRR

The effects of flooding are exacerbated by low WASH coverage in urban poor communities, because of the prevalence of in water contaminated with human waste. Polluted flood waters contribute to the spread of disease, including diarrhoea, skin infections and other afflictions, which can have a debilitating effect on residents, especially children. In response, NGOs have pursued a dual-pronged strategy of mainstreaming community-based WASH solutions into DRR programmes and policies.

First, NGOs have integrated community-based WASH into their own DRR programmes, drawing on the technology and resources of private sector partnerships to upgrade community WASH facilities. Vealsbov is the beneficiary of one such WASH DRR programme implemented by PIN and the social enterprise Wetlands Work! The programme will deliver flood-proof latrines to reduce water contamination. The latrines use microbial communities and aquatic plants to digest human waste and remove harmful pollutants. In other areas that lack sewerage systems, appropriate, community-based WASH interventions are an effective means of reducing water-related disease.

Second, NGOs have advocated for WASH mainstreaming in government DRR regulations, policies and programmes. The consortium of NGOs implementing the DIPECHO programme have submitted position papers to the government that have pushed for community-based WASH upgrading to be considered in future government DRR initiatives.

Figure 23: New house built with loan from CDF in 42 Knong, Kampong Cham.

position to negotiate with PPWSA, which eventually led to the company agreeing to provide water to the area. In 42 Knong community, members of a savings group were able to benefit from housing loans provided by CDF, which were not available to members of the community not in the group. As a result, members of the savings group often lived in far better accommodation than non-savings group members (Figure 22).

In many communities, government sponsored infrastructure projects were partly funded by community savings groups. If community savings groups could fund some of the construction, the government provided match-funding and organised the construction projects. This process of infrastructure upgrading occurred in Chamrouen, where the Sangkat part-funded and constructed the previously mentioned road, supported with funds from the community savings group.

The most radical, transformative adaptation reported by the communities was resettlement to less flood prone areas. In Kampong Cham, the community of 42 Knong were resettled from the banks of the Mekong in 2006. While the new area is indeed not affected by flooding, the government forced the resettlement in order to 'beautify' the central riverfront area. A common wish of the study communities is to live with the flooding rather than be resettled to potentially safer locations. As one participant in Borei Doemsrol (Phnom Penh) remarked, 'floods are natural events – of course we can live with it'. The threat of eviction was regarded as the most severe and likely hazard for the community, above flood risk.

5.3 UNINTENDED IMPACTS OF COPING AND ADAPTATION STRATEGIES

Microfinance Institution (MFI) debt

Household adaptations have predominantly been funded with loans from MFIs. While raising the height of houses on stilts has certainly increased the robustness of the houses to flood events, loans to make these improvements have significantly increased household debt. Health costs and the constant repair of houses following flood events and storms increases this debt further. In Chamrouen, a respondent said that she had rebuilt her house three times in the past 20 years. As a consequence, debt repayment now accounts for a significant proportion of household expenditure in the study communities. Another respondent in Vealsbov said that her monthly repayments amounted to US$25 – a substantial amount given the low incomes of residents. The study found that typically 80-100% of households in the communities had MFI debt, with interest accumulating at about 1.5-3% per month. It is common for MFI debt to be serviced with additional loans from other MFIs, further entrenching their indebtedness.

Participants from Chamrouen said the MFIs usually approached them following floods to offer loans to help rebuild their homes or make enhancements. The community recognised that without a social safety net, the MFIs were a key source of capital in times of hardship, but in the long-term they became stuck in a cycle of debt.

Flooding is only one cause of the accumulating debt, but is significant. Loans are also used to finance business set-up or expansion, private transportation (e.g. motorbike), existing debt repayments, pay bribes, cover health costs and buy food. MFI debt is a fairly recent phenomenon, beginning in the early 2000s in most of the communities.

Without access to MFIs, however,

debt is even more burdensome. Landless families in Roka Thom (Kampong Cham) cannot access MFI loans because they have no land receipts to use as collateral and in 42 Knong, the village chief has refused to sign off MFI loans for residents. Instead, households turn to moneylenders for loans, which demand higher interests rates than MFIs (10% per month) and require possession of the borrower's land title as collateral. About 33 families have given their land title to informal moneylenders in 42 Knong, and 7 households have had their property repossessed due to defaulting on their loan repayments.

