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BUILDING RESILIENCE OF THE URBAN POOR: Incorporating Climate and Disaster Risk Information into Pro-Poor Housing Investments

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For the Asian Development Bank

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Asian Development Bank

ABBREVIATIONS

ADB Asian Development Bank

BALAI Building Adequate, Livable, Affordable, and Inclusive Filipino

Communities

BNPB Badan Nasional Penanggulangan Bencana / National Disaster

Management Agency (Indonesia)

BPS Badan Pusat Statistik / Statistics Indonesia

BSPS Bantuan Stimulan Perumahan Swadaya (Indonesia)
CDMP II Comprehensive Disaster Management Programme

(Bangladesh)

CGI Corrugated galvanized iron

CRED Centre for Research on the Epidemiology of Disasters
DHSUD Department of Human Settlements and Urban Development

(Philippines)

GFDRR Global Facility for Disaster Reduction and Recovery

Gol Government of Indonesia IDR Indonesian Rupiah

IFHV Institute for International Law of Peace and Armed Conflict

IPCC Intergovernmental Panel on Climate Change IREUS Institute of Spatial and Regional Planning

MFI Microfinance institution

NAHP National Affordable Housing Program (Indonesia)

NUPRP National Urban Poverty Reduction Programme (Bangladesh)

PDP Philippine Development Plan 2017–2022

PHP Philippine Peso

PUPR Kementerian Pekerjaan Umum dan Perumahan Rakyat /

Ministry of Public Works and Housing (Indonesia)

RHEAT Resilient Housing Ecosystem Assessment Tool

SSP Shared Socioeconomic Pathways

UN United Nations

UNDP United Nations Development Programme

UNDRR United Nations Office for Disaster Risk Reduction

UNFCCC United Nations Framework Convention on Climate Change

UNFPA United Nations Population Fund

USAID United States Agency for International Development

WHO World Health Organization

WMO World Meteorological Organization

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I. THE CASE FOR CLIMATE AND DISASTER-RISK INFORMED INVESTMENTS IN HOUSING FOR THE URBAN POOR

A. Government Investment in Housing for the Urban Poor is Essential

- 1. **Substandard housing exacerbates the vulnerability of the urban poor.** One in four people in cities today are living in conditions that are harmful to their health, safety, and prosperity. The amount of informal housing in cities is rising, and is disproportionately inhabited by the poor, exposing occupants to environmental hazards and risks as a result of poor design or construction, inadequate sanitation and overcrowding, and location in a high-risk area. The urban poor are particularly vulnerable, given the challenges they face in accessing basic services, and their reliance on the informal economy and the informal housing sector. ²
- 2. Urban poverty and inadequate housing exacerbate gender inequalities. Today, more than 50% of urban women in developing countries live in conditions where they lack at least one of the following: access to clean water, improved sanitation facilities, durable housing, or sufficient living area.³ Furthermore, a 2020 study has found women to be overrepresented in urban slums compared to men. Such outcomes are rooted in gender-specific inequalities, which have typically restricted women's access to education, ownership of assets, and rights to housing, or their ability to undertake paid work.⁴
- 3. Societal norms and affordability issues have contributed to the restricted mobility of women, meaning that they are more affected by poor housing conditions. Women typically spend more time at home (often due to unpaid domestic work and caring responsibilities), meaning that they—along with others in their care (typically the elderly, children and the disabled)—may be more exposed to hazards as a result of vulnerable housing. Women often run home-based businesses, in which cases the loss of a home can also mean the loss of their income, financial security, and independence.
- 4. While inadequate housing can exacerbate gender inequalities, women should not be automatically assumed to be victims of their circumstances. Pro-poor housing investments present an opportunity to recognize the diverse roles assumed by women, and leverage their wide range of existing abilities. Build Change has found women to be excellent stewards of their family's financial resources, and responsible borrowers—research supports that a higher percentage of female clients in MFIs is associated with lower portfolio risk.⁶ Furthermore, women are proven excellent leaders, capable of leading on decisions about their family's safety and overseeing home improvement work.

¹ UN-Habitat, *World Cities Report 2020: The Value of Sustainable Urbanization*, (Nairobi: United Nations Human Settlements Programme, 2020).

² Asian Development Bank (ADB), *Building Resilience of the Urban Poor: Bangladesh,* (revised draft, version June 2021, ADB), p. 20

³ UN Women, Turning Promises into Action: Gender Equality in the 2030 Agenda for Sustainable Development, Central and Southern Asia Factsheet, (New York: UN Women, 2018).

⁴ UN Women and UN-Habitat, Spotlight on SDG11: Harsh Realities: Marginalized Women in Cities of the Developing World (New York: UN Women, 2020), p. 4

⁵ UN-Habitat, Gender Equality Enhancer: Gender and Development, Gender and Resilience, Gender and the City Resilience Profiling Tool, (Barcelona: UN-Habitat, 2018).

⁶ Bert D'Espallier, Isabelle Guérin, and Roy Mersland, "Women and Repayment in Microfinance: A Global Analysis," *World Development* 39, no. 5 (2011): 758–772.

- Certain limitations restrict the ability of the urban poor to invest in resilient housing themselves. The urban poor are the biggest investors in their own homes, which are a product of significant investment of their own time, efforts, and financial resources. This is especially true where traditional sources of financing for housing purchase or improvements (such as mortgages and construction loans) have been unavailable or inaccessible to them. However, the housing investments people have made are often poorly-conceived and constructed, and can be lost in a matter of seconds in the event of a major disaster. Government investment in housing for the urban poor is therefore critical, to support families with the additional incentives and knowledge needed to make their homes resilient against climate-induced hazards and disasters.
- Unless prices go down or incomes increase, resilient housing will only be affordable for 6. the urban poor if subsidies are provided – this was found to be the case in the Philippines, 7 and is likely to be true for most developing countries. Where traditional financing options are not viable (due to the informal nature of the employment of the urban poor and/or lack of secure tenure or land titles), microfinance institutions (MFIs) can offer a solution. However, this too has certain limitations, for example:
 - microfinance institutions have limited funding sources and may therefore be limited in their capacity to make loans more affordable for resilience building, and
 - insecurity of tenure means that low-income groups are often unwilling to invest even (ii) limited amounts of money in improving the resilience of their homes themselves.8

Housing investments must therefore be driven by adequate government subsidies that will allow people to build safely and completely, with support from a range of other funders and donors, including multilaterals and MFIs.

- 7. Additionally, inadequate or lack of community infrastructure, including access to basic services like water, electricity, and sanitation in urban poor communities creates additional challenges for the urban poor's ability to invest in their housing themselves as their spending is directed towards meeting these basic needs. Therefore, housing investments should also be complemented with other investments in community infrastructure, social protection, and livelihoods.
- Governments have already acknowledged the critical role of quality housing for the The need to provide quality housing for the urban poor has already been acknowledged by the governments of Bangladesh, Indonesia, and the Philippines, and various efforts to promote the development of climate-resilient, affordable, quality housing have already been made.
 - In Bangladesh, the Perspective Plan of Bangladesh 2021–2041 puts forward a vision for the urban sector, with no absolute poverty, no slums, and a minimum housing quality for every household. The National Housing Policy (2016) identifies the need for more targeted, affordable investments that will support the urban poor to benefit from housing programs, seeks to build institutional capacity and legal

⁸ ADB, Building Resilience of the Urban Poor: Bangladesh, p. 58

ADB, Building Resilience of the Urban Poor: Philippines, (revised draft, version May 2021, ADB), p. 64

⁹ General Economics Division, Bangladesh Planning Commission, Ministry of Planning, Making Vision 2041 a Reality: Perspective Plan of Bangladesh 2021-2041, (Dhaka: Government of the People's Republic of Bangladesh, 2020), p. 187

frameworks in order to mobilize funds for housing, and promotes housing policy reform in response to emerging housing needs.¹⁰

- (ii) In **Indonesia**, several historical initiatives targeting the urban poor have included upgrading slum settlements, providing new housing, and resettling those located in hazard-prone areas. ¹¹ The *Bantuan Stimulan Perumahan Swadaya* (BSPS) national home improvement subsidy program helps lower-middle-income and lower-income households to improve housing standards for pre-existing homes in rural, peri-urban, and urban areas of Indonesia (see Section IV). Other initiatives targeting the urban poor include:
 - (a) the KOTAKU program by the Ministry of Public Works and Housing (PUPR), which aims to eradicate slums and ensure complete access to drinking water and sanitation
 - (b) the Neighborhood Upgrading and Shelter Project (NUSP-2), which employs community engagement and public–private partnerships to improve housing and basic services
 - (c) the Rehabilitasi Sosial Rumah Tidak Layak Huni ("RS-Rutilahu"), with a focus on the renovation of houses for the urban poor
 - (d) Sejuta Rumah (One Million Homes), an initiative aimed at increasing the supply of affordable housing, by building new homes, providing social housing subsidies, improving informal or inadequate housing areas, and providing government-supported credit facilities for low-income households.¹²
- (c) In the Philippines, the Department of Human Settlements and Urban Development (DHSUD) is working through the multi-stakeholder "Building Adequate, Livable, Affordable, and Inclusive Filipino Communities" (BALAI) program to accelerate housing production, enhance housing affordability, and deliver assistance to ensure the livability and sustainability of human settlements.¹³ The DHSUD intends to build the resilience of the urban poor by integrating disaster risk reduction and climate change in land use and urban planning, urban environment, and infrastructure improvements, as part of the Philippines' New Urban Agenda and the National Urban Development and Housing Framework. This framework cultivates an integrated housing strategy in order to promote the development of climate-resilient, affordable housing. 14 The Philippine Development Plan 2017-2022 (PDP) includes the objective of "building safe and secure communities," and will support the urban poor with relocation and resettlement packages, including a plan to operationalize the National Resettlement Policy Framework (NRPF) in order to mainstream resilience building

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¹⁰ National Housing Authority, *National Housing Policy 2016*, (Dhaka: Government of the People's Republic of Bangladesh, 2016).

¹¹ Examples of these initiatives are Kampung Improvement Program, Program Penanggulangan Kemiskinan di Perkotaan, and Program Nasional Pemberdayaan Masyarakat Mandiri – Perkotaan. Source: ADB, *Building Resilience of the Urban Poor: Indonesia*, (ADB, July 2021), p. 49–50

¹² ADB, Building Resilience of the Urban Poor: Indonesia, p. 50

¹³ National Economic and Development Authority, Republic of the Philippines, *Updated Philippine Development Plan 2017–2022*, (Pasig City, Philippines: National Economic and Development Authority, 2021), p. 219

¹⁴ ADB, Building Resilience of the Urban Poor: Philippines, p. 61

into existing resettlement processes. ¹⁵ The PDP also states the intention to establish local government shelter plan management and monitoring system, to ensure the efficient delivery of housing, financing, and shelter interventions, and support interventions aimed at improving the health and well-being of vulnerable populations. ¹⁶

B. Climate and Disaster Risk Informed Investments Can Build Resilience of the Urban Poor.

- 9. Climate and disaster events disproportionately affect those who are vulnerable. The impacts of climate change are worsening; there is evidence of a surge in disasters in the last 50 years, and their disproportionate impact on poorer countries¹⁷ and those who are most vulnerable. Overall, women and children are fourteen times more likely than men to die in the event of a disaster, ¹⁸ although there is limited data on the impacts of disasters specifically for the urban poor. Others who are vulnerable and therefore most at risk include the poor, ethnic and racial minorities, the elderly, and people with disabilities. The World Bank Group found that while poor people experience asset losses due to disasters that are only half of the average, they suffer from disasters two times more than the average. The reasons for this are attributed to overexposure to hazards, higher vulnerability, less ability to cope and recover, permanent impacts on education and health, and the effects of risk on saving and investment behavior. ¹⁹
- 10. The urban poor are among those who are most vulnerable to climate and disaster risk. The 2021 Sixth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) has confirmed that certain aspects of climate change will pose a greater threat to those living in cities, including heat stress, flooding from heavy precipitation events, storm surges, and sea level rise in coastal cities.²⁰ The urban poor are already especially vulnerable, given the challenges they face in accessing basic services, and their reliance on the informal economy. ²¹ This means that the urban poor are among those who will be most severely affected by climate change. Combined with the existing challenges they face, the impacts of climate and disaster risk for them includes damage or loss of homes (due to inadequate structural integrity or location in high-risk areas, and no insurance), displacement, loss of livelihoods, increased health risks, and reduced water availability.²²
- 11. The urban poor are particularly at risk as a result of the kind of housing they typically inhabit, which is both highly exposed and highly vulnerable to hazards, as a result of the following:

¹⁵ National Economic and Development Authority, *Updated Philippine Development Plan 2017–2022*, p. 66

¹⁶ National Economic and Development Authority, *Updated Philippine Development Plan 2017–2022*, p. 222

¹⁷ UN News, "Climate and weather-related disasters surge five-fold over 50 years, but early warnings save lives—WMO report," (web page, UN News Global Perspective Human Stories: Climate and Environment, 1 September 2021).