Impacts of temporary settlement strategy

Moving houses to safe areas before floods has a number of limitations. It incurs costs as a result of damage to materials during transportation and, in Vealsbov, some families have to pay to rent the land in the safe area at a cost of 30,000 riel per month. Furthermore, elderly and female-headed households in Roka Thom have to hire boats to move their homes, at a cost of 1 million riel. The strategy can also fail during an unexpected flash flood, which is likely given deficiencies in national early warning systems. In Roka Thom, the floods of 1996 were particularly severe, with water levels rising by 3 m. Because of the sudden onset of the floodwaters, people had insufficient time to move their homes and possessions to the safe area, resulting in widespread damage to and loss of property. The government evacuated the community to another district 9 km away, where they resided for 3 months in tents provided by the Red Cross. This response had several impacts on their livelihoods (discussed below). This suggests that in severe floods, this coping strategy may-be in sufficient.

Impacts of resettlement

The communities highlighted a number of implications of resettlement. The new settlements are typically further from workplaces, thus incurring increased travel costs and reducing the length of their working day. 42 Knong residents also preferred their previous central location as it was closer to markets, health services and schools, and women could hawk on the street for additional income. In Niengkong Hing, despite now not having to move their houses annually to avoid the floods, the residents also preferred their riverbank location as they could earn a living from fishing and selling products to passing river traffic. Because the population of the new settlement is comprised of people from different slums, participants said social cohesion is weaker, with more gangsters and drug dealers, although they felt the situation was improving.

The capacity of dykes can be exceeded

The source of flooding in Vealsbov is from the release of floodwaters from a nearby overflow canal. The canalisation of the river, including the construction of dykes and overflow canals, means that, to protect downstream urban areas, water is required to be released from overflow pipes during peak floods at the expense of the community of Vealsbov. This indicates the risk of relying on hard engineered structures – when their capacity is exceeded water needs to be released, in this case into a populated area. With predicted increases in the intensity of flash floods due to climate change, these canals are likely to be under further stress.

Dangerous walkways

In Chamrouen, the walkways constructed above the flood waters became a health hazard during the dry season with children often falling 3-4 metres from them resulting in serious injury or even death (Figure 23).

5.4 STAKEHOLDER ROLES

The four types of stakeholder active in the communities were government institutions, civil society organisations, private companies and religious organisations. As the Table 2 shows, the different actors supported community resilience to disasters by engaging in a wide variety of activities, ranging from relief measures during and after floods to strengthening roads to make them more robust to flooding.

To assess the relative importance of stakeholder DRR roles, the research team conducted PHVCA stakeholder Venn diagrams with focus group participants (Annex 2). Participants across all sites identified three roles of stakeholders that were important from a DRR perspective: (i) government/NGO upgrading of hard infrastructure; (ii) microfinance lending; and (iii) NGO support for community organisations.

Figure 24: Insecure walkway, 2-3 m above ground.