¹⁸ Soroptimist International of the Americas, "Reaching Out to Women When Disaster Strikes," (Philadelphia: Soroptimist International of the Americas, 2006): p. 2

¹⁹ Stephane Hallegatte et al., *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters*, (Washington, D.C.: World Bank, 2017).

²⁰ Intergovernmental Panel on Climate Change (IPCC), Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, (Cambridge University Press, in press).

²¹ ADB, Building Resilience of the Urban Poor: Bangladesh, p. 20.

²² David Satterthwaite et al., "Responding to Climate Change in Cities and in Their Informal Settlements and Economies," (paper prepared for the International Scientific Conference on Cities and Climate Change. Edmonton, Canada. March, 2018).

- (i) the urban poor often live in slums and informal settlements located in hazard-prone areas, such as those with increased risk of flooding or landslide, due to competing uses of scarce and expensive land in cities;²³
- (ii) the urban poor often have inadequate and informally built housing that is unsafe and not resistant to hazards such as earthquakes, windstorms, and flooding.
- (iii) the urban poor also typically inhabit locations that lack adequate community infrastructure and basic services, further increasing their exposure and vulnerability to hazards.
- 12. Housing investments informed by climate and disaster risk information can help prevent disasters and protect the most vulnerable. Housing investments informed by climate and disaster risk information will help to reduce exposure and vulnerability, ultimately reducing the impact of future hazards and the risk of disaster. The housing sector has frequently suffered some of the highest damages and losses due to disasters leading to increases in displaced persons living in even worse conditions, such as tents, temporary shelters, damaged structures or camps. In 2019 alone, some 24 million internal displacements were registered worldwide due to climate-induced extreme events. ²⁴
- 13. Additionally, efforts to reduce poverty and disaster risks are complimentary—disasters can push people into poverty and poverty alleviation can make people less vulnerable to disasters.²⁵ Investments in pro-poor housing are therefore further leveraged when informed by climate and disaster risk.
- 14. Using climate and disaster risk information to design housing investments protects the investment and pays off. While housing is often considered a private asset, governments are usually responsible for supporting response, recovery, and rebuilding efforts—even for housing—after a disaster occurs. Understanding and integrating climate and disaster risk information into resilient housing investments is key to protecting the investment from loss in future disasters and avoiding having to re-invest in the same after recurrent disaster events.
- 15. Additionally, cost-benefit studies have demonstrated that investing in mitigation (measures that reduce the impact of hazards on buildings) is a sound financial investment. A recent study found there to be a 1:4 cost-benefit ratio for investing in a variety of common mitigation measures for private buildings, ²⁶ like housing. Another study has shown that storm-resilient housing in Vietnam would have high benefit-cost ratios. ²⁷ In Nepal, it was found that retrofitting vulnerable stone masonry houses to better resist earthquakes had a positive benefit-cost ratio when done all at once, but also when done incrementally through discrete steps. ²⁸
- 16. Further, investments in resilient housing for the urban poor can help to better ensure housing security after a disaster, by helping to maintain a workforce who may be engaged in the informal economy but nonetheless provides important support to the functioning of the formal

²⁴ Bündnis Entwicklung Hilft and Ruhr University Bochum— Institute for International Law of Peace and Armed Conflict (IFHV), *World Risk Report, 2020*, (Berlin: Bündnis Entwicklung Hilft and Ruhr University Bochum, 2020), p. 17

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²³ ADB. 2022. Building Resilience of the Urban Poor in Indonesia. Manila

²⁵ Stephane Hallegatte et al., *Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters*.

²⁶ National Institute of Building Sciences, Multi-Hazard Mitigation Council, *Natural Hazard Mitigation Saves: 2019 Report*, (Washington, D.C.: National Institute of Building Sciences, 2019).

²⁷ Anh Tuan Tran, Tran Huu Tuan, and Tran Vran Giai Phong, "Cost-Benefit Analysis of Climate-Resilient Housing in Central Vietnam," EEPSEA Research Report No. 2016-RR6, (Laguna, Philippines: Economy and Environment Program in Southeast Asia, 2016).

²⁸ Nicola Giordano et al., "Financial Assessment of Incremental Seismic Retrofitting of Nepali Stone-Masonry Buildings," *International Journal of Disaster Risk Reduction*, Volume 60, (2021): 102297.

economy in the city. This can help lead to an overall more resilient and timely recovery for the city in the event of a future disaster.

17. Holistic housing investments that consider climate and disaster risk can increase the resilience of the urban poor against both low- and high-frequency threats. Pro-poor housing investments can not only mitigate risk by protecting houses from damage or collapse, but can increase resilience by enhancing the health, well-being and opportunities of occupants, which can support them to withstand a wide range of future threats. Beyond providing protection from hazards, a home addresses basic needs and is essential for good health—for example, by providing sanitation, and a space in which to rest or recover from illness. A home is also typically a financial asset or a source of income and opportunity for families—through a home business, rental income, or a space in which to study (see Figure 1, "The Build Change Resilient Housing Wheel").²⁹



Figure 1. The Build Change Resilient Housing Wheel

Source: Build Change

²⁹ Build Change, The Build Change Guide to Resilient Housing: An Essential Handbook for Governments and Practitioners (Denver, CO: Build Change, 2021), p. 4

II. UNDERSTANDING CLIMATE AND DISASTER RISK INFORMATION IN THE CONTEXT OF HOUSING FOR THE URBAN POOR

18. Pro-poor investments in housing should be informed by climate and disaster risk information so that appropriate planning and mitigation measures can be put in place, in order to reduce the largest risks.

A. Climate and Disaster Risk Information

- 19. What is Climate and Disaster Risk Information? Climate and disaster risk assessments help to assess the risk to human and ecological systems as a result of climate-induced or other hazards and the occurrence of disasters. Risk information becomes available as a result of these assessments. Disaster risk is commonly considered as a function of the severity and frequency of hazards, exposure to hazards, and the vulnerability of people and assets to damage or impact.³⁰ Whether the hazards put people and homes at risk, and to what extent, is determined by their level of exposure to the hazards and their existing vulnerability.
- 20. **Influencing the Components of Climate and Disaster Risk.** When it comes to housing investments, influencing the vulnerability component of risk is the most effective way to reduce risk. Table 1 shows how reducing climate and disaster risk through influencing each of the components of risk can be viewed when designing urban pro-poor housing investments. This is followed by an overview of the three components of risk in the context of housing for the urban poor.

Table 1. The Ease of Influence for Components of Climate and Disaster Risk through Housing Investments

| RISK COMPONENT | EASE OF INFLUENCE |
|----------------|-------------------|
| Hazard | Low |
| Exposure | Moderate |
| Vulnerability | High |

Source: Build Change

1. Hazards

21. Identifying the applicable hazards is a critical first step to making informed investments in pro-poor urban housing; location will determine the applicability and severity, particularly for natural hazards. Natural hazards fall into two categories: geophysical hazards, such as earthquakes, tsunamis, and volcanic eruptions, and hydrometeorological hazards or extreme weather events, such as floods, drought, and tropical cyclones. Natural hazards are described in terms of their intensity, frequency, and geographic extent. As natural hazards are typically spatial in nature, the presence and severity of hazards for a house or housing

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³⁰ UN Office for Disaster Risk Reduction (UNDRR), "Understanding Disaster Risk," PreventionWeb (web page), (UNDRR, 2020–2021).

project are determined by its site, or location, resulting in the low ability of housing investments to change the hazard at a particular site or city.

- 22. Natural hazard information is most frequently conveyed through maps—these are typically developed based on historical records, science, and modeling. Seismic and wind hazard maps, when applicable, are available in the national building or structural code, whereas other hazard maps may be available from the related government agency or other sources³¹ (see Box 1).
- 23. Beyond natural hazards, other hazards can pose risks to housing and occupants, such as biological hazards and other human-caused hazards, like diseases, contamination, fire, and crime. These hazards must also be considered when investing in pro-poor urban housing by identifying the hazards and addressing them in the housing and program investment design.
- 24. Hydrometeorological and biological hazards are made worse by climate change in the following ways, and for houses that are expected to have a useful life from 35, to 50, to even 75 years or more, the future projections of the hazards into these timeframes should be considered.

Flood: Increases in rainfall intensity and frequency will increase river and urban flooding, which may be made worse by drought and increased urbanization, respectively. Storm surges will increase due to more intense and frequent tropical cyclones.

Box 1. National Multi-Hazard Maps Online

For Bangladesh, Indonesia, and the Philippines there are multi-hazard maps readily available through online platforms:

Bangladesh: Humanitarian Data Exchange https://data.humdata.org/dataset/bangladesh-hazards

Indonesia: inaRisk https://inarisk.bnpb.go.id/

Philippines: HazardHunterPH

https://hazardhunter.georisk.gov.ph/

Coastal flooding will also increase, with rising sea levels and increased rainfall.

Tropical cyclones: Increases in wind speeds and rainfall as well as frequency of more severe storms.

Landslides: Increases in rainfall intensity and frequency, as well as drought reducing vegetation coverage, can lead to more landslides.

Extreme heat: Rising temperatures due to climate change will broaden the areas affected by extreme heat and increase the severity and frequency of heat waves.

Biological: Higher temperatures and wet conditions can increase the transmission of vector-borne diseases.

25. One example of considering the impact of climate change in developing hazard maps is how the Ministry of Disaster Management and Relief in Bangladesh produced new flood hazard maps which include climate change impact projections into the future.³² The downscaling of

³¹ Refer to ADB, *Natural Hazard Data: A Practical Guide*, (Manila: ADB, 2017) for more detailed information about natural hazards and hazard mapping for disaster and climate risk, including information on key international and regional sources of hazard data that can be referenced when national data may not be available.

³² Comprehensive Disaster Management Programme (CDMP II), *Policy Brief: Local Level Hazard Maps for Flood, Storm Surge and Salinity*, Dhaka: Ministry of Disaster Management and Relief, 2014.

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outputs from global climate models, which are used to provide projections of climate change, is necessary to get climate change projections suitable for natural hazard risk analyses. ADB and others are endeavoring to facilitate this work.³³

- Bangladesh, Indonesia, and the Philippines are exposed to high levels of natural hazards. Many of the major natural hazards in Bangladesh, Indonesia, and the Philippines are well documented and have different effects on housing. Table 2 provides a summary, with the highest level for each hazard in each country noted. These are the current levels of risk, and do not yet consider where climate change is expected to further increase the risk.
- All three countries have high levels of flood, tropical cyclones, and landslide hazards, which means that high levels of potentially damaging and life-threatening floods, tropical cyclones, and landslides are expected to occur in the future if no action is taken to mitigate the hazard and
- Biological hazards are present in all three countries, with increased hazard levels 28. in urban areas. Biological hazards are of organic origin or conveyed by biological vectors, such as bacteria, viruses, or parasites, and mosquitoes carrying disease-causing agents. 34 Temperature, precipitation, and humidity heavily influence the life-cycles of vectors, and subsequently the transmission of water and food-borne diseases.³⁵ The spread of disease is exacerbated by overcrowding and poor sanitation, ventilation, drainage, and waste management in urban areas. All three countries are at risk of increased transmission of diseases as a result of the changing climate, particularly in cities.
- 29. Other hazards are prevalent, such as fire, crime, mold, and indoor air pollution. In Bangladesh, household air pollution causes over 4.3 million premature deaths every year.³⁶ In Indonesia, poor indoor air quality is thought to be linked to various health conditions (in particular respiratory conditions) in informal settlements, 37 and acute respiratory infection (16%) is the second leading cause of death among infants under five years old, after prematurity (19%).³⁸ The Philippines has been ranked as the second deadliest country for indoor air pollution in the Asia Pacific Region, after Laos, with women and children most at risk.³⁹

³³ ADB, Natural Hazard Data: A Practical Guide, (Manila: ADB, 2017).

³⁴ UNDRR, "Understanding Disaster Risk."

³⁵ World Health Organization (WHO) and World Meteorological Organization (WMO), Atlas of Health and Climate, (Geneva: WHO, WMO, 2012).

³⁶ WHO and United Nations Framework Convention on Climate Change (UNFCCC), Climate and Health Country Profile -2015 Bangladesh, (Geneva: WHO, UNFCCC, 2016).

³⁷ Kresna Bhayu Adinugraha, et al., "Dampness, Mold, and Health Conditions of Residents in Kampongs: A Case Study of Bandung, Indonesia," in EduARCHsia & Senvar 2019 International Conference (EduARCHsia 2019), 19-29. Atlantis Press, 2020.

³⁸ WHO, World Health Statistics, 2015, (Geneva: WHO, 2015), p. 61

³⁹ WHO, "One third of global air pollution deaths in Asia Pacific," (WHO Western Pacific Region web page, news release, 2 May 2018, Manila, Philippines).

Table 2. Summary of Natural Hazard Levels and Effect on housing: Bangladesh, Indonesia, Philippines

| | | _ | | | | | |
|----------------------|--|--|---|--|---|---|---|
| | HYDRC | METEOROLO HAZARDS | GICAL | | GEOPHY | SICAL HAZAI | RDS |
| | FLOOD (RIVER, URBAN, AND COASTAL) | TROPICAL CYCLONE | EXTREME HEAT | LANDSLIDE | EARTHQUAKE | TSUNAMI | VOLCANO |
| BANGLADESH | High | High | High | High | Medium | Medium | n/a |
| INDONESIA | High | High | Medium | High | High | High | High |
| PHILIPPINES | High | High | Medium | High | High | High | High |
| EFFECT ON HOUSING | Inundates houses, damages the structure and contents, and leaves behind sediments, bacteria, and mold. In extreme cases can sweep away the entire structure. | Heavy rain and storm surge can cause flooding (see FLOOD). Severe winds apply pressures to buildings, which can damage housing. Roofs can blow off in a storm or entire homes can lift off the foundation s. | Impacts the health and well- being of the building occupants. | Can bury houses in earth or cause displacement of part or all of the building. | Ground shaking can damage housing and cause it to collapse. Secondary risk of tsunami (see TSUNAMI) or ground failure from liquefaction or surface fault rupture. | Applies pressure and uplift to buildings, and can undermine foundation s; can sweep away the entire structure. Inundates house (see FLOOD). | Lava flow can bury or destroy houses. Ash fall can cover houses and cause roof failures and respiratory issues. |

KEY

High: Users should be highly aware of potentially severe damage from this hazard for the project location. Without taking measures to mitigate the hazard and risk, high levels of damage can be expected to occur within the project or human lifetime (and potentially frequently in that timeframe, for hydrometeorological hazards).

Medium: Users should be aware of potentially damaging effects of this hazard for the project location. Potentially damaging events can be expected to occur within the project or human lifetime and measures to mitigate the hazard and risk should be considered. For hydrometeorological hazards, damaging effects could occur frequently in that timeframe.

SOURCE: Country profiles for Bangladesh, Indonesia, and Philippines from THINKHAZARD!, https://thinkhazard.org impact on housing information by build change.

Note that Thinkhazard! assesses current risk levels but does not yet take into account where climate change is expected to further increase the risk.

2. Exposure

- 30. Exposure for housing and households is the degree of possible contact between the house or household and a potentially damaging or harmful hazard event. Census and population data can be used to gather information and obtain a broad view of the exposure across different areas and hazards—this data should be disaggregated, in order to expose hidden trends and make vulnerable populations more visible. Exposure data can be generated by creating an inventory of housing and households and superimposing it with hazard data. Aerial imagery and image processing can assist in inventorying.
- 31. Understanding exposure can inform the potential scope and prioritization of housing investments. For designing housing investments that build resilience of the urban poor, it is important to understand how many people and houses are exposed to each hazard and where the exposure is greatest. The quantity of houses, people, and sites exposed to hazards help define an upper bound on the potential investment need, while understanding concentrations of exposure, such as in urban areas, can help to define the places more susceptible to disasters and prioritize investments.
- 32. Housing investments have a moderate ability to influence exposure given that existing exposures may be embedded in the intersection of geographic constraints with the social and economic systems of the city; it is possible to change these and the exposure once this has been established, but it is more effective to use housing investments to avoid increasing or creating new areas of exposure.
- 33. **Bangladesh, Indonesia, and the Philippines all have very high levels of hazard exposure.** In Bangladesh, more than 80% of the population is potentially exposed to floods, earthquakes, and droughts, and more than 70% to cyclones. In Indonesia, over 97% of the population lives in areas exposed to natural hazards. In the Philippines, at least 60% of the country's total land area is exposed to multiple hazards, and 74% of the population is susceptible to their impact. In many cases, cities are located in hazard-prone areas along coasts, on flood plains, and close to seismic faults; this combined with rapid unplanned urbanization has increased the exposure of the urban poor to hazards.

3. Vulnerability

34. Understanding household socioeconomic vulnerability and housing vulnerability to hazards is important to understand risk, as well as the solutions needed to reduce risk. Vulnerability refers to the "propensity or predisposition to be adversely affected," and relates to susceptibility to harm and people's capacity to cope and adapt.⁴⁴ In terms of pro-poor housing investments, both household vulnerability and housing vulnerability must be considered.

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⁴⁰ IREUS (Institute of Spatial and Regional Planning), World Risk Index, (IREUS, University of Stuttgart, 2021).

⁴¹ The World Bank, "Bangladesh Disaster Risk and Climate Resilience Program," Brief, July 25, 2018, (The World Bank official website, World Bank Group, 2021).

⁴² National Disaster Management Agency (BNPB), United Nations Population Fund (UNPF), and Statistics Indonesia (BPS), *Population Exposed to Natural Hazards: A Study Based on the 2010 Population Census*, (Jakarta: BNPB, UNFPA, BPS, 2015).

⁴³ UNDRR, *Disaster Risk Reduction in the Philippines: Status Report 2019, Bangkok, Thailand: UNDRR, Regional Office for Asia and the Pacific, 2019.*

⁴⁴ IPCC, Annex I: Glossary [van Diemen, R. (ed.)]. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems, (IPCC, 2019).

- (i) The household vulnerability of certain groups relates to their socioeconomic status, and can affect their capacity to anticipate, respond, cope with, and recover from disasters. Those who are most vulnerable include the poor, women, ethnic and racial minorities, the elderly, and disabled. Increased household vulnerability can be driven by:
 - (a) economic factors, such as levels of income, income diversity, assets, and indebtedness.
 - (b) well-being factors, such as food security, health, access to water and sanitation, and
 - (c) social factors, such as level of independence, social participation, and decision-making power.
- (ii) Housing vulnerability relates to how susceptible a home is to failure, damage, or other problems due to hazards. It is influenced by deficiencies in the physical properties of the building such as the building type, materials used, the quality of construction, the layout of the building, the interconnection of the building elements, and the level of maintenance. For example, a roof that is not well connected to the rest of the building is unlikely to withstand a powerful cyclone, and unreinforced masonry structures with heavy roofs are prone to collapse in strong earthquakes. In the case of earthquakes and windstorms, most deaths can be attributed to the collapse of poorly designed and built housing units. Increased housing vulnerability can also be a result of gaps in the housing construction value chain, such as the availability of quality materials, the quality of the building standards, the capacity of the builders, the level of enforcement of standards, and the access to adequate financing for construction and technical assistance.

When housing investments are designed and implemented well, and informed by climate and disaster risk information, they have a high ability to influence the vulnerability of housing for the urban poor as well as the socioeconomic vulnerability of the urban poor.

- 35. **Differences in household composition can affect the vulnerability of the urban poor.** While female-headed households differ in terms of their access to resources and family composition, households headed by women are often more vulnerable. Widows and divorced women can be more vulnerable as a result of being marginalized or stigmatized. 45 Urban women, especially the poor, are typically more affected (as compared to men) by shortfalls in essential services and infrastructure, and experience a range of inequalities such as access to decent work, asset ownership, mobility, personal safety, and representation in formal structures of urban governance, 46 which can increase their vulnerability.
- 36. In addition to, and intersecting with gender, other vulnerable households include those inhabited by migrants, who may have more limited access to resources, information, and support networks, or lack the documentation or security of tenure needed to access support. The elderly, disabled, and ethnic minorities may also experience limitations on their access to information, financial security, and mobility, in addition to other challenges.

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⁴⁵ CARE International, *Gender and Shelter: Good Programming Guidelines*, (Geneva: CARE International, 2016), p. 19

⁴⁶ Sylvia Chant, "Cities through a 'gender lens': a golden 'urban ag' for women in the global South?" *Environment and Urbanization 25*(1): 9–29 (2013).

- 37. In all three countries, a notable portion of housing is vulnerable to hazards, due to both habitability as well as structural deficiencies. In January 2019, Build Change published *Disaster Resiliency in Housing in the Philippines: A Market Study of Residential Retrofit Financing* which estimates that 70 million Filipinos live in substandard housing. In Indonesia, the World Bank estimates that around 20% of the more than 64.1 million housing units are in poor condition.⁴⁷ In Dhaka, one in three people live in informal settlements.⁴⁸ Informal settlements are characterized by particularly poor-quality housing and a lack of basic services, although poor quality formal housing can also be inadequate. In terms of habitability (the conditions which make a house suitable for occupancy), substandard housing frequently lacks adequate space, lighting, ventilation, water and electrical services, security, egress, fire protection, and sanitation. On average, 31.7% of people live without access to basic sanitation services in urban areas in the three countries.⁴⁹
- 38. The structural vulnerability of housing is evidenced by the high levels of damage and destruction in extreme events such as earthquakes and tropical cyclones, with the housing sector often accounting for a large portion of the losses that result. Common housing types built by the urban poor include masonry (which can be particularly vulnerable to the effects of earthquakes) and timber (which can be particularly vulnerable to the effects of tropical cyclones), and these vulnerabilities are well documented. ⁵⁰
- 39. Understand the housing construction practices and market to identify root causes of housing vulnerability and opportunities. Housing subsector studies can be consulted or generated to better understand the needs and opportunities for reducing housing vulnerability against the applicable hazards. The overarching questions addressed by housing subsector studies are shown in Table 3.

⁴⁷ Taimur Samad, *Project Information Document (Concept Stage)—National Affordable Housing Program—P154948 (English)*, Report no. PIDC26050, (Washington D.C.: World Bank Group).

⁴⁹ Access to basic sanitation services defined as "improved facilities not shared with other households." Source: UN-Habitat, *World Cities Report 2020: The Value of Sustainable Urbanization.*

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⁴⁸ Ashekur Rahman, "Housing Solutions for the Urban Poor in Bangladesh," (press release on UNDP Bangladesh web page, posted on April 10, 2019).

Detailed information is available in Build Change post-disaster reconnaissance reports, found at https://buildchange.org/resources/post-disaster-reconnaissance-reports, and in Annex B of *The Build Change Guide to Resilient Housing*.