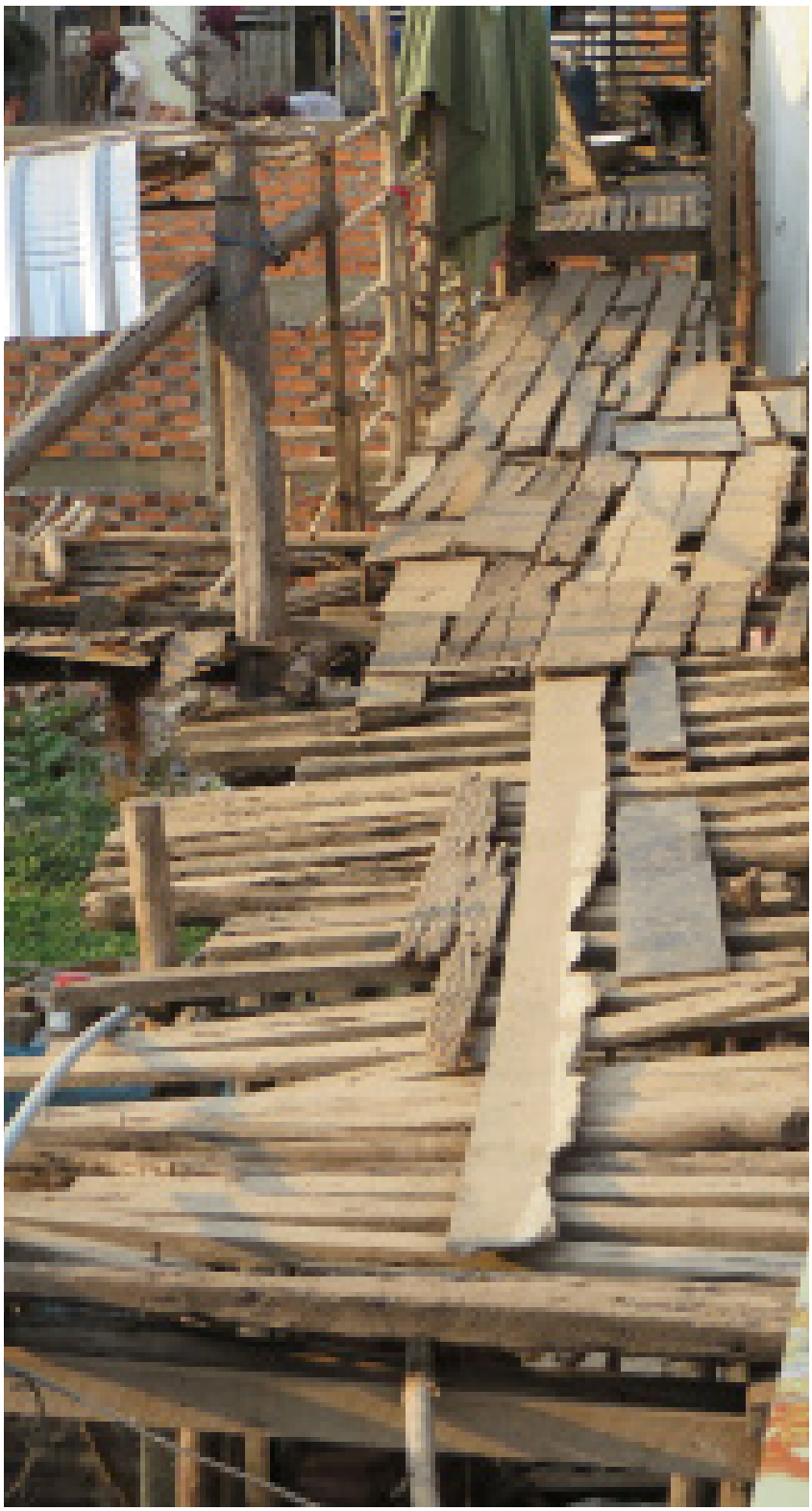


Table 2: Stakeholder DRR activities in communities

	Government	Civil society	Private company	Religious organisations
Built-up road	XXXXX	X		
Elevated walkways	X	X	X	
Dyke	XX			
Provide land	XX	X		X
Built houses	X			
Land titles	X			
Loans		X	XXXXX	
Community saving scheme		XXXXXX		
Latrines		XX		
Installed sewage systems		X	X	
Provided safe area	XX			
Piped water			XXXXX	
Healthcare	XX	X		
Well		X		
Water treatment/storage facilities		XXX		X
Building materials		X		X
Food		XXXX		XX
Clothes and other emergency supplies		XXXXX	X	XX
Fire extinguisher		X		
Sand bags	X			
Legal tenure advice		XX		
Mosquito nets		X		

Note: X represents one community, e.g. government upgraded road infrastructure in five out of the six communities

Source: Focus Group Discussions

The importance of each stakeholder group differed amongst the communities, depending on the context of the community and the nature of the hazards they faced. For example, because of a history of river flooding, the building of a dyke in Chamrouen by the government was considered to be a very significant intervention in reducing the vulnerability of residents to flooding. In Roka Thom, the government had found a safe area where the community could live during floods and installed temporary toilets. The

community valued these measures because they had increased their perception of security and wellbeing during floods. In Borei Doemsrol on the other hand, NGOs provided legal advice about how to resist government relocation plans, which reduced the threat of government implemented evictions.

5.5 DRR POLICIES AND PRACTICES

Currently, the DRR policy framework in Cambodia is based on prevention, mitigation, planning and response to large-scale disasters, particularly floods and fires. The National Committee for Disaster Management (NCDM) headed by the Prime Minister is responsible for coordinating disaster planning and response at the national level. Below the NCDM are disaster committees based at the municipality (CCDM), the district/Khan (KCDM), and the Sangkat/commune (SCDM) levels.

The basic roles and responsibilities of the relevant committees are summarised in Figure 24. The governance structure of DRR involves the transfer of information from the local level (SCDM) up the chain of committees, and resources and guidelines being transferred down from the national to local level. The SCDM is primarily responsible for allocating DRR resources locally, which was demonstrated by the PHVCAs conducted as part of this project.

Officials regard thecurrent laws and guidelines as inadequate for dealing with the complexity of the hazards facing urban communities. Importantly, disasters are too narrowly defined, limited to major natural hazards, such as river flooding, fire or storms. This focus is out of step with the emerging issues facing urban poor communities in a rapidly changing urban landscape – principally, development-induced flooding.

To address this issue, the NCDM's 2013-2018 NAP-DRR has identified urban areas as facing specific DRR issues, which, by implication, require tailored urban DRR regulations. The NCDM draft law on disaster management, once ratified, will provide a broader set of regulatory tools with which the government can address urban specific disasters. However, officials are concerned that the draft law in its current form does not target urban DRR issues in a holistic, targeted manner. Future subdecrees will have to be promulgated to address gaps in the law as more detailed knowledge of urban DRR issues becomes available.

The crucial issue of urban planning is also gaining traction within the Cambodian government because of the growing importance of the urban economy. The government's recent Industrial Development Policy framework highlighted sustainable urban planning as a critical aspect of sustainable industrial development. Moreover, issues arising from rapid, unplanned, urban development, including heightened flood risk, were highlighted at the launch of the 2015 Industrial Development Policy, presided over by Prime Minister Hun Sen (CDRI 2015). Mainstreaming DRR into future urban planning regulations is key to addressing the vulnerability of urban poor communities.

Figure 25: DRR mechanisms in Cambodia

NCDM (National Committee for Disaster Management)

- Prevention, mitigation and planning: Draft DRR laws, regulations, formulate guidelines and determine and coordinate overall national DRR strategies; allocate DRR resources,
- Response: Coordinate relevant agencies to respond to disaster at the national level

C/PCDM (Capital/Provincial Committee for Disaster Management)

- Prevention, mitigation and planning: Implement NCDM laws and guidelines; collect data and devise DRR strategy at the municipal level (EPRP); allocate resources for DRR,
- Response: Coordinate relevant agencies to respond to disaster at the municipal level

KCDM (Kha n Committee for Disaster Management)

- Prevention, mitigation and planning: Implement relevant laws and guidelines; collect data and devise DRR strategy at Khan level (EPRP); allocate resources for DRR,
- Response: Work with relevant agencies to respond to disaster at district level

SCDM (Sangkat Committee for Disaster Management)

- Prevention, mitigation and planning: Implement relevant laws and guidelines; collect DRR data; implement resources for DRR,
- Response: Work with relevant agencies to respond to disaster at the district level

06 KEY FINDINGS

This vulnerability assessment revealed a number of concerns that require further study and policy attention.

Unplanned urban development is increasing flood risk for the urban poor

Rapid urban development has occurred in the absence of effective regulatory frameworks to manage urban growth in an environmentally sustainable manner. As a result, urban development has been private sector led and often includes land filling and sealing of lakes and wetlands. This change in the land use and topography of urban areas has increased flooding of urban poor communities, which often reside in the remaining undeveloped and low-lying areas where water collects. Flood risk has been exacerbated by the absence of appropriate infrastructure, such as flood defences and drainage systems. The emerging trend of development-induced flooding brings increased health threats to hazard prone communities because waters are often polluted with human and industrial waste.

Peri-urban areas are the most vulnerable to hazards

Peri-urban areas are home to rapidly growing poor populations that are highly vulnerable to a range of hazards. City-wide studies have revealed a dramatic growth in the number of peri-urban poor communities over time, resulting from migration and state-sanctioned relocation of poor communities from central urban areas. Rapid rural to urban land use changes have increased run-off and thus flooding in low-lying peri-urban areas. In addition, peri-urban areas are more vulnerable to river floods because they have not been afforded the flood protection and drainage infrastructure found in urban areas.

Communities prefer living with floods than relocating far from their livelihoods

Despite extreme hazard exposure, especially to floods, the communities preferred remaining in their settlements than being resettled to safer areas. They did not want to move in fear of losing livelihood opportunities, incurring increased costs (such as travel), and having fewer public services and poorer infrastructure. A common sentiment was that they had always lived with flooding and would continue to do so. The study revealed a multitude of strategies employed by households and communities to cope with flooding, ranging from an inner tube ferry service to moving entire settlements to higher ground such as roads during the flood season.

Microfinance loans may increase resilience but potentially at the risk of long-term vulnerability

Loans from microfinance institutions (MFI) have enabled households to make adaptations to their homes (e.g. stilts and concrete foun-

dations) and often provide cash during periods of hardship in the flood season. While this has increased the robustness of many homes and helped households to meet short-term needs, this study found a trend of mounting household debt. The burden of debt repayment may inhibit future coping and adaptation strategies, with the potential to increase their vulnerability.

Government DRR policies have had some success in dealing with threats from natural hazards, but are failing to deal with emerging development-induced threats

The government's current DRR structure has facilitated the identification of sources of community vulnerability to natural hazards and implemented projects to increase resilience, including the building of raised, flood-proof roads and dykes. However, current regulations lack engagement with the multiple and complex sources of urban hazards and vulnerabilities, particularly flooding caused by unplanned urban development.

The urban poor are highly vulnerable to a mega-flood disaster

Perennial flooding already impacts the urban poor, many of whom inhabit areas flooded for between 3 and 8 months of the year. Major flood events exacerbate seasonal flooding and frequently exceed the coping capacities of poor urban communities in Cambodia, with households turning to humanitarian organisations and MFIs for relief and finance to sustain themselves. Recent major flooding in 2011 and 2013 caused widespread damage to property and the displacement of the urban poor, but neither is likely to have been on the scale of a 100-year flood event. Furthermore, significant increases in precipitation during the rainy season are predicted as a consequence of climate change. The potential for an unprecedented mega-flood event in the future is therefore high.