Table 3. Questions addressed by Housing Subsector Studies

| Housing Subsector Study | Questions | | |
|--|---|--|--|
| House Assessment | What types of houses do people live in now? What materials and structural systems are used? | | |
| ASSESSITIETIL | What size, shape, number of stories, and layout are common? | | |
| | Where do people cook? Bathe? Use the toilet? | | |
| | What are common architectural, cultural, and climate preferences? | | |
| Household Preferences | What does the homeowner or occupants need in the home that is currently not there? | | |
| 110101011000 | What priorities do they want to address in the house? | | |
| How do they use the home and what future aspirations do they have fo | | | |
| Construction | · · · · · · · · · · · · · · · · · · · | | |
| Materials Needs | Where are they produced and procured? How much do they cost? | | |
| Assessment | Who buys the materials (homeowners, builders, contractors)? | | |
| | Where are they stored? | | |
| Workforce Needs | What is the skill level of local builders? | | |
| Assessment | What tools and techniques do they use? | | |
| | How much do they earn and how are they paid? | | |
| | How are houses commonly built? What systems and techniques are used? | | |
| | Do homeowners build themselves? Incrementally, or all at once? Or are housing | | |
| | units built by the government or through the private sector? | | |
| | Do homeowners consult engineering or architecture professionals? | | |
| | What is the role of various professionals in the housing market? Is it formalized, or informal? | | |
| | Are there professional associations and if so, is membership common? | | |

Source: Build Change for USAID, Building Back Housing in Post-Disaster Situations—Basic Engineering Principles for Development Professionals: A Primer, (2014), P. 17–18

- 40. Historical data and forensic investigations of housing performance in past disasters can also add critical information to the assessment of housing vulnerability. Patterns of past disaster damages can provide important information on the key vulnerabilities and expected levels of damage for certain building types and configurations in different disaster events. It is important to review historical records as well as document the effects of disasters on buildings when they happen in order to better understand the vulnerabilities of the building stock. When referencing historic impacts, it is also important to keep in mind the potential changes in climate and disaster risk into the future as well.
- 41. Identify the primary building typologies used for housing and assess the typical nature and extent of structural and habitability deficiencies present in each type. The typical type, distribution, and extent of deficiencies in different building typologies can be determined through housing sub-sector studies and from historical data and forensic investigations as described above, as well as assessments using field surveys informed by qualified engineers, and through leveraging data and technology (Box 2). Group houses by building typologies which share similar characteristics, such as structural systems, number of stories, configurations, materials used, construction techniques, and also similar deficiencies. Identify the distribution of primary housing typologies within the target investment area to understand which are most prevalent and to what degree, noting that the geographic distribution of typologies can change as other influencing factors, such as economic means, change. For investments in existing housing,

knowing the general quantity and location of different house typologies will inform where and how many homes are vulnerable.

Box 2. Data and Technology for Rapid Inventorying and Characterization

Technology such as Google Street View can enable assessments of building typologies and vulnerabilities to be conducted rapidly and at scale, at a low cost. Where Street View data is not available, the use of drones can perform a similar function.

42. **Assess household characteristics to understand socioeconomic vulnerability.** Households must also be assessed to determine socioeconomic information, vulnerability factors, and eligibility for participation in a potential housing program. It is essential to collect disaggregated data on households (e.g., to show age, sex, women-headed households, children, disabilities etc.) as much as possible, to provide a complete picture of those who live there. This assessment can be embedded in a housing subsector study and coupled with field surveys of buildings. The information collected, such as the number of occupants, can also help define levels of population exposure.⁵¹

⁵¹ For more details on field surveys and building surveys, refer to pages 57–60 of *The Build Change Guide to Resilient Housing*.

III. HOW THE USE OF CLIMATE AND DISASTER RISK INFORMATION IMPROVES THE DESIGN OF HOUSING INVESTMENTS TO BUILD RESILIENCE OF THE URBAN POOR

A. Entry Points for Using Climate and Disaster Risk Information in Pro-Poor Housing Investments

- 1. Direct and Indirect Investments
- 43. Governments can make direct and indirect investments in housing that build the resilience of the urban poor.
 - (i) Direct investment: Government-led, risk-informed initiatives for:
 - new housing,
 - improving or maintaining existing housing,
 - resettlement, and/or
 - securing land tenure and access to services.

These may be implemented by the government or government partners.

- (ii) **Indirect investment** in addressing the financial, social, and technical systemic barriers to resilient housing for the urban poor which lead to high levels of risk in housing for the urban poor.
 - Financial—Government support to national and regional financial institutions and microfinance institutions in:
 - risk management,
 - existing and new product development, and
 - insurance.
 - Social—Government support to:
 - generate hazard and risk awareness and demand for more resilient housing,
 - improve the understanding of household needs, socioeconomic status, and distribution, and
 - improve and enforce policies and regulations for urban housing and land.
 - Technical—Government support to:
 - understand risk through improved information on hazards, exposure, and housing vulnerability,
 - develop and promote design and construction standards and practices for resilient and affordable housing solutions, and to
 - support workforce development for housing design and construction activities.

- 44. Investments that leverage both direct and indirect initiatives are often the most effective. Through both direct and indirect investments there are opportunities to promote gender equity in resilient housing programs, for example:
 - (i) Direct housing investments can give women more power to actively participate in decisions around their home's design and construction, while supporting them to be viewed and respected as leaders. They could provide women with cash grants, enable women to lead the design and construction of their home, or to make the decisions about relocation or resettlement
 - (ii) **Indirect housing investments** can support women to access affordable loans, through work with MFIs, and train women construction workers and materials producers: 65% of the brickmakers that Build Change has worked with in Indonesia have been women.⁵²
- 45. Figure 2 provides an overview of the information within the following sections, for making direct and indirect housing investments that are informed by climate and disaster risk information.

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⁵² For more information, see https://buildchange.org/locations/indonesia/.

Figure 2. Making Direct and Indirect Housing Investments Informed by Climate and Disaster Risk Information

DIRECT INVESTMENT

New housing Existing housing Resettlement Land tenure & services

> Combine direct and indirect investments for the most effective programs

INDIRECT INVESTMENT

Policies Standards Enforcement systems Education and training

Awareness-building

1. IDENTIFY/PRIORITIZE LOCATIONS

>>> CLIMATE AND DISASTER RISK ASSESSMENT

What hazards exist in the location and how do they affect housing?

How many houses and households are exposed the hazards? And where?

What are the levels and types of housing and household vulnerability in the location?

2. DEVELOP AN INVESTMENT STRATEGY

>>> BASED ON APPLICABLE HAZARDS

REDUCE VULNERABILITY

high winds, biological threats, extreme heat and earthquakes; build or improve the house to meet standards

REDUCE EXPOSURE

flood, landslide, extreme heat and volcanoes; relocation and/or protective infrastructure



MANAGE RESIDUAL RISK

extreme heat, tsunami; planning and preparedness, early warnings systems

3. DEFINE INVESTMENT GOALS AND **METHODOLOGIES**

>>> DEVELOP RESPONSIVE SOLUTIONS

Follow strategy with solutions to address:

- Exposure
- Housing vulnerability
- Household needs and preferences
- Gaps in construction value chain



THE CONSTRUCTION VALUE CHAIN (SOURCE: THE BUILD CHANGE GUIDE TO RESILIENT HOUSING)

4. IDENTIFY INVESTMENT LEVELS

>> TO ACHIEVE TARGETED IMPACTS

Three categories of spending for housing:

- Construction/improvement costs
- Program implementation
- Systems change for sustainability

Identify corresponding required community infrastructure investments

Source: Build Change

IDENTIFY OPPORTUNITIES FOR SYSTEMIC IMPROVEMENTS

People/Policies

Build demand for resilient housing across all stakeholders

Improve awareness of risk and solutions

Policies and enforcement



Money

Better access to finance for resilient housing from multiple sources at all levels





Technology

Improve supply of more resilient housing

Improve understanding of risk

Develop and disseminate building and housing standards

Workforce development for housing design and construction

2. Direct Investments

- 46. Climate and disaster risk information should inform where direct investments in housing will be made, what kinds of investments will be made, how the implementation will be carried out and how much will be invested. This can be approached in the following ways:
 - Prioritize investment locations. At the national and local scale, climate and disaster risk information, such as hazard levels, population and housing exposure, as well as household vulnerability and housing vulnerability (see Section II) can be combined through a disaster risk assessment to identify overlapping areas with increased risk or areas with low risk. For new housing, low hazard areas can be prioritized for development to avoid creating high levels of risk. For existing housing, households in areas of higher risk (areas with higher vulnerability and exposure to hazards) are locations with the greatest need for climate and disaster risk informed housing investments, as they are most likely to experience housing loss or damage and subsequent negative impacts from disasters; they can be prioritized for reducing risk. Where disaster risk assessments have already been performed and integrated into land use and management plans, these should be referenced and followed for guidance on location selection or prioritization. In the BSPS program (see Section IV), levels of housing vulnerability (substandard housing) and household vulnerability (lower 40%) were used as indicators to prioritize areas of investment for the program.
 - (ii) Select the investment strategy/ies and type/s. The investment strategy/ies used should be based on the types of hazards present at the selected locations to ensure a suitable approach for reducing risk and improving resilience of the targeted urban poor, for example, investing in a program that reduces the vulnerability of housing to high winds in areas prone to tropical cyclones, or a program for housing relocation in areas where existing housing is highly exposed to landslides (see Section III). It may also be necessary to re-evaluate hazards at a more localized level once broader prioritization areas have been identified (Box 3). In the case of MFIs offering incremental home strengthening loans in the Philippines (see Section IV), before the loan is approved, a house site is screened for the presence of hazards, such as flooding or landslides, which would require an alternative strategy to address other than that offered by the program.

Identifying the appropriate strategy to address the applicable hazards will also help define the type of investment required to best build resilience of the urban poor in that location—whether it be through new housing, improving existing housing, securing land tenure and access to services, or relocation and resettlement. For example, the best strategy to reduce risk due to storm surge in housing is to reduce exposure—understanding this will help ensure investments in new housing, improving housing, or formalizing housing are not made in storm surge areas, which would in fact increase or reinforce exposure and risk. Instead, investments to reduce storm surge risk should focus on reducing exposure such as through resettlement.

(iii) Define investment goals and methodologies. Once the location and type of investment are identified, the specific goals of the investment can be developed based on understanding the housing market gaps, the types of housing and their vulnerabilities, as well as the socioeconomic characteristics of the households. Climate and disaster risk informed solutions to achieve these goals can then be developed and integrated into the implementation of the selected housing investment (see Section III). For example, reference materials and guidance given to technical facilitators in the BSPS program (see Section IV) address the most common types of housing, while the program goals for each house are to provide adequate space, health, and structural safety for the home, which were areas of common housing deficiencies identified for poor households.

(iv) Identify investment levels. For housing investments that include improving existing housing of the urban poor, construction costs (including materials, labor, transport, etc.) can be estimated based on the developed solutions to reduce structural and habitability vulnerabilities according to the established goals. While this paper focuses on housing investments, housing functions within a community and community infrastructure is critical to adequate housing. Therefore, housing investments levels should be considered alongside of community infrastructure investment needs to ensure both are sufficient. In the Philippines, MFIs are making climate and disaster risk informed housing investments more affordable to low-income homeowners by providing incremental solutions (see Section IV). For new construction, the construction costs associated with building disaster-resistant, quality housing for the urban poor can also be estimated. Typical costs per household can be combined with vulnerability and exposure information on the number of households and number of buildings, in order to understand the overall level of investment needed for construction.

Beyond construction costs, the costs associated with essential program operations, such as technical assistance, quality assurance and control, program management and administration, temporary accommodations, and communications and feedback mechanisms should also be estimated and incorporated into the design of housing investments. These can also be informed by combining vulnerability and exposure data, in order to understand the magnitude of the investment needed for the program to operate at the desired scale.

Additionally, it is recommended to consider the cost of systems-level assessment and strategy advice when designing housing investments, as this can provide support for designing, evaluating, and optimizing investments in housing.

3. Indirect Investments

47. There are existing tools to help understand and identify opportunities for indirect investments in housing systems to build the resilience of the urban poor. Successful housing investments for the urban poor must be designed in a way that looks at the entire housing ecosystem, by addressing the financial, social, and technical barriers and considering how they interact. Build Change has developed various resources to support this process. *The Build Change Guide to Resilient Housing*⁵³ provides further context, and includes a detailed operational manual for designing and implementing home improvement programs. The Resilient Housing Ecosystem Assessment Tool (RHEAT, included in Annex 1 of this Technical Note) can support governments to monitor progress, identify gaps and challenges, and prioritize actions across these three key areas.

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⁵³ Available at https://buildchange.org/guide-to-resilient-housing.

B. Using Hazard Information to Select Investment Strategies

48. **Develop a strategy for addressing each type of hazard present in the location where housing investments will be made.** Disaster risk to housing and occupants can be addressed through different strategies integrated in housing investments, depending on the hazard and how it impacts the building. The two main strategies are:

(i) Reduce risk:

- Reduce the exposure. Invest in relocation, in land management and use planning, and its enforcement (see Section III). Protective gray and green infrastructure, including nature-based solutions, can also be used to reduce exposure to risk.
- Reduce the vulnerability. Invest in improving the structural and habitability aspects of existing housing, and in using disaster-resistant construction practices and habitability standards when new housing is built.
- (ii) **Manage the residual risk:** Invest in education and disaster risk management. Help people to understand the risk, how to live safely with the risk, and how to respond when an event occurs.
- 49. Table 4 summarizes relevant hazards, their impact on housing, and which primary strategy is likely to be most effective in addressing the hazard. In many cases, a combination of strategies may be possible and this is noted when applicable.

Table 4. Strategies for Reducing Hazard Impact on Housing

| Hazard | Impact on Housing | Primary Strategy to Address |
|---|--|--|
| BIOLOGICAL (Disease and contamination) | Impacts the health and well- being of the building occupants. Can accelerate the deterioration of the building (in some cases). | Reduce vulnerability by improving/incorporating key habitability standards in housing. |
| FLOOD (Coastal/Storm surge, sea-level rise, river, and urban) | Inundates houses, damages the structure and contents, and leaves behind sediments, bacteria, and mold. In extreme cases can sweep away the entire structure. | Reduce exposure by locating/relocating housing outside of flood hazard zones. In some cases, vulnerability can be reduced, e.g., by elevating the structure or increasing the finished floor height. |
| EXTREME HEAT | Impacts the health and well-being of the building occupants. | Reduce vulnerability by using materials and techniques that mitigate extreme heat, improve ventilation, ensure access to water and electricity and facilitate access to air conditioning. One such example is "cool roofs," which are designed to reflect the sun and absorb less heat. Reduce exposure through interventions that mitigate urban heat island effects, such as "green" cities (increasing vegetation and tree |

| | | cover), "blue cities" (increasing water bodies and features) and "white cities" (using more reflective, light surfaces). Manage residual risk, e.g., provide alternative accommodation during heat waves; create awareness of signs of heat stress. |
|-----------------------------------|--|--|
| TROPICAL CYCLONE/HIGH WINDS | Heavy rain and storm surge can cause flooding (see above). Severe winds apply pressures to buildings, which can damage housing. Roofs can blow off in a storm or entire homes can lift off the foundations. | Reduce vulnerability by increasing the connectivity and strength of the structure, especially ensuring the roof is adequate and well-connected to the building; maintain the building envelope. Manage residual risk, e.g., evacuation of affected areas ahead of storm arrival. |
| LANDSLIDE | Can bury houses in earth or cause displacement of part or all of the building. | Reduce vulnerability through site mitigation interventions, such as the construction of retaining walls when feasible. Reduce exposure by locating/relocating houses outside of the risk area. |
| EARTHQUAKE | Ground shaking can damage housing and cause it to collapse. Secondary risk of tsunami (see below) or ground failure from liquefaction. | Reduce vulnerability by strengthening buildings and addressing structural irregularities e.g., uneven distribution of walls. Reduce exposure to ground failure by locating/relocating housing outside of areas with high liquefaction potential (where foundation or ground improvements to reduce vulnerability are not viable). |
| TSUNAMI | Applies pressure and uplift to buildings, and can undermine foundations; can sweep away the entire structure. Inundates house (see "Flood"). | Manage residual risk, e.g., develop evacuation routes and response procedures. Reduce exposure by locating/relocating housing outside of tsunami inundation zones. |
| VOLCANO | Lava flow can bury or destroy houses. Ash fall can cover houses and cause roof failures and respiratory issues. | Manage residual risk, e.g., through evacuation and response procedures. Reduce exposure by locating/relocating houses outside of volcano hazard area. |

Source: Build Change

Box 3. Hazard Data for Planning versus Implementing

While low resolution hazard data and maps can be sufficient for regional or national planning and prioritizing of housing investments, even more detailed maps should be supplemented by detailed site surveys for localized planning and implementation. Site-specific assessments should be performed to screen sites or areas where housing investments will be made in order to understand what localized levels of hazards exist or how site conditions may affect the hazards. For example:

- a) For *earthquakes*, the site soil type affects both the level of shaking anticipated as well as the potential for soil liquefaction.
- b) For *floods*, localized evaluation of flood hazard includes review of historical flooding events and water levels at the site, distance and elevation from nearby water bodies, and site topography and drainage conditions; modeling should also be used to project future flood levels for the sites for the duration of the expected building life.
- c) For *landslides*, review of the immediate topography can identify the presence, condition, and location of steep slopes and existing retaining walls, as well as the overall slope of the site itself, which affects the site's stability.
- d) For extreme heat, identify conditions surrounding the site which influence heat levels, such as the

C. Using Exposure Information in Designing Housing Investments

- 50. Implement policies and enforcement of land use to mitigate exposure growth, incentivize densification of areas with no or low hazard exposure, and invest in housing relocation when appropriate. The number of people and houses exposed to certain hazards can be mitigated through developing and enforcing planning and zoning laws that aim to prevent densification of existing housing in high-hazard areas, and limit new construction in areas most exposed to those hazards, such as areas susceptible to flooding and landslides. Conversely, housing investments can help drive resilient densification in low-hazard areas, which can be particularly important to urban areas where the land available for completely new developments may be limited.
- 51. Relocation programs significantly reduce exposure to hazards that are otherwise expensive or unfeasible to mitigate—for example, by relocating existing households away from storm surge areas. In such cases, efforts should be made to minimize disruption to livelihoods (Box 4).

Box 4. Relocation from Storm Surge in the Philippines

After Typhoon Yolanda (2013) in the Philippines, Guiuan Development Foundation, Inc and Build Change, funded by Give2Asia, worked with the small island community of Maliwaliw through a community-driven approach to build new housing away from the storm surge area, after seaside homes had been severely impacted by the typhoon. This both reduced the community's exposure to storm surge, and opened up the storm surge-exposed shoreline for mangrove development, to help mitigate the impact of future storms. However, due to the availability of detailed storm surge mapping, the new location was able to remain close to the main sources of livelihood for the community.

D. Using Housing Vulnerability Information to Improve Housing Investments

- 52. Take housing vulnerability information into account when defining the overall goals of housing investments. Define the objectives for housing—both in terms of climate and disaster risk reduction as well as habitability. For new housing construction, it is common to set the objective as meeting the requirements of the established building code or housing standards for both structural as well as habitability aspects. For existing housing, objectives can range from making minor improvements, to completely upgrading and expanding a building to meet current code standards and create new space. Often, the highest cost-benefit ratio in terms of reducing vulnerability results from investments that target improving key vulnerabilities that can cause more significant damage or problems, while not necessarily addressing all deficiencies. Disaster risk modeling can support with understanding the potential benefits of investments under certain scenarios (see Box 5). In all cases, the goals should not only reflect the climate and disaster risk information collected, but also the homeowners' and occupants' needs based on consultations with them.
- 53. Lack of access to basic services and infrastructure can lead to habitability deficiencies in the home and household (lack of adequate sanitation, water, electricity, economic opportunity, etc.) which exacerbate housing household vulnerability. In these cases, housing investment goals may also need to include goals related to not only the housing itself but also to addressing the gaps in the surrounding infrastructure in order to build resilience, such as community access roads. minor community structures (drainage, culverts, footbridges, retaining walls,

Box 5. Risk Modeling

Risk modeling is a form of disaster risk assessment that models hazards against people's exposure and vulnerability to them, in order to understand their potential impact under a particular scenario. This can provide an understanding of estimated financial losses and casualties, in order to make the case for housing investments. For more information on risk modeling, refer to *Disaster Risk Assessment for Project Preparation: A Practical Guide* (Manila: ADB, 2017), pages 49–52.

etc.), socio-economic infrastructure, community-based water supply and sanitation, communication and early warning systems, community-based non-conventional energy plants, and community-managed small and micro-enterprises.

54. Develop appropriate solutions to the identified vulnerabilities to achieve the established goals. Once goals have been defined, based on understanding the vulnerabilities of the house and needs and preferences of the homeowner or occupant (Section II), consultation with engineers and architects experienced in disaster-resistant design, retrofitting, and home improvement is typically required to develop information on the extent and nature of the interventions needed to achieve the goals across the different housing typologies. While the urban poor typically inhabit informally constructed housing that does not meet specific standards and which leads to high levels of risk for them, government investments in housing should ensure that specific standards and practices are applied in order to reduce the vulnerabilities and levels of risk. From a social acceptance as well as an affordability perspective, it is critical that the solutions to address deficiencies are locally appropriate, utilizing skills and materials that are locally available and therefore cost competitive with existing, common building methods. Reducing vulnerability in housing does not require expensive or complex solutions.

- 55. Knowing which housing types are most prevalent and what deficiencies are common within those also helps to anticipate trends in new housing construction, and should inform focus areas for technical assistance to eliminate vulnerability in new housing, so risk does not continue to grow. Drawing from the housing sub-sector study, investments should be designed—both for building new housing as well as improving existing housing—to include technical assistance for responding to the needs identified. This may include improving standards and enforcement, building awareness and providing accessible guidance to homeowners and builders, improving the quality of materials readily available, and enhancing the skillset of design and construction professionals.
- 56. Climate and Disaster Risk Informed Housing Investments Offer Non-Structural Measures to Reduce the Vulnerability of the Urban Poor. Resilient housing programs also provide additional opportunities to reduce the vulnerability of the urban poor in some of the following ways:
 - (i) *Improving living conditions:* When informed by a careful understanding of the experiences of those who live there, housing investments can reduce the vulnerability of occupants through improvements to health and well-being (e.g., through improved access to sanitation, improved ventilation) and make other improvements that can enhance everyday life (e.g., increasing security and privacy).
 - (ii) Increasing risk awareness: People can be made more aware of the hazards they are exposed to, the key deficiencies of their houses, and actions they can take in order to reduce these vulnerabilities. Disaster-risk reduction and risk management and preparedness initiatives can further support people to stay safe in the event of an extreme hazard or following a disaster.
 - (iii) **Building capacity:** Homeowner-led housing investments provide people with additional skills and knowledge that can support long-term resilience and sustainability of housing investments. Training builders develops local technical capacity, and produces a larger, more specialized, more employable workforce who can then train others.
 - (iv) Investing in the local economy: Housing programs are an opportunity to invest resources back into the local area, through the contracting of local labor and purchasing of materials. Local materials producers can be supported to produce high-quality, appropriate materials needed for safe and resilient construction. This further supports local capacity building and stimulates local economies.

IV. CASE STUDIES

A Philippines: Working with Microfinance Institutions to Reduce Housing Vulnerability for Low-Income Families

57. Working with microfinance institutions (MFIs) to support low-income families to incrementally strengthen their homes can open up multiple opportunities: affordable financing with technical assistance can enable people to reduce the vulnerability of their homes to make them safer against typhoons and earthquakes and improve their standard of living, while creating new lines of business for MFIs. Hazard, exposure, and vulnerability information has informed Build Change's work with MFIs in the Philippines, as we support them to develop affordable loan products supported by targeted technical assistance.

1. Understanding the Components of Risk Related to Housing

- 58. **Hazards.** The Philippines is among the top 15 countries globally for being at the highest risk to natural hazards and being most exposed to them.⁵⁴ The country is particularly exposed to tropical cyclones, flooding, earthquakes, and landslides. The impacts of projected sea level rise, storm surges, and coastal flooding on low-lying coastal cities where populations are concentrated are considered a major threat.⁵⁵ Risk modeling has shown that a 7.2-magnitude earthquake in Manila today could cause US\$5.7 billion in property damage to housing alone, resulting in US\$1.4 billion in lost GDP and over 388,000 casualties⁵⁶ (see Box 5).
- 59. **Exposure.** A 2019 Build Change study sought to advance understanding of people's exposure to risk due to vulnerable housing, and assess the potential market for retrofitting in the Philippines. The study estimates there to be 15.6 million substandard housing units in the Philippines (inhabited by 69.9 million Filipinos). These figures were reached by assessing housing data from the Philippine Statistics Authority and the Philippine Institute for Development Studies for the number of occupied housing units, housing populations, housing typologies and materials, and monthly incomes.