Vulnerability to a mega-flood has been further exacerbated by the loss of wetlands, which provide valuable flood attenuation services, and the rapid growth of urban poor populations in lowland areas. The dominant response to flooding has been the construction of dykes, particularly in Phnom Penh. Experiences in other cities across the world (e.g. New Orleans) have demonstrated that too much dependence on engineered flood defences can increase vulnerability to flood events that exceed their thresholds, since the sense of security provided by the defences increases human settlement of otherwise exposed areas.

07 POLICY OPTIONS

Mainstream DRR into holistic urban planning strategies

A comprehensive, cross-cutting and coordinated approach is needed by government to urban planning, which includes DRR as part of holistic urban planning strategies. As the government has recently refocused on Cambodia's cities as engines of future industrial development and GDP growth, now is an opportune moment for civil society to stress the economic and social benefits of including DRR provisions in future urban planning laws. One of the biggest current DRR challenges is unplanned urban development, which is placing ever greater numbers of urban poor at risk to hazards, particularly floods. It is crucial that comprehensive, DRR-orientated planning regulations, including zoning and building codes, are integrated into urban master plans – and that these master plans are then implemented. The Urban Poor Poverty Reduction Working Group and the Joint Action Group for DRR provide solid platforms to ensure DRR is a key part of the urban policy agenda, and to encourage the development of workable master plans for Cambodia's cities that include DRR considerations.

Effective implementation of laws that protect communities against development-induced flooding

To protect communities from the negative environmental impacts of development, it is essential that transparent EIAs are implemented across the board in a standardised manner. Currently, the process of conducting EIAs is private sector led and poorly regulated, leading to doubts among civil society about their veracity. The power to conduct EIAs could be vested in a state entity, potentially Municipal or Khan Authorities, which would facilitate a greater level of transparency in the process. In addition to conducting EIAs, their rigorous monitoring and enforcement is also necessary during the construction phase of projects. Currently, the municipal authorities have the power to enter construction sites and check that works are being completed according to regulations. A dedicated unit to ensure that the environmental aspects of projects are adhered to could be effective in ensuring standards are met. These issues should be addressed in the new EIA law.

Protecting and expanding wetlands and other green spaces

The value of urban ecosystems such as wetlands in soaking up floodwaters is poorly understood or recognised in Cambodia, yet this study suggests it is significant, especially for the urban poor. Better valuation of these wetland services and the consideration of which in urban planning decision-making may ensure that the capacity of urban ecosystems to provide natural drainage and attenuate floods is not dimin-

ished further. Incorporation of green space in urban development could also be considered in future urban planning reforms, and may provide a cost-effective alternative to investments in hard engineered flood defences.

Extend drainage and flood protection infrastructure to peri-urban areas

Peri-urban areas have low capacity hard infrastructure to protect against hazards. A particular problem is inadequate drainage infrastructure, which leaves poor peri-urban communities vulnerable to development-induced flooding. However, current infrastructure programmes currently focus on central urban areas. A policy option for government, donors and civil society is to upgrade drainage and other core infrastructure, such as paved, raised roads, piped water and flood defences in peri-urban areas. Infrastructure development could be integrated into Commune Development Plans and coordinated with other land use changes in the locality.

Mainstream community-based WASH solutions into DRR programmes

The impact of flooding is made more severe by low WASH coverage in urban poor settlements. In areas where sewage systems are not available, community-based WASH solutions offer an appropriate solution to the issue of human waste management.

Strengthen mechanisms for community-based DRR

Cambodia's DRR frameworks are well designed to identify DRR issues at the local level, which are then fed up the chain all the way to the NCDM. Currently, however, the information obtained by officials at the local level is based on a narrow set of indicators because of a narrow conception of what/how hazards affect the urban poor. For example, officials view river floods as the most significant hazard affecting the urban poor, and so have collected information at the local level about safe sites and other measures to respond to such flood events. While this approach has yielded important information, this study has shown that hazards affect the urban poor in a wide variety of context-dependent ways. For DRR interventions to be effective, the breadth of DRR data should be broadened by taking a participatory, community-based approach to identifying hazards, their impacts and, importantly, how the resilience of communities can best be built. To achieve this, PHVCAs should be conducted in all urban poor settlements by Sangkat authorities and developed into community-specific DRR plans, with the support of civil society organisations and development partners. DRR responses should be budgeted and implemented as part of Commune Development Plans and the Commune Investment Plans to ensure they are coordinated with infrastructure upgrading and other initiatives.

REFERENCES

Adger, W. N. 2006. Vulnerability. Global Environmental Change, 16, 268-281.