60. Vulnerability

- (i) Household Vulnerability. The same 2019 study found that most of the families living in the estimated 15.6 million substandard housing units in the Philippines earn PHP 9,000–36,250 (US\$170–682) per month, and are considered to be poor (16.5% of total), low income (36.1% of total) and lower-middle income (27% of total). Poor and low-income households often have problems with land ownership, particularly in highly urbanized areas; they also have a very limited range of financing options for housing improvements.
- (ii) Housing Vulnerability. Housing subsector studies were used to identify the types of housing within the MFIs' target client base, and understand the local construction

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⁵⁴ Bündnis Entwicklung Hilft and Ruhr University Bochum—Institute for International Law of Peace and Armed Conflict (IFHV), *WorldRiskReport 2020*, p. 48

⁵⁵ Henrike Brecht et al., "Sea-Level Rise and Storm Surges: High Stakes for a Small Number of Developing Countries," *The Journal of Environment and Development* 21, no. 1 (March 2012): 120–38.

⁵⁶ Modeling conducted by Risk Management Solutions for Build Change.

⁵⁷ Build Change, *Disaster Resiliency in Housing in the Philippines: A Market Study of Residential Retrofit Financing*, (Denver, CO: Build Change, 2019).

⁵⁸ Build Change, Disaster Resiliency in Housing in the Philippines: A Market Study of Residential Retrofit Financing.

market (e.g., availability of certain materials, or the skill level and availability of the local workforce). The common types of houses identified were nipa hut, timber, unreinforced masonry, reinforced concrete with masonry, and a combination of these.

61. Engineering analysis and post-disaster observations of performance for these housing types were used to identify the vulnerabilities of houses to hazards. Key vulnerabilities identified have included insufficient connections between the roof and the structure for resisting typhoons, weak walls that are not well connected or braced against typhoons and earthquakes, examples of poor-quality construction, e.g., using low-quality materials or combinations of materials that weaken the building's structural integrity, and houses in poor condition as a result of deterioration over time or damage from a past event.

2. Building Resilience through Microfinance Housing Investments

- 62. The financial, social, and technical barriers to resilient housing for poor and low-income households were assessed and a market study on retrofit financing was conducted to understand some of the root causes of climate and disaster risk in housing. Policies and understanding of risk were found to be relatively developed for formal housing, however, the implementation and enforcement of policies, particularly in construction of housing for poorer households, as well as peoples' understanding of and access to disaster-resilient construction practices, were not well developed. Access to adequate financing for more resilient housing was limited for poor and low-income households, although it was common to use MFI loan products to make other, more limited housing improvements. There is a robust microfinance industry in the Philippines, with strong, established client bases (a large majority of which are women). Many MFIs are working to alleviate poverty and help raise the living standards of their clients and communities through the provision of financial services tailored to local needs.⁵⁹ Of the 15.6 million vulnerable housing units identified, it was estimated that MFIs can cater to about 8.6 million units.⁶⁰
- 63. Based on the gaps and opportunities noted above, indirect investments were made to develop technical resources and training focused on improving the resilience of informal housing in the Philippines and advocating with MFIs to initiate home strengthening loan products. Following a successful proof of concept in 2018, when Build Change supported 19 homeowners in Pembo, Makati, to access financing for home strengthening and improvement interventions, Build Change partnered with MFIs to develop loan products for resilient housing that are within the borrowing capacity of low-income families. This work includes finding ways to build the technical capacity of MFIs, to increase their fund source for housing loans, and to mitigate the risk associated with lending. A summary of the process through which MFIs are now integrating home improvement programs into their offerings in the Philippines is illustrated in Figure 3. In 2020, four MFIs were offering home-strengthening loans specifically for clients to increase the resilience of their homes against disasters—a first for the Philippines.

60 Build Change, Disaster Resiliency in Housing in the Philippines: A Market Study of Residential Retrofit Financing

⁵⁹ Build Change, The Build Change Guide to Resilient Housing

1 2 **Client Awareness & Builder Training &** Analysis & **Implementation** Introduction to Loan **House Assessment Loan Selection** Loan approval and MFI awareness building Builder receives training MFI officer produces sessions with clients and disbursement options for community on exposure recommended scope of to hazards and work and cost **Builder completes** Project implementation vulnerability of house roof & wall assessment questionnaire for home MFI officer discusses Homeowner wants to Project monitoring/ options with client apply for a loan Loan utilization check Homeowner selects Eligibility checks desired loan option Loan repayment Repeat loan Homeowner is supported to vet and select a builder Source: Build Change

Figure 3. MFI Journey to Resilient Housing

64. The specific ways in which climate and disaster risk information were used to inform the design of the MFI loan products and services for direct investment in housing are highlighted in the following section. Along with the development of loan products, there is an emphasis on awareness raising and capacity building: all finance products are accompanied by a comprehensive range of support materials tailored to the local construction environment, to ensure that home improvement investments consider the housing ecosystem in its entirety while working to reduce the vulnerability of housing. Support materials include implementation tools, workshops, and training materials for local homeowners, MFI loan officers, and builders.⁶¹

3. Using Information on Hazards, Exposure, and Vulnerability to Inform Program Design and Implementation

65. **Prioritizing/Validating the Location.** For one MFI partner with an existing client base in Quezon City, an assessment of climate and disaster risk information was performed to understand if this location would be suitable for a pilot program. Hazard Hunter Philippines was consulted to understand the applicable hazards and overall levels of exposure. It was determined that there were high levels of exposure to earthquakes and high winds, as well as pockets of exposure to flooding. The National Structural Code of the Philippines was consulted to understand the design hazard levels for earthquake and winds. A housing study was also performed in the projected areas of intervention to identify the building types, common deficiencies, and extent of vulnerability for the targeted building types and household characteristics; this also provided an opportunity to interview homeowners and occupants to understand their housing preferences and needs.

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⁶¹ Build Change, The Build Change Guide to Resilient Housing

- 66. **Developing an Investment Strategy.** An investment strategy was developed for improving existing housing in consideration of the applicable hazards. For reducing risks through addressing exposure, houses exposed to the pockets of flooding would be excluded from the program in order to avoid inadvertently reinforcing or increasing exposure to those hazards. For reducing risk through reducing vulnerability, specific interventions would be offered to reduce the vulnerability of houses to typhoon and earthquake winds, while ensuring that key architectural elements for mitigating extreme heat, like longer roof overhangs, could be maintained. Basic repairs to the home, such as replacing damaged roofing, would also be made, knowing that this could also improve habitability; also, the strengthening loan product would be offered in conjunction with existing loan products for other habitability upgrades. Further, to help reduce household vulnerability, the loans would be offered in affordable increments, and a product would be developed and offered for adding a second story slab for future vertical expansion and potential rental income. Finally, to help manage residual risks, the program would include a strategy of building awareness through climate and disaster risk information campaigns.
- 67. **Defining Investment Goals and Methodologies.** Overall, the program solution took an incremental approach to building resilience through a menu of loan options based on homeowner preference and affordability. The scope items were prioritized and grouped to ensure that resilience would be improved at each step. First, looking at repairing existing damages in the house, then stabilizing the structure in the roof, the walls, or both, and then adding strengthening elements to increase disaster resistance.
- 68. The program design incorporated responsive solutions along the construction value chain based on the collected climate and disaster risk information, from building awareness in the community and client base about typhoons and earthquakes, to providing streamlined, simple, and clear tools for MFIs and homeowners to assess, scope, and select the desired and needed loan for each house (see Figure 4). In order to support quality construction, detailed visual guidance was developed for the homeowner's builder to implement each of the selected scope of work activities, while visual and tailored guidance was provided to the MFI officers for reviewing and checking the quality and progress of the selected loan option. Training materials and training-of-trainer workshops were provided to the MFI staff, for using the tools and resources and for training homeowners and builders in their respective roles in the value chain for resilient housing.
- 69. **Identifying Investment Levels.** Through defining the different actions to reduce vulnerability in the house and grouping them together, estimates of the construction costs for different loan options could be assessed to help ensure affordability at different increments. Low-income homeowners already borrowing from MFIs prefer smaller loans (under PHP 50,000, or approximately US\$950) so that weekly payments are affordable. This necessitates retrofit projects that are phased or incremental to ensure repayment terms are sustainable and loan terms suit the cash flow needs and repayment capacity of the homeowner. ⁶² Understanding what MFI clients were willing to finance for construction materials and labor was a key consideration in designing the loan product options. Homeowners also had to invest time in attending the trainings and managing the builder they hired.

⁶² Build Change, Disaster Resiliency in Housing in the Philippines: A Market Study of Residential Retrofit Financing

Loan explanation and **Wall Repair Package** selection guide for homeowners ASSESSMENT FORM PARA SA PADER AT BUBONG BUILD BUILD Descriptive scope of HINDI work based on assessment and loan selection HIND HINDI Simple visual house assessment form for diagnosis

Figure 4. Tools Developed to Provide Technical Assistance to MFIs and Homeowners for Incremental Home Strengthening Loan Products

Source: Build Change

- 70. The MFI partners had to assess and make available capital investments for the loans to be disbursed, as well as plan investments for program operational expenses for logistics, staffing, and training. Build Change also had to plan levels of investment at the program level to provide technical assistance, develop tools and resources and provide capacity building and piloting activities.
- 71. Further, systems level investments are being made in advocacy and awareness raising to help influence market actors to support and adopt the program initiatives.

B. Indonesia: A National Home Improvement Subsidy Program: BSPS

72. Bantuan Stimulan Perumahan Swadaya (BSPS) is a subsidy program that was started in 2006 by the Government of Indonesia (GoI) and supported in part by the National Affordable Housing Program (NAHP) since 2017, to help lower-income households to improve housing for pre-existing homes in rural, peri-urban, and urban areas of Indonesia. BSPS is overseen by the Ministry of Public Works and Housing (PUPR).

1. Understanding the Components of Risk Related to Housing

- 73. **Hazards.** Indonesia has many active volcanoes, and frequently experiences earthquakes. Between 1970–2015, there have been 97 significant earthquakes which have amounted to US\$11.7 billion in losses and damages.⁶³
- 74. Though not situated directly in the path of cyclones, Indonesia experiences strong winds and heavy rainfall as a result of the movement of tropical cyclones.⁶⁴ Indonesia is highly exposed to all types of flooding (urban, coastal, and river floods). The compounded impacts of sea level rise and storm surges on low-lying coastal cities where populations are concentrated are considered a major threat for the country.⁶⁵ Indonesia is also at risk of heat stress and heatwaves.⁶⁶
- 75. **Exposure**. Most areas of Indonesia are exposed to hazards, with exposure to seismic hazard being the highest (over 60% of the population exposed). Between 2003–2017, approximately 25% of disasters happened in urban areas, but they accounted for about half of the total disaster-related fatalities in the country during that period. Around 110 million people across 60 cities are exposed to natural hazards including tsunamis, earthquakes, floods, and disasters related to climate change, But almost all metro areas are prone to geophysical hazards. But 2025, it is estimated that over 180 million people (68% of the population) will live in cities.
- 76. **Vulnerability**. Almost 20% of the 64.1 million housing units in Indonesia are categorized as substandard (due either to the use of poor-quality materials, overcrowding, or a lack of access to basic services) and approximately 70% of these substandard units are self-built and owned by low-income households. ⁷¹ Only the wealthiest 20% of households in Indonesia are able to obtain housing in the formal commercial market, while the remaining 80% are unable to afford formal housing solutions without full or partial subsidy enhancements. ⁷² Houses are frequently damaged in disasters due to substandard construction—in 2016 and 2018 alone, three earthquakes in three different islands affected 236,000 residential buildings and left 680,000 people homeless. A study on housing performance in these three earthquakes found several common deficiencies. ⁷³

2. Government Investment in Improving Substandard Housing for the Poor

77. The BSPS home improvement subsidy product enables low-income households to purchase construction materials and undertake self-help ("swadaya") construction with the support of a technical facilitator. In 2016, the subsidy was IDR 10 million (US\$744)⁷⁴ for incremental home improvements,

⁶³ Center for Excellence in Disaster Management and Humanitarian Affairs, *Indonesia: Disaster Management Reference Handbook*, (Ford Island, HI: Center for Excellence in Disaster Management and Humanitarian Affairs, June 2018).