ADPC, 2015, Citizenry-Based & Development-Oriented Disaster Response. Accessed from http://www.adpc.net/pdr-sea/cbdo-dr/toc.html [May 2015].

ACAPS, 2011. Secondary data review - Cambodia. The Assessment Capacities Project: Geneva.

ADB, 2014. Central Mekong Delta Region Connectivity Project: Rapid climate change threat and vulnerability assessment. Asian Development Bank: Mandaluyong City, Philippines.

BABSEA, 2011. Case Study on Boeung Kak. Bridges Across Borders Southeast Asia. Accessed from http://babcambodia.org/articles/docs/Case%20Study%20on%20Boeung%20Kak.pdf [April 2015]

CIA, 2014. Cambodia map. US Central Intelligence Agency. Accessed from https://www.cia.gov/library/publications/the-world-factbook/geos/cb.html [March 2015]

Davies, G.I., McIver, L., Kim, Y., Hashizume, M., Iddings, S., Chan, V., 2014. Water-Borne Diseases and Extreme Weather Events in Cambodia: Review of Impacts and Implications of Climate Change. Int. J. Environ. Res. Public. Health 12, 191–213.

Fee, L., Visal, P.,Visa, Prak, Sally, N.,Nay, Sok, V.,Vanna, 2012. Sihanoukville, Cambodia: Climate Change Vulnerability Assessmentvulnerability assessment. United Nations Human Settlements Programme (UN-Habitat): Nairobi.

Grimsditch, M. and Henderson, N, 2009. Untitled: Tenure Security and Inequality in the Cambodian Land Sector. Bridges Across Borders Southeast Asia: Phnom Penh.

IPCC, 2012. Determinants of Risk: Exposure and Vulnerability. Intergovernmental Panel on Climate Change. Accessed from http://www.ipcc.ch/pdf/special-reports/srex/SREX-Chap2_FINAL.pdf [May 2015].

Keskinen, M., Chinvanno, S., Kummu, M., Nuorteva, P., Snidvongs, A., Varis, O., Västilä, K., 2010. Climate change and water resources in the Lower Mekong River Basin: putting adaptation into the context. J. Water Clim. Change 1, 103–117.

Khemro, B.H.S., G. Payne, 2004. Improving Tenure Security or the Urban Poor in Phnom Penh, Cambodia: An Analytical Case Study, Habitat International, 2004, 28, 2, 181-201.

Maplecroft, 2014. Climate Change Vulnerability Index: Bath, UK

McSweeny, C., New, M., Lizcano, G., 2010. UNDP Climate Change Country Profiles: Cambodia. United Nations Development Programme.

PIN, 2014. Multiple Indicator Assessment of the Urban Poor. People in Need: Phnom Penh.

PPM, 2012. The Phnom Penh Urban Poor Assessment: A baseline survey on the social and economic situations and capacity of existing services in urban poor communities. PPM: Phnom Penh
.

Murphy, T., Irvine, K., Sampson, M., 2013. The stress of climate change on water management in Cambodia with a focus on rice production. Clim. Dev. 5, 77–92.

RGC, 1998. General Population Census of Cambodia 1998. Royal Government of Cambodia: Phnom Penh.

RGC, 2008. General Population Census of Cambodia 2008. Royal Government of Cambodia: Phnom Penh.

RGC, 2014. Post-flood early recovery need assessment. Royal Government of Cambodia: Phnom Penh.

RGC, 2014. National Action Plan for Disaster Risk Reduction. Royal Government of Cambodia: Phnom Penn.

RFA, 2015. Cambodia Orders Temporary Halt to New Licenses for Sand Dredging. Radio Free Asia. Accessed from http://www.rfa.org/english/news/cambodia/cambodia-dredging-03252015170821.html [May 2015]

S&P, 2014. Climate Change is a Global Mega-Trend for Sovereign Risk. Standard and Poor. Accessed from http://www.acclimatise.uk.com/login/uploaded/resources/climate-change-is-a-global-mega-trend-for-sovereign-risk-15-may-14-.pdf [May 2015]

So, S., Sopheap, R., Utey, U., Rathmony, S., Ballard, B. & Acharya, S, 2002. Social Assessment of Land in Cambodia: A Field Study, Working Paper No. 20. CDRI: Phnom Penh.

STT, 2009. The 8 Khan Survey. Sahmakum Teang Tnaut: Phnom Penh.

STT, 2011. Displaced Families: Phnom Penh 1990-2011. Sahmakum Teang Tnaut: Phnom Penh.

STT, 2014. The Phnom Penh Survey: A Study on Urban Poor Settlements in Phnom Penh. Sahmakum Teang Tnaut: Phnom Penh.

Sotharith, C., 2006. Urban Poverty and Safety Net in Cambodia, CICP Working Paper No.10. Cambodian Institute for Cooperation and Peace.