⁶⁴ ADB and The World Bank Group, *Climate Risk Country Profile: Indonesia,* (Manila: ADB, 2021; Washington D.C.: The World Bank Group, 2021), p. 18

⁶⁵ Henrike Brecht et al. "Sea-Level Rise and Storm Surges: High Stakes for a Small Number of Developing Countries."

⁶⁶ ADB and The World Bank Group, Climate Risk Country Profile: Indonesia

⁶⁷ Mark Roberts et al., *Time to ACT: Realizing Indonesia's Urban Potential*, (Washington D.C.: World Bank, 2019), p. 161

⁶⁸ Iwan Gunawan et al., City Risk Diagnostic for Urban Resilience in Indonesia, (Washington, D.C.: World Bank, 2015), p. 2

⁶⁹ Mark Roberts et al., Time to ACT: Realizing Indonesia's Urban Potential, p. 161

⁷⁰ Iwan Gunawan et al., City Risk Diagnostic for Urban Resilience in Indonesia, p. 3

⁷¹ Taimur Samad, Project Information Document (Concept Stage)—National Affordable Housing Program—P154948 (English).

⁷² Taimur Samad, Project Information Document (Concept Stage)—National Affordable Housing Program—P154948 (English).

⁷³ Laura M. Putri, Timothy.M Hart, and Oluwaseun A. Okusanya, *Characteristics of Existing Residential Buildings in Indonesia and Their Typical Damage During Earthquakes*, 17th World Conference on Earthquake Engineering, 2021.

⁷⁴ Based on a 2016 average annual exchange rate of USD 1 = IDR 13,436

such as upgrading of materials or addition of floor space, and IDR 20 million (US\$1,488) for complete reconstruction of preexisting but structurally insufficient homes (see Figure 5). From 2010 to 2013, BSPS reached 544,000 people, with an average per unit cost of IDR 20 million (US\$1,488), and was identified by the World Bank as the most efficient and best targeted GoI housing program.⁷⁵ With the support of the NAHP, the Government of Indonesia planned to scale up BSPS in urban areas after previously primarily targeting rural areas.⁷⁶ The NAHP planned to support 450,000 home improvement solutions to reach 1.8 million people through the BSPS program.

- 77. The program implementation is a combination of top-down and bottom-up approaches: The central government (through PUPR) establishes the policies and technical guidelines to be used nationally for the programs, while the local governments prioritize the locations and candidate households for enrollment.
- 79. Some of the ways in which the program has incorporated hazards, exposure, and vulnerability information into its design are discussed below.
 - 3. Using Information on Hazards, Exposure, and Vulnerability to Inform Program Design and Implementation
- 80. **Prioritizing/Validating the Location.** The program is national but the specific households and locations are selected at the local government level. Selected locations/households are prioritized based on the qualitative (how many houses are substandard) and quantitative housing deficit in the area, and level of household vulnerability. Given the high exposure to hazards across the country, introducing a simple screening process for climate and geophysical hazards when houses are identified for the BSPS program has been identified as an opportunity to increase climate and disaster resilience in the program. ⁷⁷
- 81. **Developing an Investment Strategy.** The BSPS program has sought to integrate structural and habitability standards to reduce vulnerability and address risk from multiple hazards. ⁷⁸ Specifically, the program design adopted a strategy to reduce vulnerability through the reconstruction or improvement of houses according to three pillars: space adequacy, health (improving ventilation, lighting, and access to clean water and sanitation), and structural safety. The program focuses on existing houses or sites. Investments in housing relocation were not covered under this program.⁷⁹
- 82. **Defining Investment Goals and Methodologies.** The program incorporates household and housing vulnerability into the design of the goals and methodologies in several ways. The program targets the bottom 40% of all households, as measured by gross household income.⁸⁰ It seeks to reduce vulnerability to risk through home improvements in three areas: space, health, and structural safety. Households were eligible for support if the head of household had an income no greater than the regional minimum wage, ranging from IDR 1.1–1.3 million per month. The elderly and people with

⁷⁵ The World Bank Group, *Indonesia—National Affordable Housing Program Project (English)*, Project Appraisal Document, Report No. PAD1788, (Washington, D.C.: World Bank Group).

⁷⁶ Taimur Samad, Project Information Document (Concept Stage)—National Affordable Housing Program - P154948 (English).

⁷⁷ The World Bank Group, *Indonesia—National Affordable Housing Program Project (English)*, p. 26

⁷⁸ The program guidance indicates indirectly that biological and earthquake hazards will be addressed.

⁷⁹ Directorate General of Housing, Ministry of Public Works and Housing, *Petunjuk Teknis Penyelenggaraan Kegiatan Bantuan Stimulan Perumahan Swadaya*, (Jakarta: PUPR, 2021), p. 7–12.

⁸⁰ The World Bank Group, Indonesia—National Affordable Housing Program Project (English), p. 17

disabilities could use up to 15% of the assistance to pay labor costs (instead of the standard requirement to use the assistance only for material costs).⁸¹

- 83. The program design demonstrated an understanding of the market in order to help address the causes of housing vulnerability in the construction value chain. It leveraged existing methods used for building homes in low-income households, i.e., houses built by homeowners themselves, which is sometimes done with the support of local builders. The design includes the provision of technical facilitators, to support homeowners with technical assistance and guidance, and to fill gaps where the relevant capacity of or access to licensed building professionals may be limited. The technical guidance for facilitators in the program targets the two most common housing types for homes: single-story masonry and timber.
- 84. Additional opportunities to build climate and disaster resilience in the program have been identified, and some of the proposed improvements include:
 - (i) practical how-to guidance on specific home improvements that reduce vulnerability for each type of hazard;
 - (ii) socialization, to raise awareness of the risks among homeowners; and
 - (iii) training for BSPS facilitators who will support homeowners with hands-on guidance.82
- 85. **Identifying Investment Levels.** For construction costs, the subsidy portion for builder wages is tailored to the schedule commonly used in a particular area. The subsidy amount for materials considers the type of construction and availability and variability (in terms of quality/price) of materials across regions, although these options are still limited in certain areas. The program costs include provisions for technical facilitators, as well as administration.



Figure 5. BSPS Program-Supported House and Homeowners

Source: PUPR, Indonesia

⁸¹ The World Bank Group, Indonesia—National Affordable Housing Program Project (English), p. 18

⁸² The World Bank Group, Indonesia—National Affordable Housing Program Project (English), p. 26

APPENDIX 1: The Resilient Housing Ecosystem Assessment Tool (RHEAT)¹

- 1. The Resilient Housing Ecosystem Assessment Tool (RHEAT) has been developed by Build Change to help countries, states, territories, and cities to identify key gaps and challenges as they work toward achieving resilient housing at scale.
- 2. RHEAT can be used by governments and implementers as they prepare to launch a housing program, or during the implementation of an existing program. The tool supports users to obtain a snapshot of the current housing environment, by assessing conditions at a given point in time. It can be a useful monitoring tool to guide understanding on priorities and resource allocation, and in doing so can help to maximize the chance of a program's success.
- 3. RHEAT specifically tracks progress against the three areas of People, Money, and Technology. Users are guided by a series of benchmark indicators, and a score is assigned to each based on the current level of progress in that area. The tool should be revisited at regular intervals to review and reassess progress against each indicator. Over time, progress is observed as the colors on the assessment tool change from red—indicating that certain criteria are inexistent or not working—to blue—indicating that resilient housing goals have been achieved.

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¹ From The Build Change Guide to Resilient Housing, (Build Change, 2021), p.26 / Annex A



RESILIENT HOUSING ECOSYSTEM ASSESSMENT TOOL (RHEAT)

| KE | Υ |
|----|--|
| 1 | Initial stages (Inexistent or not working) |
| 2 | Getting ready (Existent, needs fixing) |
| 3 | On the road (Working, needs improvement) |
| 4 | At destination (All good) |

| PEOPLE/POLICY | 0.0 |
|---------------|-----|
| | |

| P1 | Policy & Legal Framework for Risk & Resilience | 0.0 | | | |
|----|--|-----|--|--|--|
| | 1 Decent housing is a constitutional right | | | | |
| | 2 Resilient housing is addressed in national development plans | | | | |
| | 3 Habitability issues are addressed | | | | |
| | 4 Structural vulnerability is addressed 5 Urban housing is addressed | | | | |
| | | | | | |
| | 6 Climate change is addressed | | | | |
| | 7 Land use and management is addressed | | | | |

| P2 | Understanding and Framing of Risk | 0.0 |
|----|--|-----|
| | Policymakers are aware of the risk posed by natural hazards to the housing stock | |
| | 2 Public disaster risk awareness | |
| | 3 Improvement of existing buildings is prioritized | |
| | 4 Framing of the problem: shift from poverty to income and risk | |
| | 5 Gender and minorities' needs are addressed | |

| Р3 | Enabling Environment for Effective Building Codes & Standards | 0.0 | | |
|----|---|-----|--|--|
| | 1 Compliance with building codes is required by law | | | |
| | 2 Code development and revision bodies | | | |
| | 3 Mechanism for code development and revisions | | | |
| | 4 National standards agency | | | |
| | 5 Openness to incremental improvements | | | |

| P4 | P4 Program Implementation Framework | |
|----|--------------------------------------|--|
| | 1 Housing improvement program status | |

HOW TO USE THIS TOOL

This tool is intended to provide a quick, high-level snapshot of the ecosystem for resilient housing for a user-specified point in time and location. USE THE "+" AND "-" BUTTONS ON THE FAR LEFT TO TOGGLE OPEN/CLOSED THE TWO LAYERS OF DETAIL OF THE TOOL.

ENTER VALUES INTO GRAY CELLS ONLY. DO NOT EDIT WHITE CELLS.

ENTER WHOLE NUMBERS ONLY.

Queries or comments regarding the use of this tool can be emailed to info@buildchange.org

Constitution (or equivalent) recognizes housing as a right.

Development plans acknowledge and include proposals to address quantitative and qualitative housing deficits.

Government policy includes measures to improve building habitability, including: overcrowding, waterproofing, ventilation and temperature regulation, provision of services (water, electricity, waste management, sewage), fire safety, and security.

Government policy includes measures for structural safety improvements to adequately resist known hazards.

Government includes measures specifically targeted to the needs of urban housing.

Government policy addresses the impacts of climate change and outlines adaptation strategies, including (where applicable) for increasing strength and frequency of hurricanes, floods, drought, landslides, storm surge, and sea level rise.

Government policy includes measures for land use and management planning and improvement, including for increasing urbanization and for management of informal settlements. There are plans and policies in place for land regularization.

All departments and levels of government are aware of the relevant natural hazards, and the exposure and physical, social, economic, and environmental vulnerabilities that increase risk to the housing sector.

Public bodies are actively working to increase awareness of disaster risk in the general population through media campaigns and training.

Government policies identify the need to prioritize strengthening of existing buildings over new construction to address the qualitative housing deficit.

The need for resilient buildings is viewed as a public need and not a symptom of poverty. Programs toward resilient building appropriately prioritize the buildings that are most in need of strengthening.

Policy adequately identifies and addresses the needs of different gender and minority groups with regard to resilient housing.

Compliance with adopted building codes is required by law, such that the building regulatory authority has a legal basis for their enforcement of the codes in housing permitting.

A code development body exists (or the location participates in and subscribes to regional/international code development) to manage the development of and updates to building codes.

Policy mechanisms exist to develop and revise all building codes (or for timely adoption of updates to regional/international codes). There is a schedule for regular code updates to incorporate international developments and latest best practices.

A standards agency exists, with a legal mandate to oversee management of and conformity to standards in the construction sector (Refer to T3.4 for assessment of the effectiveness of construction material quality control by the standards agency).

Policy allows structural improvements to occur in stages over time (partial or incremental voluntary upgrades).

Assess at what stage of planning, developing, and implementing a housing improvement program is.

| 2 Improvement program operative guidelines and institutional framework functional | |
|---|--|
| 3 Programs for social housing | |

| P5 | Implementation Framework: Building Permitting | 0.0 |
|----|---|-----|
| | 1 Building permit process for formal construction | |
| | 2 Building permit process for informal home strengthening | |
| | 3 Fast track semi-automated permitting for vulnerable housing | |
| | 4 Strong, consistent enforcement of permitting process | |
| | 5 Process for land regularization | |

| Р6 | Implementation Framework: Construction Monitoring | 0.0 |
|----|--|-----|
| | Legal requirement for regulatory review of works during construction | |
| | 2 Capacity of implementers | |

| P7 | Enabling Environment for Construction Workforce | 0.0 |
|-----------|---|-----|
| | 1 Professional associations | |
| | 2 Worker protection body and laws | |
| | Clear legal definition of the roles and responsibilities of AEC professionals | |
| | | |
| P8 | Homeowner Perception & Participation | 0.0 |
| | Level of awareness of population regarding hazards, exposure, and vulnerability | |
| | Ease of building owner participation and navigation of programs | |
| | 3 Permitting adoption by population | |
| | 4 Coupling structural improvements with habitability improvements or building expansion | |

| MONEY | 0.0 |
|-------|-----|
|-------|-----|

| M1 | Budget Allocations for Resilient Housing Policy & Technology | 0.0 |
|----|--|-----|
| | Budget is allocated for systemic assessment and strategic planning | |
| | 2 Budget is allocated for informed understanding of risk | |
| | 3 Budget is allocated for program implementation | |
| | 4 Budget is allocated for materials and labor | |
| | 5 Budget is allocated for local level implementation | |

The housing improvement program has outlined program operative guidelines and set up the institutional framework required for implementation at scale.

Housing welfare systems exist that provide free or low-cost housing (permanent or temporary shelter) to those in need due to home improvement or after

A process exists to obtain a building permit for all types of construction. The process to obtain a building permit is clear, and well understood by all stakeholders. There are no significant barriers to access, including physical, financial, or social barriers.

A process exists to obtain a building permit for structural strengthening and/or habitability improvements for housing which was built without a building permit. The process to obtain the permit is clear, and well understood by all stakeholders. There are no significant barriers to access, including physical, financial, or social barriers.

A fast-track, semi-automated system exists and effectively prioritizes permit applications for vulnerable housing.

The building permit process is enforced in all cases in a rigorous, systematic way. Penalties for non-compliance are used appropriately.

A process for land regularization exists that is accessible and transparent.

Construction monitoring of new housing or housing strengthening is required by law, ensuring construction is carried out in accordance with approved plans and associated building codes. Certificates of occupancy are issued upon completion of construction.

Implementers exist in sufficient numbers to implement and enforce the permit process. They are qualified and trained for the role. Refer to M1.5 for assessment of adequacy of budget allocation for local implementation authorities.

Professional associations exist for engineers, architects, and builders to represent members, to provide quality control on professional services through member vetting and registration, and to promote continuous professional development to ensure members keep abreast of international developments in best practice.

Adequate worker protection body exists and their authority is enacted in law. Laws related to occupational health and safety exist and are regularly enforced.

Law clearly defines the roles and legal responsibilities of all actors, including building designers, builders, utility providers, occupants, developers, and regulators.

Homeowners are aware of the natural hazards that affect the country, and the particulars of exposure and vulnerability based on their specific location and building characteristics. They are aware of the impact climate change is having on natural hazards' strength and frequency.

Homeowners are aware of and understand housing programs' requirements. Level of compliance is high.

People are aware of the need for building permits, the requirements, and the process. Level of compliance is high.

Homeowners opt to couple resilience improvements, such as structural retrofitting, with other priorities such as building expansion, functional improvements, etc.

Ecosystem assessment and strategic planning, including innovations to the system, are adequately funded.

Risk data and mapping (see T2) is adequately funded.

The cost of managing and administering a housing improvement program is adequately funded.

The cost of materials and labor for home improvements is adequately funded.

Implementation authorities for building permitting and construction monitoring (see P5 and P6) receive adequate funding.

| 6 Budget is allocated for workforce development and training | |
|--|--|
| 7 Budget is allocated for disaster risk awareness | |

| M2 | Supply of Resilient Housing | 0.0 |
|----|---|-----|
| | 1 Government investment in infrastructure service provision | |
| | 2 Government supply of resilient housing | |
| | 3 Private sector supply of resilient housing | |
| | 4 Blended funding instruments exist | |
| | 5 Rental market | |

| M3 | Government Finance for Resilient Housing | 0.0 |
|----|---|-----|
| | 1 Funded programs for housing improvements — structural | |
| | 2 Funded programs for housing improvements — habitability | |
| | 3 Funded programs for new construction | |
| | 4 Funded incentives are adequate | |
| | 5 Provision of technical assistance included | |
| | 6 Homeowner driven | |

| M4 | Private Sector Finance for Resilient Housing | 0.0 |
|----|--|-----|
| | 1 Financing for new (resilient) construction | |
| | 2 Financing for structural home strengthening improvements | |
| | 3 Financing for home habitability improvements | |
| | 4 Provision of disaster risk insurance | |
| | 5 Financial and insurance products are adequate | |
| | 6 Provision of technical assistance included | |

| M5 | Homeowner Participation & Demand for Resilient Housing | 0.0 |
|----|---|-----|
| | 1 Access to financing | |
| | 2 Adoption of disaster risk insurance | |
| | 3 Homeowner willingness to contribute to home strengthening | |
| | 4 Residents are able to access financial assistance when needed | |

Workforce professional institutions and protection bodies (see P7) receive adequate funding.

Budget allocations include funding for public disaster risk awareness, preparedness, and management organizations and activities.

Government provision of infrastructure (roads, water and sanitation, electricity, and solid waste management systems) adequately complements public and private sector construction to address qualitative and quantitative housing deficits.

Public construction of housing focuses on social and affordable housing, to adequately serve the housing needs of the lowest income levels in the population.

There is an active market of private sector housing construction, providing new housing units for all income levels of the population.

Financial institutions offer options for blended financing instruments, including options for pairing private sector finance with government subsidies/grants/loans and homeowner savings.

An active housing rental market exists and provides affordable and resilient alternatives to those unable or unwilling to invest in home ownership.

Government funded programs exist to support owners to make structural resiliency improvements to existing buildings through grants, subsidies, (concessionary) loans, or other financial incentives.

Government funded programs exist to support owners to make habitability resiliency improvements to existing buildings through grants, subsidies, (concessionary) loans, or other financial incentives.

Government funded programs exist to promote the supply of new, resilient housing through incentives to the private sector (such as loans, grants, subsidies, tax breaks, etc. to homeowners and/or developers of affordable/low-cost resilient housing).

Financial incentives are sufficiently high to create demand for program participation.

Technical assistance, such as published guidance, training, or access to design and construction professionals, is funded as part of government new construction or building improvement schemes.

Government funded housing programs for new construction or improvement are driven by homeowners: homeowners control the budget, programs include a mechanism for homeowner contribution, and tranche disbursement is vetted for technical and fiscal compliance.

Financial institutions offer products for new construction, such as mortgages. A variety of products (or product pricing, terms, or requirements) are available, to suit different market groups. Financial products are available that require and/or incentivize resilient construction.

Financial institutions offer products, such as loans or microfinance loans, for structural strengthening of existing houses. A variety of products (or product pricing, terms, or requirements) are available, to suit different market groups.

Financial institutions offer products, such as loans or microfinance loans, for habitability improvements of existing houses. A variety of products (or product pricing, terms, or requirements) are available, to suit different market groups. Financial products are available that require and/or incentivize pairing structural strengthening with habitability improvements or building expansion.

Financial institutions offer disaster risk insurance. Insurance products are inclusive of all hurricane and other relevant hazards, all land areas, and all common building typologies. Insurance rates and requirements are affordable and accessible for homeowners.

Financial and insurance products are sufficiently attractive to create demand for product.

Technical assistance, such as published guidance, training, or access to design and construction professionals, is funded by financial institutions for private sector new construction or building improvement schemes.

Market adoption of private sector financing for new construction or building improvements is high as measured by housing loan penetration (where available). Field consultations indicate high levels of adoption of financial products among general population.

Quantitative/qualitative/anecdotal evidence indicates high levels of adoption of disaster risk insurance.

Quantitative/qualitative/anecdotal evidence indicates homeowners are willing to pay increased cost of resilient building construction or strengthening.

Those who want to improve their home but otherwise could not afford to are able to access financial assistance.

TECHNOLOGY 0.0

| T1 | Technical Content and Quality of Building Codes & Standards | |
|-----------|---|--|
| | 1 Building codes and standards for new construction | |
| | 2 Building codes and standards for habitability | |
| | 3 Building codes and standards for improving existing buildings | |
| | Technical guidance to codes and standards is available for a variety of audiences | |

| T2 | Risk Data & Mapping | 0.0 |
|----|---|-----|
| | 1 Hazard data and mapping is available | |
| | 2 Exposure data is available | |
| | 3 Physical vulnerability data is available | |
| | Social, economic, and environmental vulnerability data is available | |

| T3 | Technical Capacity of Construction Workforce | 0.0 |
|----|---|-----|
| | 1 Skilled workforce for resilient new buildings | |
| | 2 Skilled workforce for resilient improvements to existing buildings | |
| | 3 Adoption of available risk data and mapping by designers and builders | |
| | 4 Quality and availability of materials | |

| T4 | Digital Technology | 0.0 |
|----|--|-----|
| | 1 Permitting process is supported | |
| | 2 National databases for risk | |
| | 3 Technology for design and construction | |

| T5 | Homeowner Perception & Participation | 0.0 |
|-----------|---|-----|
| | 1 Technical assistance and information access by workforce and homeowners | |
| | 2 Code adoption and enforcement in general population | |

Building codes include requirements for new construction, including guidance for all relevant hazards and for all commonly used building systems and materials.

Building codes include requirements for habitability components (adequate space, lighting, ventilation, accessibility, etc.).

Building codes include requirements for retrofit, repair and renovation of existing buildings, including guidance for all relevant hazards and for all commonly used building systems and materials.

Guidance to the building codes and standards is available, for example, design manuals, graphic "do and don't" construction guides, summary checklists of design requirements, and type designs and typical details; guidance on how to prioritize structural improvement interventions is provided.

Up-to-date data on the predicted frequency and intensity of applicable hazards exists and has been consolidated into a single, coherent source to adequately inform both high level policy and decision making, and detailed design and planning.

Up-to-date data on exposure exists and has been consolidated into a single, coherent source to adequately inform both high level policy and decision making, and detailed design and planning.

Up-to-date data on the common physical vulnerabilities of the housing sector exists and has been consolidated into a single, coherent source to adequately inform both policy and decision making, and detailed design and planning.

Up-to-date data on the social, economic, and environmental vulnerabilities (including land tenure) within the population exists and has been consolidated into user-friendly, accessible data sources.

Engineers, designers, and builders have the necessary training and experience for new construction. They are aware of all local hazards, and the potential impacts of climate change.

Engineers, designers, and builders have the necessary training and experience for structural and habitability improvements to existing buildings. They are aware of all local hazards, and the potential impacts of climate change.

Designers and builders are aware of the latest sources (databases, technical guidance, mapping, community knowledge etc.) for information on hazards, exposure, and vulnerability. This risk information guides decision making.

Materials required for resilient housing construction in all common building typologies are readily available on the local market. For example, where lightweight roofs are common in hurricane-prone areas, treated, graded lumber and hurricane-rated ties and screws are readily available.

The national standards agency is effective in guaranteeing minimum required quality standards for locally produced and imported construction materials.

Their certification system is respected and relied upon as a mark of quality and is widely understood and used by construction professionals.

The permitting process (refer to P5 and P6) is managed via an efficient and effective digital management information system. For example, all land tenure and permitting data is held and backed up in a digital database, and homeowners are able to apply and pay for building permits online.

All risk data is readily accessible in digital forms. For example, GIS hazard maps are available to engineers, and databases of social vulnerability are available to government policy advisors.

AEC professionals utilize digital technology effectively to improve work efficiency and quality at scale.

People are aware of and use technical assistance, from any source (government, private sector, or civil society) and in any form (published materials, training, etc.). There are no prohibitive financial, technological, or social barriers to access.

People are aware of the building codes and regulations. Level of compliance in design and construction is high.

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