Sovann, R., 2006. Disaster Information Management and Database. National Committee for Disaster Management: Phnom Penh.

UNICEF, 2009. Health service access among poor communities in Phnom Penh. UNICEF Cambodia and Ministry of Health: Phnom Penh.

UN Statistics, 2014. Cambodia, in: World Statistics Pocketbook. United Nations Statistics Division.

UNU-EHS, 2013. World Risk Report 2013, United Nations University Institute for Environmental and Human Security. Accessed from http://worldriskreport.entwicklung-hilft.de/uploads/media/WorldRiskReport_2013_online_01.pdf [May 2015]

UNISDR, 2009. UNISDR Terminology on Disaster Risk Reduction. United Nations International Strategy for Disaster Reduction: Geveva.

URC, 2002. Study of Relocation of Urban Poor Communities in Phnom Penh. Urban Resource Centre: Phnom Penh.
WaterAid, 2015. Cambodia. Accessed from http://www.wateraid.org/uk/where-we-work/page/cambodia [March 2015]

Yusuf, A.A., Francisco, H., 2010. Hotspots! Mapping climate change vulnerability in Southeast Asia. IRSA.

WDI. 2015. World Development Indicators. Accessed from http://databank.worldbank.org/data/views/variableselection/selectvariables.aspx?source=world-development-indicators [April 2015]

100 Resilient Cities. City Resilience. Accessed from http://www.100resilientcities.org/resilience#/ [May 2015]

ANNEX 1: URBAN PHVCA IMPLEMENTATION TOOLS

STEP	TOOL	TOOL DESCRIPTION	ISSUES COVERED
1	Introductory Presentation	Explain to the participants PHVCA objective and steps	• Introduce PHVCA tools • Make plan for the day • Answer questions from participants about process and objectives
2	Socio-economic background flipchart	Produce chart covering key socioeconomic characteristics of settlement	**Demographic characteristics of community** • How many households in settlement • Female-headed households • Disabled people • Old people **History of the community** • How long have community lived in area • Where residents lived before coming to area • Why people moved to area **Access to Jobs, health, education services** • Livelihood strategies of people in community • The different roles in community men and women have (e.g. work in house for women) • Distance of people's job from community (km) • Major expenses (e.g. debt; health; food; travel; education etc.) • Distance of school, hospital, market from settlement **WASH** • Main sources of water • % of houses connected to water supply network (estimate) • % of houses with access to sewage system (estimate) • % covered by garbage collection service (estimate) **Housing and tenure security** • Description of housing in area • Reasons why people do/do not make their houses more strongly • What documents residents have for their land • Proportion of residents that are owners and renters

3	Stakeholder Venn diagram	Produce Venn diagram showing roles of key stakeholders in the community ranked by importance	**Organisations in the community** • NGOs working in the community • Savings group • Religious groups (church/pagoda) providing help to the community • Government (Sangkat etc) • Private sector company (e.g. microfinance) **What kind of help do stakeholders give?** • Provide health care • Provide loans • Provide help to build housing, pave roads, upgrade sanitation • Provide legal service (e.g. protect land rights). **What benefits does the community get from help?** • How successful is assistance increasing household income? • How successful in improving healthcare, sanitation? • Does assistance have effect on how bad impact of disasters? • Do groups provide assistance post-disaster? • Are there negative effects (e.g. loans cause debt)? **Which is the most important organization and why?** • Rank the rest of individuals, groups and organizations involved in the community.
4	Hazard Assessment Matrix	Matrix identifying various hazards facing community, with likelihood of hazard occurring on one axis and severity of hazard on the other axis	• What are the hazards affecting the community? • How likely is hazard to occur? • What % of community would be affected by disaster?
5	Historical Timeline	Timeline of key disasters to affect the community and key changes in the environment.	**<u>On bottom of timeline</u>** **Hazard** • What was hazard? • How has hazard changed (e.g. intensity, duration)? • Warning signs • How long is the time before warning signs to danger? • How long does it last?

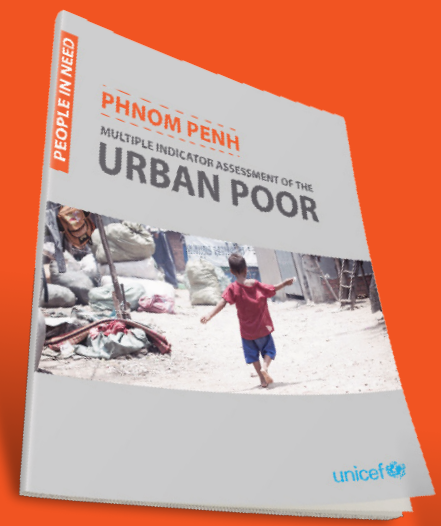
			Impact of hazard • Did hazard damage housing? • Did hazard damage water supply, roads, electricity supply? • How has hazard affected different social groups (women, old)? • How have impacts changed over time (better/worse)? and why? (e.g. New construction near area) • How did you cope with the hazard? **<u>On top of timeline</u>** **Changes in settlement and environment** • New construction and/or change in way land is used (e.g. filled in lake; river dredging; new highway; new big building) • Housing quality changes over time (e.g. wood houses changed to concrete house) • Other changes that community have made to lessen impact of disasters (e.g. building up land to prevent flooding; social responses) • Changes other stakeholders (NGOS, government etc.) have made to lessen disaster
6	Community Walk	Walk with community members around their settlement to identify key sites of hazards, vulnerabilities, and capacities. Take pictures of key sites and make note of significance.	• Identify resources in the community that are vulnerable to disaster (e.g. wells; businesses; homes) • Identify what community have done to make disaster effects less bad • Identify things in community that could make disasters effects worse (garbage, sewage; land use change, construction etc.) • Identify assets that are used when responding and recovering from a hazard event (e.g. forests to rebuild houses, water supply, shelters such as schools, transportation)
7	Hazard and Capacities Map	Community members identify on map or draw map key sites of hazards, vulnerabilities, and capacities.	• What are the hazards that put the community at risk? • What places/areas in the community are at risk? What areas are normally most affected? • What are the most important places for community and are they at risk? (important for money, health etc.) • What have the community or others (NGOs etc) done to protect important places in community? • What are the most important assets in the community when a hazard strikes? (e.g. forests to rebuild houses, water supply, shelters such as schools, transportation) • Who are the people that are most exposed to risk and will likely need assistance? (e.g. women, young old)

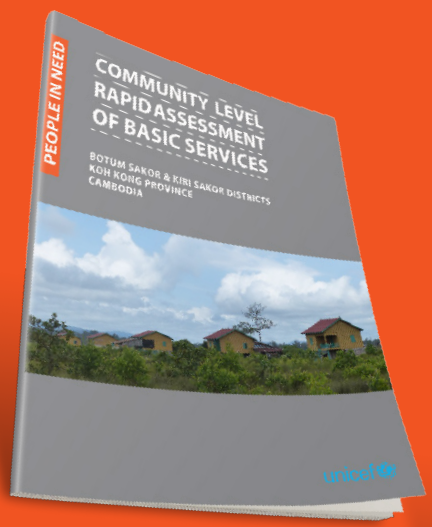
8	Seasonal calendar	Fill in matrix with month on one axis and hazards, vulnerabilities and capacities on another axis.	• What are the different seasons in a year? • What are the hazards/disasters that occur in the community? • What time of year do they happen? • How long to they last? • Are there food supply/income/other shortages at some times of year? • What times of year is expenditure greatest? • Do families have less money at some times of year? Why? (e.g. pay more for weddings; less income from work) • Are more people ill at some times of year?

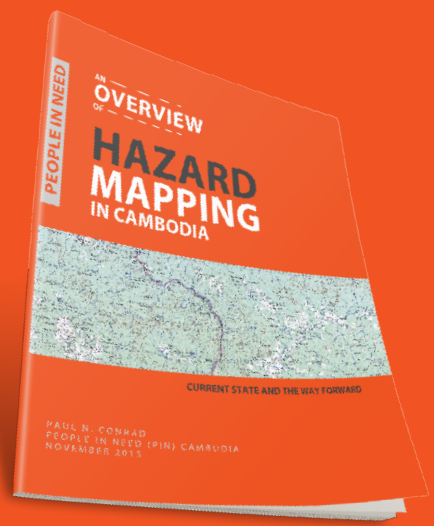
ANNEX 2: EXAMPLE OF STAKEHOLDER VENN DIAGRAM (CHAMROUEN)

Colour code key: grey=NGO; red=private company; yellow=religious organisation; green=government

READ ALSO:







CONTACT US

CAMBODIA@PEOPLEINNEED.CZ

WWW.PEOPLEINNEED.CZ

People in Need (PIN) is a Czech non-governmental organization providing relief and development assistance while working to defend human rights and democratic freedoms in over 20 countries. With a global annual turnover of 25 million USD and over 800 employees worldwide, PIN's food security, WASH, health, education, emergency response and other programs have assisted millions of people. In Cambodia, PIN has operated since 2008 in rural and urban areas, specifically in three sectors: markets development for improved livelihoods and environment, maternal and child health with focus on nutrition and disaster management.

PEOPLE IN NEED (PIN) - CAMBODIA,
ADDRESS # 33, STREET 71, SANGKAT TONLE
BASSAC, KHAN CHAMKARMON, PHNOM PENH